MEMORANDUM

To: Lisa Belenky, Center for Biological Diversity

Neal Desai, National Parks Conservation Association

From: Andy Zdon, P.G.; Roux Associates, Inc.

Date: May 29, 2026

Re: Comments regarding the Castle Mountain Mine, Project, Draft Environmental Impact Report and Draft Environmental Impact Statement and associated groundwater analyses

This technical memorandum (Tech Memo) provides comments related to the Castle Mountain Mine Project Phase II Expansion Draft Environmental Impact Statement (DEIS)[1] and the associated Castle Mountain Mine Project Phase II Expansion Draft Environmental Impact Report (DEIR)[2] and associated reports related to groundwater resources. Additional foundational documents reviewed were (but not limited to) the associated numerical groundwater modeling report (Geo-Logic Associates, 2024a)[3] and a dewatering requirement report (Geo-Logic, 2026).[4] These documents are associated with the proposed expansion of mining activities at the Castle Mountain Mine (Project) operated by Equinox Gold Corporation (Equinox) Castle Mountain Venture. The proposed mine expansion would disturb approximately 1,434 acres within the existing Mine Area (3,905 acres), and the proposed underground water pipeline and 69-kV overhead powerline rights-of-way (ROWs) would disturb approximately 380 acres outside of the currently authorized Mine Plan Boundary. Including the 1,474 acres of existing disturbance, the total project disturbance area is approximately 3,288 acres. The mining Project Area occupies both private land owned by Castle Mountain Venture (CMV) and unpatented mining claims on BLM-administered land while the proposed rights-of-way (ROWs) cross BLM-administered public lands in both California and Nevada

In addition to the land disturbance, groundwater extraction in Lanfair Valley and Ivanpah Valley (to the north) would occur to support mining operations. That groundwater pumping and dewatering of the mine pit would together extract a substantial amount (more than triple) of groundwater compared to current extraction rates, rising from 625 acre-feet per year to up to 2,250 acre-feet per year (to be discussed in more detail later in this memo). Potential impacts to water quantity and water quality could affect nearby domestic wells and springs that are present in the mine area with the principal spring being Piute Spring to the east. These springs are important ecological receptors, and this memo will discuss these resources and associated impact analyses in detail. Although groundwater development in Ivanpah Valley (north of the New York Mountains and the project area) is associated with the proposed project, the primary focus

[1] U.S. Bureau of Land Management, 2026. Castle Mountain Mine Project Phase II Expansion Draft Environmental Impact Statement DOI-BLM-CA-D090-2025-0016-EIS. April.

[2] County of San Bernardino, Land Use Services Department, Planning Division, 2026. Castle Mountain Mine Project Phase II Expansion Draft Environmental Impact Report. Prepared by SCWA Environmental Consultants). April.

[3] Geo-Logic Associates, 2024a. Lanfair Valley Groundwater Model Report, Castle Mountain Mine, San Bernardino County, California. Second Revision. July 26.

[4] Geo-Logic Associates, 2026. Evaluation of Dewatering Requirements and an Updated Simulation of Pit Lake Water Quality, Castle Mountain Mine, San Bernardino County, California. January 5.

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of these comments are centered on impacts to Lanfair Valley and beyond including Piute Spring. Roux was unable to receive Project report "Evaluation of Planned Pumping in Ivanpah Basin (GLA 2022)" related to potential groundwater impacts to Ivanpah Valley relied on in the DEIS and DEIR in time to review for this memo. However a review of the Mountain Pass Mine annual groundwater monitoring report (TRC, 2026)[5] identified that according to TRC, two new monitoring wells were installed along Nipton Road in Ivanpah Valley to monitor the high total dissolved solids, chloride and nitrate plumes resulting from historic operations at that mine. This is in the vicinity of the proposed pumping for the Project in Ivanpah Valley, and in addition to a groundwater flow analysis, fate and transports modeling effort should be conducted to assure that the Project pumping would not exacerbate the movement of or capture the contaminated water from Mountain Pass Mine.

As will be discussed in this memo and *based on the foundational deficiencies identified in the supporting documentation for the hydrology analyses in the DEIS and DEIR that rely on those technical reports for their findings, it is our opinion that revisions and updates to address these foundational deficiencies should be conducted and be followed by a subsequent review period. These changes will all need to be incorporated into a revised DEIS and DEIR and recirculated for public comment.*

EXPERIENCE

As Technical Director at Roux, I am a California Certified Hydrogeologist (No. 348), California Professional Geologist (No. 6006), and a California Certified Engineering Geologist (No. 1974), as well as being certified in other states. I have more than 38 years of professional experience. I have personal knowledge and experience of the Castle Mountain Mine area dating back approximately 40 years, which includes both professional and recreational experience in the area. Additionally, while an employee at The MARK Group in Las Vegas, Nevada in 1990, I conducted Piute Spring, groundwater level, and precipitation monitoring on behalf of the then operator of the Castle Mountain Mine, Viceroy Gold Corporation

Additionally, I have worked on multiple mining exploration and hydrogeology projects during my career which included working at the Round Mountain Gold Mine in Nye County, Nevada (in similar geologic terrain) from 1988 into 1990. I have been a member of the Society for Mining, Metallurgy and Exploration (SME) since 1988. I have also reviewed hydrogeologic aspects of minerals exploration projects throughout the southwestern United States in California, Nevada and Utah. Over the past fifteen years, much of my experience has been related to the environmental forensics of spring discharge in eastern California, and potential risks to springs and other groundwater-dependent ecosystems resulting from groundwater development and other development/exploration activities. My professional profile is attached to this memo.

BACKGROUND

The proposed project is located within the eastern Mojave Desert in San Bernardino County, California. The Project area is within the Mojave Desert geomorphic province, an area characterized by basins of internal drainage with considerable topographic relief. The topography alternates between narrow faulted mountain chains and flat arid valleys or basins. Mountain-range orientations vary due to differential rates of slip along faults that cut across the region (California Geological Survey, 2002).[6] More specifically the project is located within the eastern portion of the New York Mountains, with Lanfair Valley Groundwater Basin located immediately south of the New York Mountains. The Lanfair Valley Groundwater Basin

[5] TRC, 2026. Annual 2025 Monitoring Report, Mountain Pass Mine and Mill Site, San Bernardino County, California. March 27.
[6] California Geological Survey, 2002. California Geomorphic Provinces. California Geological Survey Note 36.

(Groundwater Basin #7-001) is nearly entirely within Mojave National Preserve (managed by the US National Park Service [NPS]) and is bounded by the New York and Castle Mountains to the north, the Piute Mountains to the east, the Hackberry Mountains to the south, and the Providence Mountains and Mid-Hills to the west. The elevation of the valley floor generally ranges from approximately 3,700 feet above mean sea level (ft amsl) in the southeastern portion of the basin near the Vontrigger Hills, to above 5,000 ft amsl along the base of the New York Mountains. Groundwater elevations typically range from approximately 3,500 ft amsl to 4,600 ft amsl across the valley (California DWR, 2004)[7].

According to California Department of Water Resources Bulletin 118 (California DWR, 2004a), "*The valley slopes southeasterly with valley floor elevations ranging from 3,500 to 5,000 feet above sea level. The basin is bounded by impermeable rocks of the New York and Castle Mountains on the north, of the Piute Range on the east, of the Hackberry Mountain on the south, and of the Providence Mountains and Mid Hills on the west. Caruthers Creek flows intermittently southeastward during periods of heavy precipitation. Piute Spring discharges groundwater from Lanfair Valley to an adjacent valley and other smaller springs are found throughout the valley. Average annual precipitation ranges from 7 to 10 inches*." Additionally, in 2004 Bulletin 118 notes that natural recharge in the basin is estimated at 1,800 acre-feet per year (afy). The Castle Mine is located within Tertiary-aged volcanic rocks inclusive of a mixture of rhyolite, andesite, basalt and pyroclastic rocks. These volcanic rocks are present northeast of Lanfair Valley in the Castle Mountains (frequently considered an extension of the New York Mountains), the Piute Range to the east and south (Hackberry and Woods Mountains). These rocks also make up the Grotto Hills and Lanfair Buttes in the valley (Geo-Logic, 2024a). Mesozoic-aged granite is also present and comprises the main portion of the New York Mountains and in the southeastern portion of Lanfair Valley in the Vontrigger area. Other bedrock units include undifferentiated Precambrian rocks (primarily metamorphic).

The Lanfair Valley Groundwater Basin is hydraulically connected to the Fenner Valley Groundwater Basin to the south. The Fenner Valley Groundwater Basin (Groundwater Basin #7-002) is an important consideration when long-term Project-related groundwater impacts are considered as will be discussed later in the memo. The Ivanpah Basin north of the New York Mountains (and the Project site) underlies a north-trending valley located along the California-Nevada border in northeast San Bernardino County. The basin is bounded by nonwater-bearing rocks of the Clark Mountains on the northwest, the Ivanpah Range on the west, and by the New York Mountains on the southeast. According to the Bulletin 118 Ivanpah Basin summary, the physical groundwater basin extends northward into Nevada (California Department of Water Resources, 2004b).[8]

Springs and what are they like in the Project area?

Springs are places where groundwater reaches the ground surface and discharges as surface flow. By nature of their character, springs are sensitive to changes in groundwater level. For some springs, the reduction of less than one foot of groundwater elevation can result in the difference between surface water flow being present or absent. Some springs are small, seasonal, and locally perched features where last year's rainfall that soaked into the ground has hit a barrier to its downhill flowpath, forcing that water back to the ground surface. These gravity-flow driven springs are sometimes referred to as "descending" springs. Other springs are tied to deeper and more distant groundwater flowpaths that may extend well beyond the boundaries of the local watershed - sometimes by tens or hundreds of miles. Because these flowpaths are deep, they are generally not affected by seasonal rainfall and changes in air temperature, usually have more consistent flow and if the flowpaths are sufficiently deep, warmer groundwater

[7] California Department of Water Resources, 2004a. Basin Summary Lanfair Valley. Bulletin 118. February 27.
[8] California Department of Water Resources, 2004b. Basin Summary, Ivanpah Valley. Bulletin 118. February 27.

temperatures that remain relatively consistent over time. These latter springs are sometimes referred to as "ascending" springs as the water rises to the surface under pressure.

The principal spring in the Project area is Piute Spring. For Piute Spring as is typical for Mojave Desert Springs, the presence of the spring(s) will first be given away by a change in the plants present. The plants will change from those that rely solely on seasonal rainfall to those that benefit from, or require, shallow groundwater (also known as groundwater dependent vegetation). Upon reaching a spring, it is common to find bulrush, willows (like Gooding's Willow), arrowweed, baccharis, cottonwood, mesquite, saltbush of various species, and numerous other water-loving plants. Additionally, watercress may be observed living in the water itself.

These spring oases provide shelter, food, and water for the many animal species that inhabit the Project Area such as desert bighorn sheep, mule deer, mountain lions, bobcats, coyotes, kit foxes, badgers, black-tailed jackrabbits, striped skunks, and desert cottontails. Amphibians and invertebrates (for example freshwater snails) may live in and around springs where surface water is present and are dependent on the presence of continuous surface water. Additionally, where a spring provides sufficient moisture for preferred vegetation, desert tortoise may be present. Based on our experience at more than 500 springs across the Mojave Desert, the presence of a spring with surface water can also be recognized by increased bird activity in the vicinity long before reaching the actual spring.

In the Project Area, the primary risks to springs are:

- Potential impacts due to proposed pumping, inclusive of proposed project pumping for pit dewatering;
- Potential impacts due to site-specific field activities and disturbance;
- Climate change, and,
- Potential water quality impacts due to human-caused spills or other chemical releases, erosion and or other influences.

Impacts to springs from regional groundwater pumping can occur whether that pumping is upgradient or downgradient from a spring. This is particularly relevant for the closed groundwater basins in the Mojave Desert (Barlow and Leake, 2012[9]; Leake, 2011[10]; Masbruch, et al., 2014[11]). Future climate change in the Project Area is anticipated to result in hotter and drier conditions (Meixner et al., 2016)[12] that are expected to have long-term impacts to groundwater recharge in this Project Area. In addition to these hotter and drier conditions, climate change will likely also see an increase in extreme storms (like those observed in 2023) within the Project Area. The effects of these hotter and drier conditions will result in a reduction in groundwater recharge in the area and to Lanfair and Ivanpah Valleys that was not addressed in the DEIS and DEIR. This will be discussed in further detail later in this memo along with modeling from the U.S. Geological Survey..

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[9] Barlow, P.M., and Leake, S.A., 2012, Streamflow depletion by wells—Understanding and managing the effects of groundwater pumping on streamflow: US Geological Survey Circular 1376.
[10] Leake, S.A., 2011. Capture – Rates and Direction of Flow Don't Matter! Groundwater Volume 49, No. 4. July-August. Accessed at: https://doi.org/10.1111/j.1745-6584.2010.00797.x.
[11] Masbruch, M.D., Gardner, P.M., and Brooks, L.E., 2014. Hydrology and numerical simulation of groundwater movement and heat transport in Snake Valley and surrounding areas, Juab, Millard, and Beaver Counties, Utah, and White Pine and Lincoln Counties, Nevada: US Geological Survey Scientific Investigations Report 2014-5103, 108 p., http://dx.doi.org/10.3133/sir20145103.
[12] Meixner, T.; Manning, A.H.; Stonestrom, D.A.; Allen, D.M.; Ajami, H.; Blasch, K.W.; Brookfield, A.E.; Castro, C.L.; Clark, J.F.; Gochis, D.J.; et al., 2016. Implications of projected climate change for groundwater recharge in the western United States. J. Hydrol., 534, 124–138

Groundwater Discussion – Groundwater Balance

The volume of groundwater in storage is an important aspect of the groundwater system. Changes in storage are identified in the field by changes in groundwater levels. A fundamental groundwater equation and the basis for evaluations of groundwater budgets (inflow vs. outflow estimates) is:

Inflow – Outflow = Change in Storage

When outflow exceeds inflow, there is a negative change in groundwater in storage and groundwater levels can be expected to decline. When inflow exceeds outflow, the reverse is true. When the system is in equilibrium, water levels will generally remain relatively constant despite short-term fluctuations. Long-term groundwater level declines are a clear indication that outflow has been exceeding inflow for an extended period of time. It should also be noted that in many areas, the recovery of groundwater levels after groundwater has been removed from storage can take longer than the period to remove it, depending on the volume removed from storage, precipitation trends and the geology of the basin.

Taking this one step further, under predevelopment conditions, a groundwater system is in equilibrium, a condition where inflow equals outflow. Groundwater pumping causes a disruption in this equilibrium, and recharge amounts and patterns can change. More often, discharge amounts and patterns are impacted by groundwater pumping. This includes the loss of phreatophytic vegetation (vegetation whose water requirements are met by roots tapping groundwater such as in and near springs) and reduction or elimination of spring flow. All pumped water must be supplied by one or more of the following:

- Decreases in groundwater storage;
- Increased or induced recharge; and
- Decreased discharge either in the form of reduced subsurface outflow or decreases in natural forms of discharge such as evapotranspiration or spring flow.

Regardless of the amount of groundwater pumped, there will always be groundwater drawdown (and the removal of water from storage) in the vicinity of pumping wells, a necessity to induce the flow of groundwater to said wells. For most groundwater systems, the change in storage in response to pumping is a transient phenomenon that occurs as the system readjusts to the pumping stress. The relative contributions of changes in storage, increases in recharge, and decreases in natural discharges evolve over time.

If the system can come to a new equilibrium (i.e., a combination of increased recharge and/or decreased discharge), the storage decreases will stop at a reduced groundwater level, and inflow will again equal outflow. The amount of groundwater “available” for a future groundwater development project is therefore dependent on what these long-term changes are, and how these changes affect the environmental resources of the area. Numerical models are ideal tools to evaluate these issues as an initial matter in that the complexities of the groundwater system can be evaluated in detail, and assumptions of how the groundwater system works can be evaluated for internal consistency. However, determining a reasonable set of geologically-reasonable assumptions can be complex, and uncertainties and faulty assumption can lead to substantial error.

For the purposes of the proposed Project, the numerical modeling effort is critical for understanding the effects and risks associated with the Project, particularly on resources such as Piute Spring and other springs in the area including those in the immediate area of the New York Mountains, and further afield toward Vontrigger Spring.

COMMENTS – NUMERICAL MODELING

Given the importance of the numerical modeling conducted on behalf of the proposed Project (Geo-Logic, 2024a) the presentation of the report is unusual in multiple ways. First and foremost is that the modeling effort on which the analysis for the both the DEIS and DEIR are based appears to be incomplete or unfinished. Roux obtained the Revised Lanfair Valley Groundwater Model Report (Geo-Logic, 2024a) which was provided by the County of San Bernardino to the Center for Biological Diversity. [13] The critical nature of the report leads to the conclusion that the groundwater model report should have been included as an appendix to the DEIR and DEIS for public review. The effects of groundwater extraction and potential water quality impacts are among the most critical issues for the environmental review of this proposed Project to assess.

What is unusual about the Geo-Logic, 2024a report is that it has a "Draft" watermark on its internal pages and a header stating "Privileged – Preliminary Data Awaiting Verification." In this case, that such a critical document, the basis for the DEIR and DEIS analyses, remains in a draft state with potential reporting errors or misstatements awaiting verification is of considerable importance when considering the reliability of the data and analyses presented in the report, and subsequently restated in the DEIR and DEIS. Indeed, absent finalization of the report, and reliance of the DEIR and DEIS on key aspects of this unfinished product may be speculative. What is also curious about this draft report is that it is signed and stamped which is typically conducted on final documents, not draft. This adds more confusion to the status of this report.

In reviewing the model report, Roux was required to rely entirely on this draft, unverified report to conduct our technical review. It is our understanding that the National Parks Conservation Association reached out to Equinox to obtain copies of the numerical model files that would allow our cross-checking of input and output data. According to the Association, that file request was denied because of a concern of Equinox in parties altering files after their release. This is not a logical concern as any altering of a model file would result in a new model file save date and any deception would be obvious. This suggests other reasons for withholding the files.

The model consists of a three-layer model grid with grid cell dimensions varying from 125 meters square (410 feet) to 500 meters square (1,640.4 feet). Model layer elevations were based on geologic mapping and well log data (Geo-Logic, 2024a). Layer 1 simulates the alluvium in the central area of the model, layer 2 simulates the deep alluvial and volcanic aquifer in the Lanfair Valley, while layer 3 simulates the shallow, "impermeable" Tertiary-aged volcanic rocks in the model domain. Low permeability would be a better term as in some areas of the model, the Tertiary-aged volcanic rocks are indeed considered permeable.

Model Reporting

The inability to obtain the model files had a heightened effect on our technical review due to critical model-related information that is standard professional practice to include in a model report (e.g., as discussed in Reilly and Harbaugh (2004)[14] and Anderson and Woessner (1992)[15]) being missing, particularly in relation to model calibration, and groundwater budget (inflows and outflows as discussed earlier) results both for baseline conditions and under simulated Project conditions. Obtaining the model files would have allowed Roux to work through the report deficiencies and cross-check conditions. Roux

[13] The Center for Biological Diversity was unable to obtain a copy of the document "Evaluation of Planned Pumping in Ivanpah Basin (GLA 2022)" in time to include many of the Ivanpah Valley issues in this memo.
[14] Reilly, T.E., and A.W. Harbaugh, 2004. Guidelines for Evaluating Ground-Water Flow Models. U.S. Geological Survey Scientific Investigations Report 2004-5038.
[15] Anderson, M.P., and W.W. Woessner, 1992. Applied Groundwater Modeling: Simulation of Flow and Advective Transport. Academic Press, San Diego. 381p.

has focused on the larger, more critical issues identified in the report as they overwhelm smaller, more granular comments. These deficiencies in the Geo-Logic, 2024a report include but are not limited to:

1. No disclosure of the actual, on-the-ground elevation of Piute Spring with only the drain elevation used in the numerical model. Indeed a table of model target coordinates, groundwater elevations (including historic range of groundwater levels), spring elevations, and associated information is not provided in the report with only a map showing locations of calibration points. Without the actual Piute Spring elevation information assigned in the model drain package, it is impossible to interpret the reliability of the impacts of Project-caused drawdown and the impacts to Piute Spring.

2. Section 2.2 Climate and Recharge section describes historical precipitation but provides no information on future climate trends, which is a critical component for discussion. Without this information, the reviewer is unable to assess the environmental impacts of the project over its lifetime to water resources in this area. A climate snapshot for the Lanfair Valley zip code 92332 (for Essex, California) was run on the Cal-Adapt website (Cal-adapt, 2026[16]) and is provided as an attachment to this memo. As shown in the Cal-Adapt report, temperatures by mid-century are expected to increase from 4.6 to 5.5 degrees Fahrenheit through the period 2035-2064. With increasing temperatures and aridification, increasing evaporation will result in lesser groundwater recharge, and will have other effects on the proposed Project increasing the possible need for increased water usage. The model report needs a discussion this issue more fully, and to account for that in the modeling.

3. Section 7.4 of the model report describes the model area water budget. The discussion is incomplete in that a table showing each of the groundwater inflow and outflow components is not presented. While a discussion is presented of natural recharge to the Project area, there is no discussion of evapotranspiration. The quantification of discharge at Piute Spring and other springs in the area including Vontrigger Spring (where surface water was present during Roux's last monitoring at that location under a research permit from the Mojave National Preserve) is not presented. Nor is an estimate of groundwater underflow to neighboring Piute Valley to the east, or Fenner Valley to the south. Although pumping for livestock and domestic purposes based on a 1984 U.S. Geological Survey report (Freiwald, 1984)[17] in the area is considered trivial, an updated analysis of the water use, well depths and groundwater trend data should have been included in the report as an update to the 40-year-old water use analysis presented by Freiwald. as the assumption used in the model may be obsolete and impacts to surrounding well-owners may be significant depending on well depths and locations.

4. The recharge discussion in Section 7.4 reports on the 1988 estimate of groundwater recharge developed by The MARK Group (MARK Group, 1988)[18]. However, the BLM and San Bernardino County are familiar with and have access to the Basin Characterization Model (BCMv8) that characterizes groundwater recharge and was last updated in 2025 (U.S. Geological Survey, 2026).[19] BCMv8 represents the best available science on current and projected recharge rates of aquifers.[20] The

[16] Cal-adapt.org, 2026. Climate Snapshot for Zip Code 92332 (Essex, California). https://cmip5.cal-adapt.org/tools/local-climate-change-snapshot/
[17] Freiwald, D.A., 1984. Ground-water Resources of the Lanfair and Fenner Valleys and Vicinity, San Bernardino County, California. U.S. Geological Survey Water-Resources Investigation Report 83-4082. July.
[18] MARK Group, 1988. Development of a Ground Water Supply for Viceroy Gold Corporation, Vol. I, II, and III. Report #87-2114.38. August 17.
[19] U.S. Geological Survey, 2026. California Basin Characterization Model: A Dataset of Historical and Future Hydrologic Response to Climate Change. BCM Model web page at https://ca.water.usgs.gov/projects/reg_hydro/basin-characterization-model.html
[20] As the USGS states in a published paper, "This report documents the computer software package, Basin Characterization Model, version 8 (BCMv8)—a monthly, gridded, regional water-balance model—and provides detailed operational instructions and example applications. After several years of many applications and uses of a previous version, CA-BCM, published in 2014, the BCMv8 was refined to improve the accuracy of the water-balance components, particularly the recharge estimate, which is the most difficult to accurately assess. The improvement of the various water-balance components targeted the actual evapotranspiration component,

BCMv8 model is used by the USGS to determine historical and future natural recharge, including in Mojave Desert groundwater basins such as Indian Wells Valley and Lucerne Valley, both located in San Bernardino County.[21] It is also used by the State of California to estimate recharge, as seen in the California Department of Water Resources California's Groundwater Update 2025 / Bulletin 118.[22]

The BCMv8 model presents important information related to natural recharge to Lanfair Valley (and Ivanpah Valley) that should have been considered (further discussion of how is presented in the discussion section of this memo). It provides important insight not only into current estimated recharge rates, but how those recharge rates will change over the next 40 years as the climate becomes warmer and drier. It is important to recognize that there is substantial uncertainty associated with estimated recharge rates, because estimating groundwater recharge rates in the California desert is difficult with a substantial number of parameters affecting those recharge rates, all varying substantially with spacial variation of rock types, soil characteristics, north vs. south slope aspects, vegetation cover and numerous other factors. Indeed, Healy (2010),[23] "*Accurate estimates of recharge are always desired; yet is beyond our current capabilities to determine, with any degree of confidence, the uncertainty associated with any recharge estimate, let alone claim that an estimate is accurate. Actual recharge rates are unknown; therefore there are no standards that can be used to evaluate the accuracy of recharge rates.*" In light of this, any overestimation of recharge rates is particularly problematic and undermines the conclusions in the model report and the conclusions regarding impacts to hydrology in the DEIS and DEIR.

As noted in Section 7.4 of the model report, the MARK Group in 1988 estimated the natural recharge to range from 2,000 to 5,000 acre-feet. The MARK Group analysis would have been based on a precipitation period earlier than 1988. As noted previously, the author of this memo conducted precipitation monitoring at several rain gages in the area in 1990, post-dating the MARK Group report. The frequent assumption that past data can be relied upon with confidence to predict the future, which is what an environmental review/impact analysis strives to do, is a faulty assumption for recharge in this area as the BCMv8 model presents.

The U.S. Geological Survey BCMv8 gridded groundwater recharge model allows for calculation of hydrologic-unit mean annual recharge volumes to support screening level review, visualization of broad spacial patterns, and comparison across baseline and future periods. According to the U.S. Geological Survey (2026),[24] the Basin Characterization Model (BCM) currently in version 8, is a simple grid-based model that calculates the water balance by using climate inputs, precipitation, minimum and maximum air temperature. Potential evapotranspiration is calculated from solar radiation with topographic shading and cloudiness, snow is accumulated, sublimated, and melted (sublimation, snowfall, snowpack, snowmelt), and excess water moves through the soil profile, changing the soil

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which, in turn, reduced the uncertainty of the recharge estimate. The improvement of this component was enabled by the availability of a national, gridded actual-evapotranspiration product from the U.S. Geological Survey that was unique in its scope to combine remotely sensed spatial variability and ground-based long-term water-balance constraints. This dataset provided the ability to assess monthly actual evapotranspiration for 62 vegetation types and to perform regional calibration in watersheds throughout California with the objective of closing the water balance using improved estimates for each component. The refinements, including vegetation-specific evapotranspiration, enabled the development of applications that could explore various aspects of landscape disturbance, such as wildfire, forest management, or urbanization. The improvements to BCMv8 also provided the ability to assess long-term sustainability of water resources under a variety of management applications or future climate projections. https://www.researchgate.net/publication/350960152_The_Basin_Characterization_Model_--_A_Regional_Water_Balance_Software_Package

[21] "Assessing natural recharge in Indian Wells Valley, California: A Basin Characterization Model case study"
"Hydrogeology and simulation of groundwater flow in the Lucerne Valley groundwater basin, California"

[22] "State of California - California's Groundwater Update 2025 (Bulletin 118)" – see Appendix C: Methods and Assumptions

[23] Healy, Richard, 2010. Estimating Groundwater Recharge. Cambridge University Press, New York. 245p.

[24] U.S. Geological Survey, 2026. California Basin Characterization Model: A Dataset of Historical and Future Hydrologic Response to Climate Change. BCM Model web page at https://ca.water.usgs.gov/projects/reg_hydro/basin-characterization-model.html

water storage. Changes in soil water are used to calculate actual evapotranspiration, and when subtracted from potential evapotranspiration calculates climatic water deficit. Depending on soil properties and the permeability of underlying bedrock, water may become recharge or runoff.

The BCMv8 includes the specific basins impacted by the pumping, including the Lanfair Valley, and provides the associated data to calculate recharge. The model is calibrated to calculate the mean annual recharge in the 1991 to 2020 time period as well as the 2020 to 2049 time period. Of particular concern is that with a hotter, drier climate, as the USGS and other agencies have determined for this region, the recharge rate is estimated to decrease. Therefore assuming a steady state condition on the past precipitation record is problematic when applying to future-looking model scenarios, and assuming a dry period is still an overestimation of recharge to the Lanfair Valley basin (and Ivanpah Valley basin) because what has previously been considered a drought condition would be a new normal condition and new drought calculations would need to be considered from that baseline. Additionally, in this Mojave Desert region where precipitation of less than 8 inches per year results in negligible groundwater recharge in most years, and as the estimated 8-inch precipitation elevation rises across the landscape it results in less recharge over the Lanfair Valley area as a whole.

5. In Section 7.5 Boundary Conditions, there is no table presenting the actual drain elevation and conductance values used in the model. This is a particularly critical oversight as Piute Spring is represented by two drain cells and the elevation at which the drain is represented in the model if off by only a few feet could have substantial implications related to reliability of the model to predict impacts to the Piute Spring and groundwater-dependent resources at that location. This lack of clarity in the data used is particularly troubling and calls into question the estimated minimal change (less than one gallon per minute) in flow estimated for Piute Spring in Table 7 of the model report given the magnitude of assumed groundwater pumping in relation to the overall water budget for the Project area. Again, not having access to the model files results in an inability to adequately review the groundwater model thoroughly. All of the boundary conditions should be represented in tabular form with the boundary condition input parameters summarized in order to allow meaningful review of the model report. Additional comments are provided on the implications of this Boundary Conditions issue combined with the use of constant head boundaries is discussed in the Analysis and Interpretation of Model Results section provided below.
6. Section 8.1.1 Targets and Goals section summarizes what the goals of the calibration and associated target were but does not provide a firm discussion and table of why individual targets were chosen and what they represent (e.g., what layers were wells completed in), nor does it provide detail on the number of targets chosen representing each model layer. The targets and goals section should have clearly discussed areas where substantial data are present and what areas are lacking monitoring wells (e.g., along the western edge of the Piute Range above Piute Spring).
7. Section 8.1.2 Steady State Calibration states that hydraulic parameters were adjusted during calibration but there is not a table or summary of precisely what was adjusted. Were only transmissivity and storativity adjusted? Were boundary condition conductances adjusted? Were boundary condition elevations adjusted? If so, within what ranges were they allowed to adjust while still maintaining geologically reasonable values? If elevations were adjusted, what was the basis for the adjustments if tied to actual ground surface elevations (e.g., at drains)? This is critical information to evaluate the robustness of the model and its reliability, and is information widely provided in modeling reports as part of standard professional practice but is absent in this modeling report. This

information should be provided in a revised and updated model report (the draft is dated in 2024a and has apparently not been finalized as of the date of this memo).

8. Drawdown contours presented in the model report, for example on Figure 46, have a minimum drawdown contour of five feet. Based on our past reconnaissance of springs in the area (e.g., Vontrigger Spring) a reduction of five feet of groundwater elevation at these features would likely result in a loss of surface water at the features. A loss of five feet of groundwater elevation would also greatly affect Piute Spring. The geometry of a cone of depression is logarithmic, and a one or two foot drawdown contour would likely extend across a substantially greater extent of the model area than that shown in the model report. Therefore the drawdown maps should be revised to show a maximum 2-foot drawdown contour to understand the zone of groundwater capture more fully for the analysis of the impacts of the Project pumping. This is critical information to assess the full extent of environmental impacts including to Piute Spring other springs in the area including Vontrigger Spring.

9. Figure 60 presents residual drawdown for 100 years after Project pumping ceases and shows scattered areas of 50 feet of residual drawdown in the area of the Piute Mountains. This is odd given its proximity to the constant head boundary in the model. It is also concerning as it relates to Piute Spring and the drawdown lag that can occur in areas such as this which perpetuates the effects of groundwater drawdown far into the future. It appears that there may be a data input error in the model, possibly in the constant head elevations, that would cause this. If that is the case, the error would need to be fixed (or removed entirely to address the issue in Point #2 in the next section regarding the constant head boundaries). In any event, additional figures showing residual drawdown at the end of pumping, and at 25 year increments are needed to evaluate whether after 100 years of non-pumping, the cone of depression is continuing to expand laterally as recovery continues closer to the mine site, and to evaluate what the maximum extent of drawdown is, regardless of time frame (even if longer than 100 years) to fully evaluate impacts to Piute Spring. The model also needs to clearly take into account continued future water loss from the proposal to leave pit lake un-reclaimed (discussed further below) and also model the alternatives where the pit is filled and reclaimed. As currently shown in the model report, the time frame presented appears to be chosen ad hoc and may not represent the full extent of groundwater impacts.

ANALYSIS AND INTERPRETATION OF MODEL RESULTS

1. Section 2.4 Hydrogeologic Setting notes that "*Review of historical studies and groundwater modeling -completed for CMV (GLA, 2021) indicate that groundwater in the westernmost portion of Lanfair Valley discharges via underflow to Fenner Valley to the south, while the majority of groundwater in the remainder of the valley discharges via underflow to Piute Valley at the southeast corner of Lanfair Valley*." However, Figure 6 (Water Level Data) presents groundwater elevation contours that show groundwater underflow toward Piute Valley occurring along the length of the Piute Range, a substantially greater extent of underflow than stated in the report calling into question the accuracy of the assumptions and analysis in the modeling report. The model simulations are not consistent with the conceptual model, this must be corrected. Additionally, there is no GLA referenced report for 2021 (2017, 2018, 2022only) so it is unclear which report is referred to, or if another unreferenced report should be listed.

2. The extent and use of constant head boundaries in the model, particularly along the eastern edge of the model grid, is exaggerated and appears to be strongly influencing the model results, particularly potential impacts to Piute Spring. The use of the constant head boundaries will allow groundwater to enter and leave the model across the extent of those constant head boundaries as needed (whether

geologically reasonable or not), and the elevations assigned to those boundaries will constrain the simulated heads at those locations. The proximity of the constant head boundaries to Piute Spring appears to constrain the predicted cone of depression from Project pumping. As the groundwater elevations are constrained, the model is not allowing for accurate simulate to response in Piute Spring. The eastern constant head boundary as used in the model is also the apparent reason why relatively even groundwater flow toward the east is simulated despite the relative impermeable volcanic rocks present in the Piute Range which would impede that flow. The use of the constant head boundaries as presented also amplifies the need to present full water budget tables for baseline, project, and post-project periods to show whether reasonable amounts of groundwater are passing through the modeled area, or if exaggerated amounts of groundwater are passing through in response to a faulty simulation of the conceptual model.

3. Limited storativity data are available for the Lanfair Valley Groundwater Basin. Storativity is calculated using time-drawdown data during pumping and recovery tests and can only be calculated using data from monitoring wells (and not from pumping wells). Therefore, storativity estimates across the model area could be substantially different than would be developed had additional aquifer testing with monitoring wells occurred historically across Lanfair Valley. A key effect of storativity on the simulations goes to the timing of drawdown and recovery and those modeled estimates are highly uncertain based on the lack of data in the area. Not only does this indicate that the report may not be presenting the full extent of Project groundwater impacts but also has a substantial impact on the design of the monitoring program, and it's ability to be an early warning system for identifying groundwater conditions indicating that Piute Spring may be at risk, and pumping corrected, in a manner that preserves flow at Piute Spring.

   The uncertainty associated with spacial variability of storativity will also affect the simulated lag in recovery that occurs after pumping ceases for a project. When a substantial stress is placed on an aquifer system such as at Lanfair Valley, once pumping ceases, although recovery will immediately begin to occur in the well field or mine pit, the more distal portions of the cone of depression may continue to expand and deepen for many years after pumping ceases. In some cases, this can occur over a much longer period of time than which the pumping was conducted. The uncertainty around timing of recovery and expansion of the cone of depression during dewatering and other water use may be considerably different than expected. This also affects the planning for a monitoring and mitigation plan, especially as it relates to Piute Spring increasing the uncertainty and risk associated with pumping impacts to the springs and any mitigation measures protecting that feature.

4. Piute Spring is in an area where the rocks present have little primary permeability but have significant secondary permeability from fracturing associated with north-trending normal faults in the Piute Range (Martin and Schroeder, 2015)[25] The faulting is not identified in the geologic cross section presented on Figure 25D but instead by a zone of higher hydraulic conductivity in the area of Piute Spring. The model design in the Piute Spring area then appears geologically inaccurate and combined with the constant heads modeled immediately to the east of Piute Spring, likely misidentify Piute Spring impacts.

[25] Martin, Peter, and Schroeder, R.A., 2015, The source, discharge, and chemical characteristics of selected springs, and the abundance and health of associated endemic anuran species in the Mojave network parks: U.S. Geological Survey Scientific Investigations Report 2015–5027, 128 p., http://dx.doi.org/10.3133/SIR20155027.

EFFECT OF MODEL DEFICIENCIES ON DEWATERING AND PIT LAKE ANALYSES AND REPORTING

The draft, unverified numerical model was used to prepare a report describing an analysis of dewater requirements for the Project along with an updated simulation of the mine pit lake and water quality analysis (Geo-Logic, 2026b).[26] The dewatering-pit lake evaluation report is presented in final form but relies heavily on the draft groundwater model report (Geo-Logic, 2024a). It is difficult to understand how the draft groundwater model report can lead to a final dewatering and pit lake analysis report for the same reasons described above. The model simulations presented are based on information in a report that is stated to be draft and unverified. As presented above, given all the deficiencies in the model report and associated analyses, the dewatering and pit lake analyses are unreliable. .

As noted in the dewatering and pit lake report, the maximum pumping for dewatering is 1,340 acre-feet per year. This report does not appear to evaluate the drought condition evaluation considered in the model report (Geo-Logic, 2024a) which itself underestimates drought due to a lack of consideration of climate change as discussed above. Again, this is an area where it is assumed that the average precipitation and recharge conditions of the past will be the same for the future, and this is likely an invalid assumption that should be addressed by considering data in the BCMv8.

As described earlier, the absence of storativity data results in the timing of pit dewatering as well as post-dewatering regional groundwater recovery as highly uncertain.

The flaws in the model undermine any conclusions in the DEIS and DEIR analyses regarding the short- and long-term impacts to hydrology and water quality from the proposal to leave a pit lake un-reclaimed at the site in the South pit (vs. reclamation with full or partial backfill). The impacts to Lanfair Valley groundwater and local springs from the proposal to leave a pit lake in the South pit include significant evaporation losses post closure (that were not calculated in the context of periodic drought or a warming and drying climate), water quality impacts due to the pit being a vector to leach additional toxins into the groundwater, and potential wildlife impacts due to exposure to contaminated waters and drowning risks.

A change to the model was made in the pit area, where a higher hydraulic conductivity zone was added to simulate a fracture zone in the pit area. This was not included in the simulations described in the model report, and sensitivity analysis of what including this zone would have done to the results of the impact scenarios in the model report should have been conducted but was not. According the dewatering and pit lake report, "*A hydraulic conductivity value of 0.4 feet per day was assigned to the new zone based on the 2017 aquifer testing results for wells CMM-W-01 and CMM-W-02. The original model had been calibrated around regional water level data, which resulted in too low a value for this area. The new zone was added to model layers 1 and 2.*" This is a puzzling statement. It recognizes that there had been a problem calibrating the pit area, but new zone was not in the impact scenario analyses. Whether this relates to the potentially flawed simulation of the conceptual model, or a flaw in the conceptual model on which the model is based, in either case, the modeling must be revised.

MONITORING AND MITIGATION

Monitoring and mitigation are important pieces to future groundwater management associated with the Project if it should be approved. As shown in the Revised Groundwater Monitoring Plan (Geo-Logic, 2024b)[27] the monitoring plan relies on the results of the model report as a basis for planning purposes. As with other documents inclusive of the DEIR, and DEIS, the reliance on a draft, unverified report is problematic and the model report should be revised, finalized and re-released for public comment as part of a revised the DEIR and DEIS review (and other associated documents as described in this memo). More

[26] Geo-Logic Associates, 2026b. Revised Evaluation of Dewatering Requirements and an Updated Simulation of Pit Lake Water Quality, January 5, 2026
[27] Geo-Logic Associates, 2024b. Revised Groundwater Monitoring Plan, Castle Mountain Mine. July 26.

confusingly, the monitoring plan states it relies on an earlier revision of the model report (Geo-Logic, 2023).[28] It is unclear and highly unusual for the monitoring plan to rely on an older revision of critical modeling for the project, when the second revision was released (apparently on the same day by the same firm). Regardless, because the modeling for the groundwater impacts and drawdown is inaccurate and inadequate in many respects (as detailed above), the reliance on those documents to develop monitoring measures is inappropriate.

The monitoring and mitigation plan is comprised of the following components:

- Monthly collect groundwater level data from existing wells listed in Table, and annually compile the data and record changes in groundwater level;
- Annually revise the groundwater model based on the newly acquired data; and,
- Mitigation based on percent loss of flow (and accordingly habitat) of Piute Spring.

The plan as presented is wholly inadequate to protect Piute Spring. Table 7uses the *combined* spring surface discharge and underflow to report the decrease in discharge to be accepted in each of the stages. First to be lost at Piute Spring will be surface flow before remaining underflow is decreased—using combined decreases will not protect the surface flow sufficiently. As shown on Table 7 of the groundwater model report (Geo-Logic, 2024a), surface flow typically ranges from 40 to 45 gallons per minute at Piute Spring. Since surface flow will be lost first, that means that according to the monitoring plan, nearly half the flow at Piute Spring has to be lost before a change in pumping patterns (Action D) is implemented. Not only is this ineffective (allowing a 50% loss of surface water flow), but fails to consider the lag in recovery, and that at that point, a change in pumping patterns (pumping less from the mine site and Lanfair Valley and possibly more from Ivanpah Valley) will not be immediately effective in preventing ongoing and future loss of surface water flow at Piute Spring. As a result, Piute Spring would be subject to years of additional spring flow reduction at that point before spring flow would begin to recover, if it does. In arid areas, with the absence of substantial recharge sources, and even after reductions in pumping, the groundwater drawdown recovers slowly by continuing to capture additional groundwater from the outer edges of the cone of depression. This allows the cone of depression to expand spatially in width, sometimes for many times the length of the pumping that was conducted.

Monitoring triggers and thresholds for changing water management should be based on anticipated groundwater level changes at monitoring wells closer to the pumping location than to the ecological receptor itself. The groundwater model, when finalized, should be able to be used to identify effective groundwater level triggers that identify changes in groundwater conditions that will ultimately impact Piute Spring long before Piute Spring is impacted. We have seen this “wait until the spring is impacted” approach proposed at other mines. To put it simply, it doesn’t work. Barlow and Leake (2012)[29] present four common misconceptions regarding surface water depletion (such as a reduction of spring flow) due to groundwater pumping:

- Total development of groundwater resources from an aquifer system is “safe” or “sustainable” at rates up to the average rate of recharge;
- Depletion of spring flow is dependent on the rate and direction of water movement in the aquifer (i.e., is the spring upgradient or downgradient);
- Depletion of spring flow will stop when pumping ceases; and,

[28] Geo-Logic Associates, 2023. Lanfair Valley Groundwater Model Report, Castle Mountain Mine, San Bernardino County, California. First Revision. June 20.
[29] Barlow, P.M., and Leake, S.A., 2012, Streamflow depletion by wells—Understanding and managing the effects of groundwater pumping on streamflow: US Geological Survey Circular 1376.

- Pumping groundwater exclusively below a confining layer will eliminate the possibility of depletion of surface water connected to the overlying groundwater system.

In the case of the monitoring plan, the monitoring plan appears to rely on the first three of these misconceptions, rendering its design highly flawed. Monitoring Piute Spring flow while it continues to decrease without corresponding action is not protective of Piute Spring.

The groundwater monitoring plans should be fully revised based on the discussion above and additional analyses with a finalized version of the groundwater model and should be made available for re-review.

Another aspect of any monitoring and mitigation plan that typically arises is the question of attributability. Did the spring decrease because of the Project pumping or was some other influence at work? Ultimately that question should be answered by additional analyses after a change to pumping (reduction) has been implemented. Waiting to implement a change in pumping while analyzing the attribution issue is harmful to the ecological resources the plan is designed to protect. In addition, the decision-maker for the implementation of revised pumping and reviewer of any attributability analyses should be an independent reviewer and not the Project proponent. A regular reporting schedule should also be implemented with quarterly reports at minimum. There should be no reason why updating an excel table or database of groundwater level information should be so rigorous as to only be able to be reported on annually. Indeed, an annual review of monitoring data is too long a time period because it could allow losses of spring flow and habitat at Piute Spring to continue for one year before any outside party is made aware of the problem.

WATER QUALITY – PER and POLYFLUOROALKYL SUBSTANCES (PFAS) and SIMILAR COMPOUNDS

Per- and polyfluoroalkyl substances (PFAS) and similar compounds have been used in leach solutions at gold mines for their properties as surfactants (Barfoot, et.al., 2022).[30] During mining activities, PFAS uses include ore leaching in copper and gold mines, ore floating, separation of uranium from ore/minerals, concentration of vanadium compounds, acid mist suppressing agent, wetting agents, hydrocarbon foaming agent, and the use of fluoropolymer in pipes, cables, hoses, and conveyor belts (Gluge et al., 2020).[31] Additionally, PFAS may be present at mining facilities for uses that are ancillary to the mining operation, such as PFAS-containing aqueous film forming foam (AFFF) for fire suppression/firefighting activities, cleaning of metal surfaces, and use as a foaming agent in drilling fluids, paints, and coatings (Barfoot et al., 2022; Hunt, 2021[32]). At active mine sites, the main use of PFAS is expected to be from AFFF. However, another major use, although to a lesser extent, is PFAS used for processing (Barfoot et al., 2022).

Human and ecological receptors can be exposed to PFAS through various pathways at mining sites, as well as offsite due to fate and transportation mechanisms such as surface runoff, groundwater migration, wind erosion, and aerial deposition (Barfoot et al., 2022). For both human and ecological receptors, the following scenarios list the most common potential exposure pathways:

- Incidental ingestion of soil/sediment;
- Direct contact with PFAS-containing products;
- Ingestion of potable water;
- Inhalation of PFAS in air particulates/dust;

[30] Barfoot, Krista, Angus McGrath, Sasha Richards, Tanya Shanoff, Janice Stonebridge, 2022. PFAS and the Mining Industry: Understanding the Challenges. Proceedings of Mine Water Solutions 2022, Vancouver, Canada. June 14-16.
[31] Gluge, J., et al., 2020. An overview of the uses of per- and polyfluoroalkyl substances (PFAS), Environmental Science Processes & Impacts, 22: 2345-2373, DOI: 10.1039/d0em00291g.
[32] Hunt, P., 2021. PFAS a toxic problem in 'wild west' mining industry, Australia's Mining Monthly, Aspermont Information for Industry.

- Incidental ingestion of non-potable water;
- Direct contact with PFAS-contaminated soil;
- Consumption of food exposed to PFAS through watering, soil uptake, or irrigation;
- Exposure to PFAS-impacted surface water and sediment; and
- Ingestion of aquatic biota from PFAS-impacted waters (Barfoot et al., 2022; ITRC, 2022[33]).

The DEIR and DEIS fail to address these compounds. The water quality analyses and recommendations for monitoring should include discussions as to whether these compounds could be found on site and what actions should occur if they are found, and consideration of a ban on their use on site to protect resources. Additionally, these compounds must be included as future constituents for analysis during groundwater monitoring, particularly given the proximity of springs inclusive of, but not limited to, Piute Spring, and other well owners in the area. These compounds may only be noted as "surfactants" on product labels. As part of future water quality management activities, a remediation/mitigation plan should be developed to address anticipated actions in the event that PFAS and related compounds are identified in groundwater to protect downgradient groundwater-dependent ecosystems (e.g., springs) and well users.

DISCUSSION AND CLOSING

As discussed throughout this review memo, there is substantial amount of model report deficiencies that need to be addressed, and re-analysis of dewatering and pit lake formation and water quality are needed, a revised monitoring plan developed based on the updated modeling and with a revised trigger and threshold monitoring protocol, and a commitment to not use PFAS and/or related compounds as an additive in leaching solutions or other mine processes. Further, PFAS and related compounds should be added to an annual sampling event to assure that the compounds have not been released accidentally by using products that may or may not forthrightly disclose their presence (indeed many of these compounds are only labeled as surfactants on some ingredient lists). This is a significant amount of work that must be undertaken, and because the DEIS and DEIR currently rely on these incomplete and/or inadequate reports and plans they must also be revised.

Additionally, although not part of the Project, other proposed groundwater development in the Fenner Valley Groundwater Basin is anticipated to create a large regional cone of depression that will result in additional groundwater capture along the Lanfair Valley – Fenner Valley flow path (Santa Margarita Water District, 2012).[34] The cumulative effects of that groundwater interbasinal dynamic should not be ignored as induced underflow toward Fenner Valley would further reduce the groundwater availability in Lanfair Valley at the potential expense of Piute Spring. That proposed groundwater development should be treated as a reasonably foreseeable project, and its impacts should be assessed in a revised DEIS and DEIR that are recirculated for public review and comment.

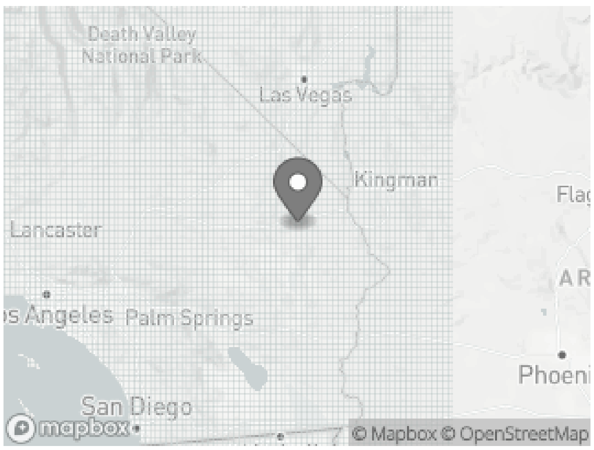
Therefore it is Roux's opinion that these revisions and updates should be conducted and be followed by a subsequent review period. These changes will all need to be incorporated into a revised DEIS and DEIR for public comment.

Attachment:

[33] ITRC, 2022b. PFAS – Per- and Polyfluoroalkyl Substances, 7 Human and Ecological Health Effects of Select PFAS, Accessed at: https://pfas-1.itrcweb.org/7-human-and-ecological-health-effects-of-select-pfas/.
[34] Santa Margarita Water District. 2012. Final Environmental Impact Report: Cadiz Valley Water Conservation. Recovery and Storage Project. July.

Cal-adapt.org, 2026. Climate Snapshot for Zip Code 92332 (Essex, California).

Local Climate Change Snapshot



Essex

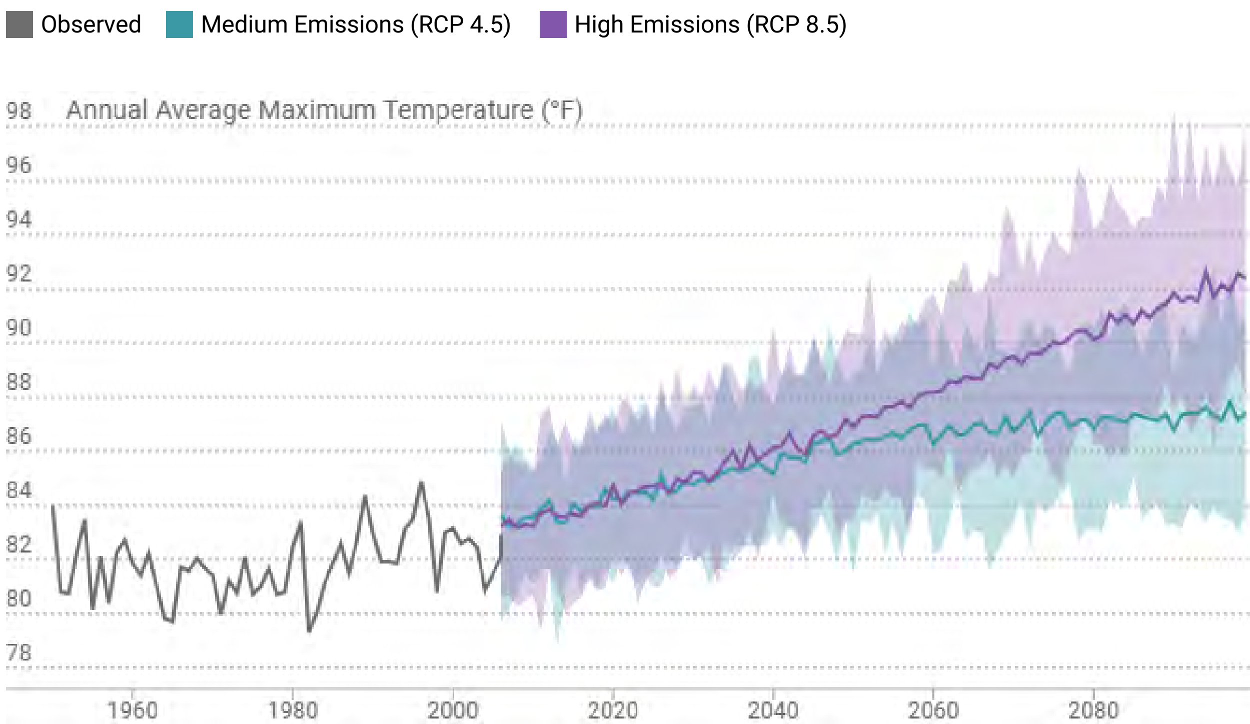
California 92332, United States

Temperature

Overall temperatures are projected to rise in California during the 21st century. While the entire state will experience temperature increases, the local impacts will vary greatly with many communities and ecosystems already experiencing the effects of rising temperatures.

Annual Average Maximum Temperature

Average of all the hottest daily temperatures in a year.



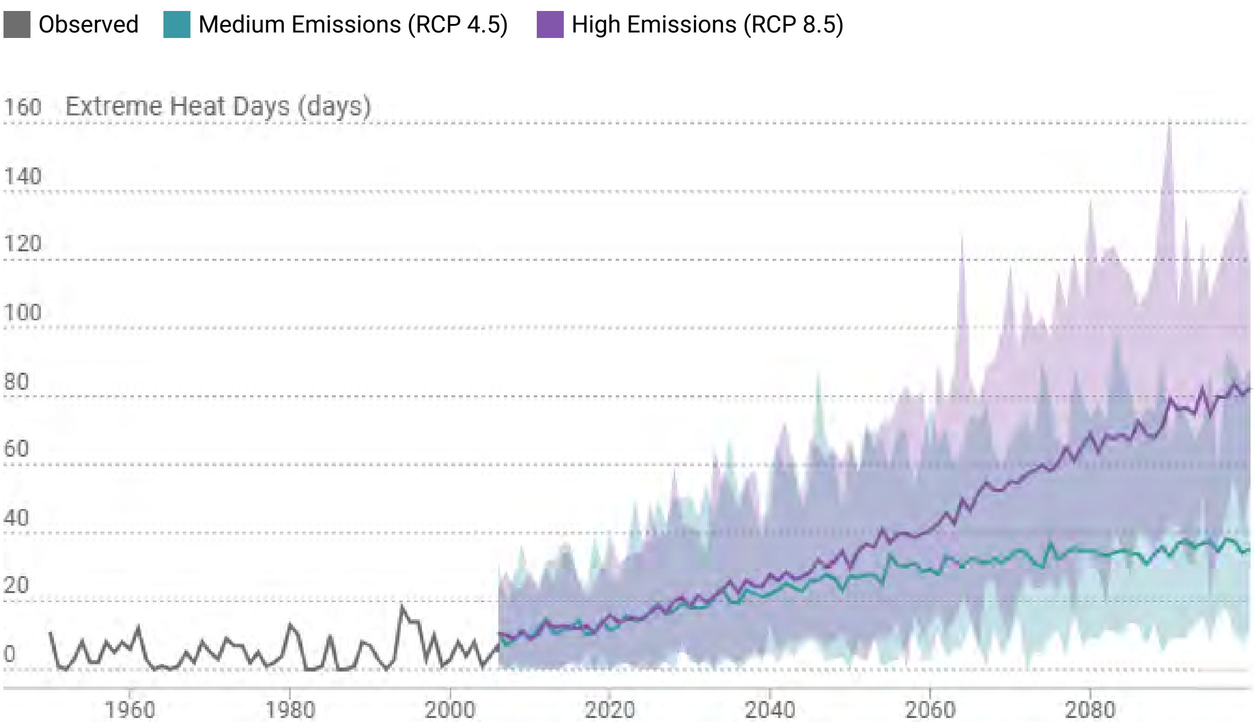
Observed (1961-1990) 30yr Average: 81.5 °F

	Change from baseline	30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	81.6 °F	81.4 - 81.9 °F
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+4.6 °F	86.2 °F	83.9 - 88.5 °F
HIGH EMISSIONS (RCP 8.5)	+5.5 °F	87.1 °F	85.1 - 89.1 °F
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+5.6 °F	87.2 °F	84.8 - 89.5 °F
HIGH EMISSIONS (RCP 8.5)	+9.3 °F	90.9 °F	87.8 - 94.4 °F

1. Data derived from 32 LOCA downscaled climate projections generated to support California's Fourth Climate Change Assessment. Details are described in Pierce et al., 2018.
2. Observed historical data derived from Gridded Observed Meteorological Data. Details are described in Livneh et al., 2015.
3. Data presented is for LOCA grid cell (~ 6km x 6km resolution) at -115.244318,34.733873.

Extreme Heat Days

Number of days in a year when daily maximum temperature is above a threshold temperature



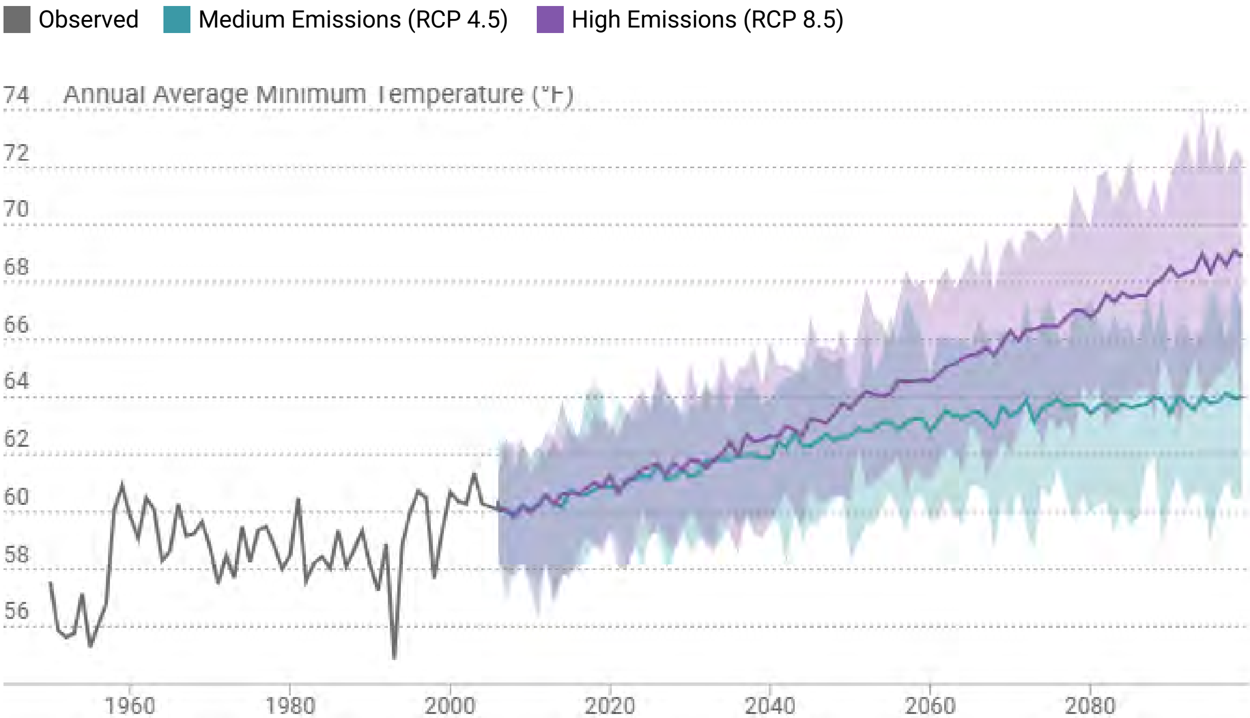
Observed (1961-1990) 30yr Average: 4 days

	Change from baseline	30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	4 days	3 - 5 days
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+22 days	26 days	13 - 57 days
HIGH EMISSIONS (RCP 8.5)	+30 days	34 days	17 - 64 days
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+31 days	35 days	19 - 78 days
HIGH EMISSIONS (RCP 8.5)	+65 days	69 days	49 - 117 days

1. Data derived from 32 LOCA downscaled climate projections generated to support California's Fourth Climate Change Assessment. Details are described in Pierce et al., 2018.
2. Observed historical data derived from Gridded Observed Meteorological Data. Details are described in Livneh et al., 2015.
3. Data presented is for LOCA grid cell (~ 6km x 6km resolution) at -115.244318,34.733873.

Annual Average Minimum Temperature

Average of all coldest daily temperatures in a year. of 109.5 °F



Observed (1961-1990) 30yr Average: 58.9 °F

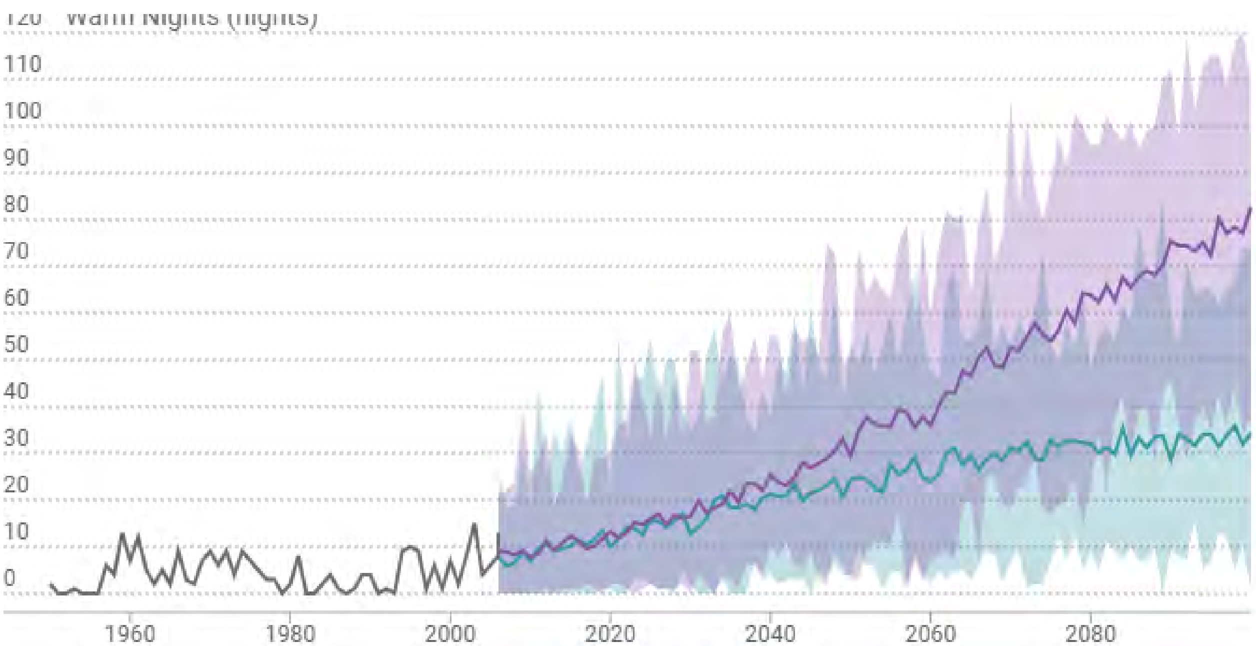
	Change from baseline	30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	58.5 °F	58.3 - 58.8 °F
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+4.2 °F	62.7 °F	60.9 - 64.2 °F
HIGH EMISSIONS (RCP 8.5)	+5.2 °F	63.7 °F	61.8 - 65.4 °F
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+5.2 °F	63.7 °F	61.4 - 65.2 °F
HIGH EMISSIONS (RCP 8.5)	+9.0 °F	67.5 °F	64.5 - 69.8 °F

1. Data derived from 32 LOCA downscaled climate projections generated to support California's Fourth Climate Change Assessment. Details are described in Pierce et al., 2018.
2. Observed historical data derived from Gridded Observed Meteorological Data. Details are described in Livneh et al., 2015.
3. Data presented is for LOCA grid cell (~ 6km x 6km resolution) at -115.244318,34.733873.

Warm Nights

Number of days in a year when daily minimum temperature is above a threshold temperature

Observed   Medium Emissions (RCP 4.5)   High Emissions (RCP 8.5)



Observed (1961-1990)   30yr Average: 4 nights

	Change from baseline	30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	4 nights	1 - 10 nights
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+19 nights	23 nights	11 - 45 nights
HIGH EMISSIONS (RCP 8.5)	+28 nights	32 nights	12 - 58 nights
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+28 nights	32 nights	15 - 50 nights
HIGH EMISSIONS (RCP 8.5)	+62 nights	66 nights	40 - 91 nights

1. Data derived from 32 LOCA downscaled climate projections generated to support California's Fourth Climate Change Assessment. Details are described in Pierce et al., 2018.
2. Observed historical data derived from Gridded Observed Meteorological Data. Details are described in Livneh et al., 2015.
3. Data presented is for LOCA grid cell (~ 6km x 6km resolution) at -115.244318,34.733873.

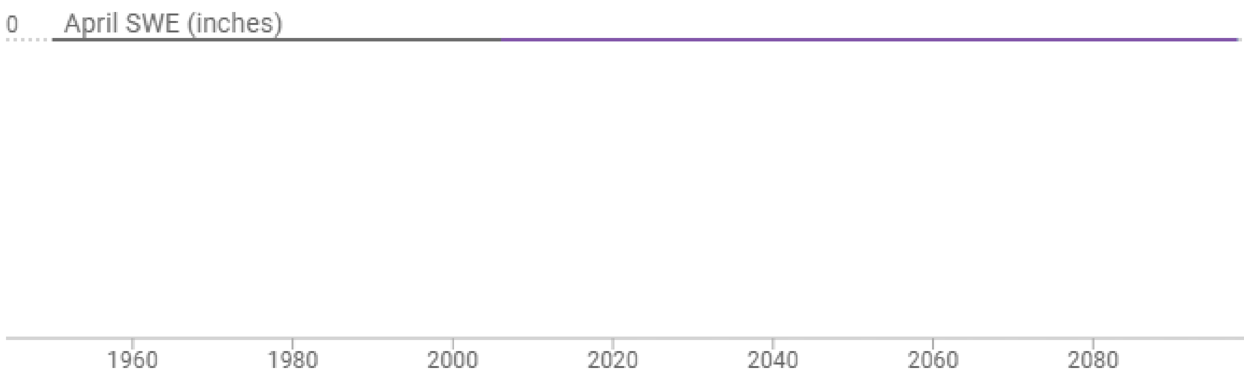
Precipitation

California's climate varies between wet and dry years. Research suggests that for much of the state, wet years will become wetter and the dry years will become drier. Dry years are also likely to be followed by dry years, increasing the risk of drought. While California does not see the average annual precipitation changing significantly in the next 50-75 years, precipitation will likely be delivered in more intense storms and within a shorter wet season. We are already seeing some of the impacts from a shift towards larger year to year fluctuations.

April SWE

Snow Water Equivalent (SWE), is a commonly used measurement used by hydrologists and water managers to gage the amount of liquid water contained within the snowpack. of 85.3 °F

Observed | Medium Emissions (RCP 4.5) | High Emissions (RCP 8.5)



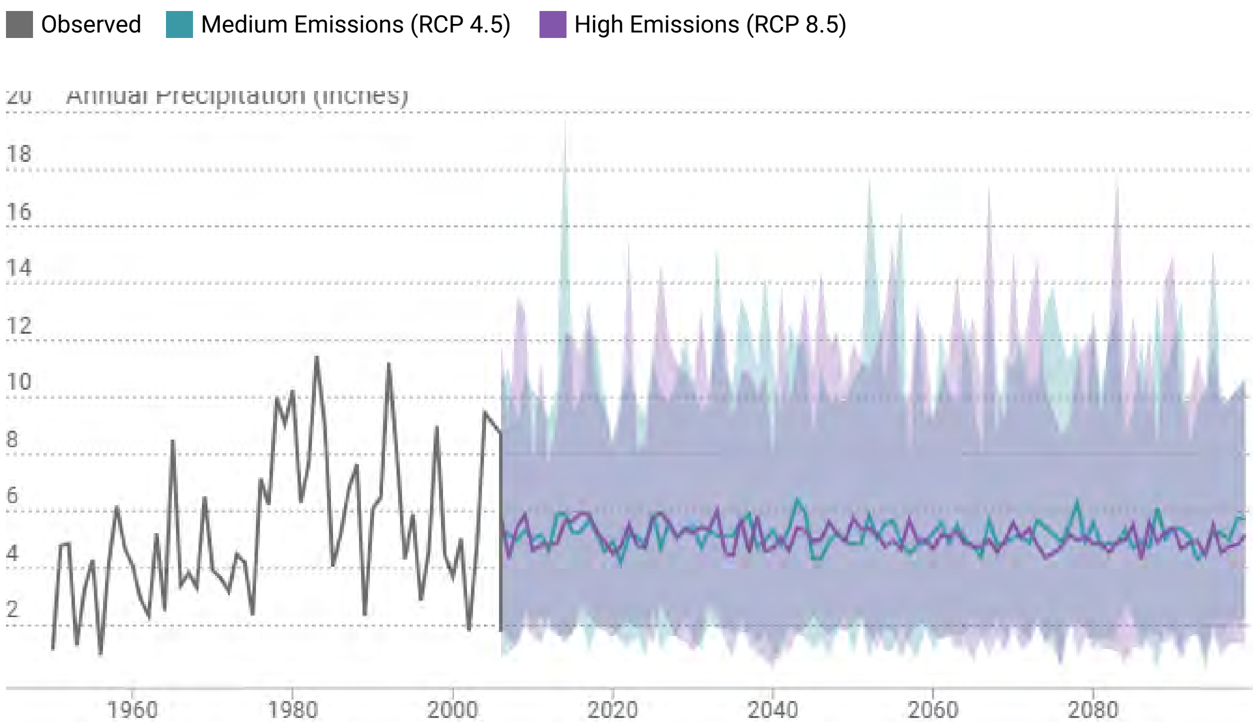
Observed (1961-1990) 30yr Average: 0.0 inches

	Change from baseline ⓘ	30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	0.0 inches	0.0 - 0.0 inches
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	-	0.0 inches	0.0 - 0.0 inches
HIGH EMISSIONS (RCP 8.5)	-	0.0 inches	0.0 - 0.0 inches
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	-	0.0 inches	0.0 - 0.0 inches
HIGH EMISSIONS (RCP 8.5)	-	0.0 inches	0.0 - 0.0 inches

1. Data derived from 32 LOCA downscaled climate projections generated to support California's Fourth Climate Change Assessment. Details are described in Pierce et al., 2018.
2. Observed historical data derived from Gridded Observed Meteorological Data. Details are described in Livneh et al., 2015.
3. Data presented is for LOCA grid cell (~ 6km x 6km resolution) at -115.244318,34.733873.

Annual Precipitation

Total precipitation projected for a year



Observed (1961-1990) 30yr Average: 5.7 inches

	Change from baseline	30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	5.3 inches	4.7 - 5.9 inches
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	-0.1 inches	5.2 inches	4.4 - 6.4 inches
HIGH EMISSIONS (RCP 8.5)	-0.2 inches	5.1 inches	3.9 - 6.3 inches
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	-0.1 inches	5.2 inches	4.1 - 6.5 inches
HIGH EMISSIONS (RCP 8.5)	-0.3 inches	5.0 inches	3.7 - 8.1 inches

1. Data derived from 32 LOCA downscaled climate projections generated to support California's Fourth Climate Change Assessment. Details are described in Pierce et al., 2018.
2. Observed historical data derived from Gridded Observed Meteorological Data. Details are described in Livneh et al., 2015.
3. Data presented is for LOCA grid cell (~ 6km x 6km resolution) at -115.244318,34.733873.

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EDUCATION

BS, Geology, Northern Arizona University, 1984

PROFESSIONAL LICENSES

State of California, Professional Geologist (No. 6006)

State of California, Certified Engineering Geologist (No. 1974)

State of California, Certified Hydrogeologist (No. 348)

State of Arizona, Registered Geologist (No. 33683)

State of Utah, Professional Geologist (No. 11907683-2250)

PROFESSIONAL TRAININGS

Assessment, Use and Management of Groundwater in Areas of Limited Supply, 2006, Groundwater Resources Association of California

Introduction to ArcGIS9 and Environmental Applications of GIS, 2005, Northwest Environmental Training

EXPERIENCE SUMMARY

Mr. Zdon has more than thirty-five years of experience in a variety of geology and hydrogeology-related projects. He is a California Professional Geologist, Certified Hydrogeologist and Certified Engineering Geologist. Mr. Zdon is a recognized subject matter expert in numerical groundwater flow modeling and has been an instructor at California State University, Los Angeles in Groundwater Models and Management (1995).

Mr. Zdon was also appointed in 2013 by the Inyo County Superior Court as Watermaster for a surface water system in the Owens Valley. His specialties include basin analyses and relationships with spring systems, numerical groundwater modeling including, flow, groundwater/surface water interactions including spring flow, contaminant transport and dual-phase flow in both basin fill and fractured rock environments. Investigations in these areas can be in support of CEQA/NEPA analyses, water resource development evaluations, or providing third party review, supervision of UST identification, abandonment, and removal.

He has served as an expert witness on many cases and has provided both depositions and court testimony. Mr. Zdon was appointed to serve on the first Technical Advisory Committee for the newly combined California Board for Engineers, Land Surveyors and Geologists. He also received Certificates of Commendation and Appreciation for his volunteer service as a Subject Matter Expert for the former California Board for Geologists and Geophysicists.

TECHNICAL SPECIALTIES

Providing services for governmental agencies (federal, state, and local), non-profit and for-profit corporations, and private individuals. Providing services ranging from water resource/supply investigations, impact analyses related to NEPA and CEQA analyses, groundwater modelling, water sourcing investigations, water supply management plans, mine hydrology investigations, minerals remoteness assessments, restoration project management, and environmental investigations.

REPRESENTATIVE PROJECTS

Environmental Forensics related to Desert Riparian Habitats.

- **Environmental Forensics related to Desert Riparian Habitats.** Principal investigator on forensic evaluations of spring water sources for multiple locations in Mono, Inyo, San Bernardino and Kern Counties, California. Methodologies used in these analyses have included stable isotope analysis of waters, water age-dating (using tritium and carbon-dating methods), noble gas analysis, general chemistry, and remote sensing techniques inclusive of Landsat imagery time-series analysis associated with Normalized Difference Vegetation Index (NDVI) signals, and changes in NDVI over time. The results of these studies have been published in the peer-reviewed journals Hydrology, Environmental Forensics and the International Journal of Water Resources and Environmental Management.
- **Technical Expert – Groundwater Dependent Ecosystems and Impacts from Groundwater Extraction.** Technical expert on behalf of California-state departments relating to potential impacts to water resources with an emphasis on groundwater-dependent ecosystems associated with state lands. Those state lands are in multiple areas across California. Work includes understanding projected impacts from groundwater pumping as well as existing mitigation effectiveness due to past pumping impacts, along with evaluating effects of groundwater management planning under the Sustainable Groundwater Management Act on those state ecological resources.

- **Hydrogeology Analysis and Minerals Assessment, Ash Meadows National Wildlife Refuge Area, Nye County, Nevada.** Prepared hydrogeologic analysis inclusive of use of the U.S. Geological Survey-developed Death Valley Regional Flow System Model (DV3) to provide technical support related to a proposed 300,000-acre minerals withdrawal area surrounding Ash Meadows National Wildlife Refuge and the Devil's Hole portion of Death Valley National Park. Additionally, prepare a minerals assessment to evaluate potential mineral resources that would be affected by the proposed minerals withdrawal area.
- **Spring Survey, Mojave and Sonoran Deserts, San Bernardino, Los Angeles, Kern and Inyo Counties, California.** Principal investigator for Mojave Desert-wide spring survey for the Barstow, Needles and Ridgecrest U.S. Bureau of Land Management Districts. Also included lands owned by project partner land trusts. Work consisted of records search (inclusive of technical data, water rights information, BLM records search, and cultural historic information), field inspection of more than 300 springs, and preparation of a comprehensive report and catalog of springs that serves as the most comprehensive and temporally consistent investigation of springs ever to occur in the region. Field data included refining location information, field water quality parameters and flow, collection and analysis of water samples for stable isotope analysis, identification of vegetation present including invasive species, identification of wildlife use including use by non-native animals, types of spring disturbance, and general geological observations. Subsequent work has included extensive isotopic characterizations including stable isotope, tritium, and radiocarbon analyses to evaluate regional aquifer connections with springs and working cooperatively with biologists conducting vegetation mapping and environmental DNA analyses on selected springs. This project was reported on in several publications including USA Today.
- **Water Resources Investigation, Half Moon Bay Terrace Groundwater Basin, San Mateo County, California.** Provided hydrogeologic services related to feasibility of potential water-recycling operations and potential effects of recycled water being used for groundwater recharge or other uses.
- **Technical Expert, Pine Valley and Wah Wah Valley Groundwater Basins, Utah.** Serving as technical expert to the Beaver County Board of Commissioners regarding proposed groundwater export project by the Central Iron County Water District. The project proposes to export groundwater from proposed wells on public lands managed by the U.S. Bureau of Land Management to alleviate overdraft and related subsidence issues in the Cedar City area. Work involves evaluating the effects of proposed groundwater production on springs and other resources in Beaver County, and preparing comments to upcoming environmental impact statement.
- **Technical Expert, Orange County Groundwater Basin, California.** Served as an expert witness and provided deposition regarding hydrogeologic conditions and numerical groundwater flow and transport modeling associated with the shallow, principal, and deep aquifers of the Orange County Groundwater Basin. Focus was on groundwater flow, Irvine Ranch Water District well field-caused hydraulic gradient changes, and the potential for shallow contamination to reach the principal and deep aquifers.
- **Technical Expert, Hydrogeology of Proposed Yucca Mountain Nuclear Waste Repository, Nevada.** Technical expert representing the County of Inyo, California relating to potential impacts to water resources in the County of Inyo including downgradient groundwater/spring water users in the communities of Shoshone and Tecopa and ecological resources associated with springs and the federally designated Amargosa Wild and Scenic River and Death Valley National Park. Work has included reviewing existing numerical groundwater flow and transport modeling for the region, and running the carbonate-aquifer model (which covers portions of California, Nevada and Utah) developed by the U.S. Geological Survey to evaluate the effect of pumping related to Southern Nevada Water Authority water rights and applications on vertical hydraulic gradients beneath Yucca Mountain and preparation of comments to Supplemental Environmental Impact Statement for Groundwater (prepared and submitted during 2015).
- **Project Management and Water, Supply Well, Feather River Basin, Plumas County, California.** Project management and hydrogeological services related to a restoration of the historic Heart K Ranch project along Indian Creek in the Feather River headwaters for the Feather River Land Trust. Work included organizing hydrogeological (including production well drilling) and engineering and irrigation subcontractors to complete infrastructure for the project in a brief timeframe (less than six months). Successful sitting of the well resulted in yield more than two times greater than client expectations.
- **Groundwater Recharge Operations, San Joaquin Valley, California.** Technical and operational review of groundwater recharge/replenishment operations throughout the San Joaquin Valley, California. Work included identifying all non-private groundwater replenishment facilities in the San Joaquin Valley, providing technical review of operations including periodicity of use, spreading-basin geometry, and reviewing surrounding environment (including potential liabilities) associated with the potential use of the operations as water-bird habitat.

- **Hydrogeologic Evaluation, Amargosa River Basin, California and Nevada.** Principal in Charge and project manager for ongoing basin-wide investigation of the resources of the California-portion of the Amargosa River basin. Investigations have ranged from baseline data collection efforts to wide-ranging geochemical investigations (including isotope studies) of groundwater issuing from springs, from the Amargosa River, and from existing wells. Results have been groundbreaking and have resulted in ongoing reevaluation of the conceptual model of this part of the basin (more than 2,000 square miles) that had been held for nearly 50 years. Being a spring-fed river, the investigations along the Amargosa River highlight the evaluation interactions between surface water and groundwater. These data have been incorporated into multiple peer-reviewed journal articles and in U.S. Geological Survey report on the Lower Amargosa River Valley (Scientific Investigations Report 2018-5151).
- **Hydrogeologic Characterization and Flow Modeling, Big Valley Groundwater Basin, Lake County, California.** Conducted numerical modeling analysis of the Big Valley Groundwater Basin (inclusive of Soda Bay) in Lake County, California as part of environmental review/feasibility study related to using the Kelseyville water system as an alternative water supply review for the Soda Bay area. The Soda Bay area is in complex volcanic terrain and has been previously served primarily by surface water from Clear Lake which is seasonally problematic due to water quality issues. Additionally, numerical modeling provided estimates of streamflow depletion in Kelsey Creek due to groundwater pumping addressing concerns related to the Clear Lake Hitch, a California-state listed threatened species fish (also under federal review).
- **Hydrogeologic Characterization and Flow and Transport Modeling in Volcanic Terrain, Mono County, California.** Served as expert witness and manager of environmental activities at 7,000-gallon gasoline release that occurred in faulted, volcanic terrain upgradient of a town water-supply well field. Work conducted at the site also included characterization of rock units including the use of rotary drilling and oriented-core drilling, surface and down-hole geophysical surveys, and extensive vapor and groundwater sampling. Developed a conceptual model and follow-up numerical groundwater flow and transport model to evaluate potential timing and magnitude of impacts to down-gradient town water-supply wells and associated remediation scenarios both to evaluate on-site remedial effectiveness and risk reduction associated with water supply.
- **Well Siting along the San Andreas Fault Zone, Lake Elizabeth area, Los Angeles County, California.** Provided technical review and recommendations for future well siting in the Lake Elizabeth area. The Lake Elizabeth area is situated along the San Andreas Fault Zone, the lake being a manifestation of the fault zone (sag pond). Groundwater in this complex area is highly compartmentalized, and differences in well yields and groundwater quality can vary substantially in short distances. This work successfully informed the Lake Elizabeth Mutual Water Company in new well siting after previous well construction attempts.
- **Watershed Assessment, Flow Modeling and Impact Analysis for Potential Well-field, Sierra Nevada, Mono County, California.** Consultant to Mammoth Mountain Ski Area in a joint project with the Mammoth Community Water District regarding water resources issues associated with a proposed land transfer with the Inyo National Forest, and the potential development of a water supply in an eastern Sierra watershed. Work involved developing conceptual model and associated preliminary numerical groundwater flow model of an eastern Sierra watershed, conducting field investigations to evaluate hydrogeologic parameters (including aquifer testing of potential water-supply wells) identified to be sensitive in the numerical model, and finalizing the numerical groundwater flow model through updating parameters and boundary conditions based on data obtained from the field investigations and performing a transient calibration. The final numerical model was used to evaluate potential groundwater impacts of the proposed project.
- **Seepage Modeling, Multiple Projects, New Zealand.** Provided technical oversight for finite element groundwater seepage modeling (SEEP/W) and hydrogeologic evaluation of tailings mitigation, Coeur Gold Golden Cross Mine Tailings Impoundment, New Zealand. Modeling was conducted to evaluate the practicability of tailings dam dewatering schemes. Additionally, we conducted seepage modeling to evaluate effects and feasibility of dewatering for the Mangare Waste Treatment Plant Upgrade. This would ultimately lead to the biggest environmental restoration program to be undertaken in New Zealand including removing 500 hectares of oxidation ponds (the subject of the modeling) and restoring 13 kilometers of coastline.
- **Numerical Flow Modeling, Owens Valley, Inyo County, California.** Hydrogeologic consultant for the Owens Valley Indian Water Commission through the development of hydrogeologic data gathering, development of conceptual models for the Lone Pine Reservation, Big Pine Reservation and Bishop Reservation areas of the Owens Valley, and development of numerical groundwater models for each of these areas. The models developed provide these Paiute/Shoshone tribes with tools to evaluate the impacts on local reservations of water resource activities conducted by outside agencies. This U.S. Geological Survey – peer reviewed

modeling effort provided strong water management tools for the tribal community of the Owens Valley.

- **Water-Supply Feasibility Study, Inyo County, California.** Principal in Charge for hydrogeologic services associated with a feasibility study for a potable water supply and fire-flow system for the community of Tecopa in Inyo County, California. Work was conducted under a California Department of Water Resources grant (Integrated Regional Water Management Planning – Proposition 84). Waters in the area typically have elevated dissolved solids and metals such as arsenic and residents routinely obtain water from distant sources. The study was being conducted under a grant from the California Department of Water Resources, and because of this work, a grant to implement the water system has been received and the facility constructed and operational.

- **Water Resource Assessments, Mono County, California.** Served as consultant to Mono County conducting groundwater availability assessments for several Mono County communities including Antelope Valley (West Walker River); Mono City and Lee Vining (Mono Basin), Crowley and the Tri-Valley areas (Owens River). Work included conducting field reconnaissance activities, developing groundwater recharge estimates, evaluating local groundwater budgets, identifying potential future impacts due to regional growth, water quality issues, etc. He has also provided hydrogeologic support to the County of Mono with respect to reviewing and evaluating groundwater modeling conducted to evaluate potential impacts caused by expansion of a geothermal plant in Mono County.

- **Groundwater-Supply Feasibility Study, San Mateo County, California.** Currently conducting a feasibility/well siting study related to the development of a groundwater supply for the La Honda area in the northern Santa Cruz Mountains of San Mateo County. The area has relied on surface water for its water supply and groundwater is being considered as a supplemental source of water for the San Mateo County Community Service Area No. 7 water system.

- **Vineyard Water Resource Assessment, Lake County, California.** Served as consultant to Shannon Vineyards to evaluate water supply for existing and future development of vineyards in Lake County, California. Investigation identified a previously unidentified aspect to the hydrologic conceptual model indicating that more groundwater may be available to support future development and potentially alleviate long-term concerns for local impacts to springs. Additional data collection and analysis were recommended to support these new findings.

- **Well Siting Analysis, Los Angeles County, California.** Conducted analyses including fracture trace analysis to identify potential production sites for the Elizabeth Lake Mutual Water Company. The area of the well will be within the trace of the San Andreas Fault Zone, resulting in a complex fracture analysis and review of existing of wells and springs.

REPRESENTATIVE EXPERT RETENTIONS/APPEARANCES

- CV Communities, LLC, City Ventures LLC, Plaintiffs vs. Antelope Valley – East Kern Water Agency, San Gorgonio Pass Water Agency, City of Palmdale; Cross Complaint City of Palmdale vs. CV Communities, LLC, City Ventures LLC, Antelope Valley Easter Kern Agency. Deposition (2024).

- Center for Biological Diversity and Amargosa Conservancy, Plaintiffs vs. Debra Haaland in her official capacity as Secretary of the Interior, Tracy Stone-Manning in her official capacity as the Director of the Bureau of Land Management, U.S. Department of the Interior, Bureau of Land Management, and Nicholas B. Pay in his official capacity as Field Manager of the Bureau of Land Management Pahrump Field Office, Defendants. Declaration (2023).

- State of California Water Resources Control Board, Office of Administrative hearings, Draft Cease and Desist Order issued against Bluetriton brands, inc. relating to spring capture in San Bernardino County, California. Declaration and Oral Testimony (2022).

- Laubro No 1 LLC and against City National Bank as Trustee of the Herbert and Helen Kelly Trust, Wells Fargo Bank NA as Trustee of the Robert F. Faust Trust, et.al., in Superior Court for the State of California, County of San Diego. Expert Report, Deposition, Court Testimony (2018).

- Eddie Falzon and S. Jo Falzone v. Wack, Casey, Carey Williams, et.al., in Superior Court for the State of California, County of Inyo. Physical Solution, appointment as Watermaster (Representative of the Court), 40-Acres Water System.

- Orange County Water District v. Sabic Innovative Plastics US LLC; Brenntag West, Inc., Gallade Chemical, Inc.; et.al., In the Superior Court for the State of California in and for the County of Orange, Case No. 30-2008-00078246-CU-TT-CXC, Deposition (2013).

- State of California Energy Resources Conservation and Development Commission, Application for Certification for the Hidden Hills Solar Energy Generation Project; Intervenor Amargosa Conservancy, Docket No. 11-AFC-2, Declaration and Oral Testimony (2013).

- Little Lake Ranch, Inc. v. County of Inyo Board of Supervisors, Inyo County Planning Commission, Inyo County Planning Department, Coso Geothermal, Inc., Superior Court of the State of California, County of Inyo. Expert Report (2009).

- Southern California Gem Industries v. Roth, in the Superior Court of the State of California, County of San Diego. Expert Report (2009).
- Garry N. Holdgrafer, et.al., v. Unocal Corporation, A Delaware Corporation, Union Oil Company of California, Unocal California Pipeline Company, 76 Products Company, Superior Court of the State of California, County of San Luis Obispo. Deposition and Court Testimony (2003).
- Kvaerner Aronson, Inc. v. Mammoth Mountain Ski Area, Mammoth Mountain Ski Area v. EMCO Wheaton, Inc., In the Superior Court for the State of California, County of Mono. Deposition (2003).

PROFESSIONAL AFFILIATIONS

National Ground Water Association

Geological Society of America

Society for Mining, Metallurgy and Exploration

PUBLICATIONS

Fraga, N.S. Fraga, Brian S. Cohen, Andy Zdon, Maura Palacios Mejia, Sophie S. Parker "Floristic Patterns and Conservation Values of Mojave and Sonoran Desert Springs in California," *Natural Areas Journal*, 43(1), 4-21.

Love, A.H., Zdon, A., Fraga, N., Cohen, B., Palacios Mejia, M., Maxwell, R. and Parker, S.S. (2022) "Statistical Evaluation of the Similarity of Characteristics in Springs of the California Desert, USA. *Frontiers in Environmental Science*, p.2101. https://doi.org/10.3389/fenvs.2022.1020243.

Zdon, A., Love, A.H. (2020). "Groundwater Forensics Methods for Differentiating Local and Regional Springs in Arid Eastern California, USA." Environmental Forensics. https://doi.org/10.1080/15275922.2020.1836075.

Parker, S.S., Zdon, A., Christian, W.T., Cohen, B.S., Mejia, M.P., Fraga, N.S., Curd, E.E., Edalati, K., and Renshaw, M.A. (2020). "Conservation of Mojave Desert Springs and Associated Biota: Status, Threats and Policy Opportunities." Biodiversity and Conservation. https://doi.org/10.1007/s10531-020-02090-7.

Zdon, A. (2019). "An inventory of operational and planned groundwater recharge basins in the San Joaquin Valley, California." Prepared for Point Blue Conservation Science. https://data.pointblue.org/apps/data_catalog/dataset/california-ecological-data-layers.

Zdon, A., Rainville, K., Love, A.H., Buckmaster, N., and Parmenter, S. (2019). "Identification of source-water mixing in the Fish Slough spring complex, Mono County, California, USA." Hydrology 2019, 6. 26. https://www.mdpi.com/2306-5338/6/1/26.

Love, A.H., Zdon, A. (2018). "Use of Radiocarbon Ages to Narrow Groundwater Recharge Estimates in the Southeastern Mojave Desert, USA." Hydrology 2018, 5, 51. https://www.mdpi.com/2306-5338/5/3/51.

Zdon, A., Davisson, M.L., and Love, A.H. (2018) "Understanding the source of water for selected springs within Mojave Trails National Monument, California." Environmental Forensics, Volume 19, No. 2, 99-111. https://doi.org/10.1080/15275922.2018.1448909.

Zdon, A. (2017). "Water in the Desert? A Survey of Springs 2015-2016." Desert Report: News of the Desert from Sierra Club California and Nevada Desert Committee. June.

Potter, Christopher, Zdon, A., and Weigand, J. (2017) "Monitoring Springs in the Mojave Desert using Landsat Time Series Analysis. International Journal of Water Resources and Environmental Management, Volume 8, No. 2. December.

Zdon, A., Davisson, M. L., and Love, A.H. (2015) "Testing the Established Hydrogeologic Model of Source Water to the Amargosa River Basin, Inyo and San Bernardino Counties, California." Environmental forensics, v. 16,.4 pp. 344-355. https://doi.org/10.1080/15375922.2015.1091406.

Zdon, A. (2014) "Wading Deep: The Importance of Hydrological Monitoring." California Council of Land Trusts, Conservation Frontiers, Volume 5.3, July. 8 p.

Traylor, R.L., Zdon, A., Zawadki, A. (2001) "Identification of Areas for Potential Recharge Projects, New Well Siting Areas and Basin Source Water Assessment." Proceedings of the XXXI International Association of Hydrogeologists Congress Munich, Germany, 10-14 September 2001: New Approaches Characterizing Groundwater Flow. Pages 657-661.

Brothers, K., Tracy, J., Kaufmann, R. F., Stock, M., Bentley, C., Zdon, A., and Kepper, J. (1992) "Hydrology and Interactive Computer Modeling of Ground and Surface Water in the Lower Virgin River Valley, primarily in Clark County, Nevada." Las Vegas Valley Water District, Cooperative Water Project, Series Report No. 1, 90 p.

Brothers, K., Buqo, T. S., Tracy, J., Kaufmann, R. F., Stock, M., Bentley, C., Zdon, A., and Kepper, J., 1993, Hydrology and steady state ground-water model of Cave Valley, Lincoln and White Pine Counties, Nevada: Las Vegas Valley Water District, Cooperative Water Project, Series Report No. 11, 48.

Zdon, A., ed. (1991) "Geology of the Las Vegas Region." American Association of Professional Geologists, Nevada Section, 1991 Field Trip Guidebook. Las Vegas, Nevada.

PRESENTATIONS

Edalati, E., Yuerong, M., Shih, B., Curd, E., Renshaw, M., Mejia, M.P., Wayne, R., Fraga, N., Zdon, A., Parker, S. (2020). "Environmental DNA and Biodiversity Assessment of Mojave Desert Springs." 2020 California Aquatic Bioassessment Workgroup and California Society for Freshwater Science Meeting. October 13.

Palacios, M., Edalati, K., Curd, E., Renshaw, M., Fraga, N., Zdon, A., Wayne, R., Parker, S. (2020). "Assessing Biodiversity of Mojave

Desert Springs using Environmental DNA, Botanical Surveys, Geology and Ecoregion." Poster Presentation, 2020 California Aquatic Bioassessment Workgroup and California Society for Freshwater Science Meeting. October 13.

Rosen, S., Zdon, A. (2020). "PFAS in Eastern California." Webinar presented to Transition Habitat Conservancy and regional agencies and NGOs. May 12.

Zdon, A. (2019) "Current efforts for Baseline Understanding of Groundwater-dependent Ecosystems in Arid California," Oral Presentation, Los Angeles County Bar Association-Environmental Law Section Spring Symposium, Los Angeles, California (April 12, 2019).

Zdon, A. (2019) "Increasing our Understanding of Eastern California Springs: the Amargosa and Beyond." Oral Presentation, University of California White Mountain Research Station public lecture series, Bishop, California. (March 12, 2019).

Zdon, A. (2018). "Water – California's most precious resource," Oral Presentation, Oakland Museum of California, Oakland, California. (November 5, 2018).

Zdon, A. (2017) "Hydrologic Processes in a Shifting Climate in the Arid Southwest," Oral Presentation, 2017 University of California, Davis – California Department of Water Resources – Point Blue Conservation Science Riparian Summit, Davis, California. (October 18, 2017).

Zdon, A. (2017) "Spring Surveys for Land Trusts - Lessons Learned from a Regional Survey," Oral Presentation, 2017 California Council of Land Trusts, 2017 Land Conservation Conference, University of California, Davis (March 2017).

Davisson, M.L., A. Zdon (2015) "Constraints on the Recharge Sources, Flowpaths, and Ages of Groundwater in the Amargosa River Valley", Oral Presentation with Abstract, 2015 Jim Deacon Memorial Devil's Hole Annual Workshop, Ash Meadows National Wildlife Refuge, Nevada. (May 7, 2015).

Belcher, W., D. Sweetkind, C. Hopkins, M. Poff, A. Zdon, L. Davisson (2015) "Evaluating Groundwater Flow Paths in Lower Amargosa Valley, Nye County, Nevada and Inyo County, California: Conceptual Model." Oral Presentation with Abstract, 2015 Jim Deacon Memorial Devil's Hole Annual Workshop, Ash Meadows National Wildlife Refuge, Nevada. (May 7, 2015 – Joint presentation with U.S. Geological Survey).

Love, A.H., A. Zdon (2015) "Assessing Limited Water Resources - Water Resources Forensics." 25th Annual International Conference on Soil, Water, Energy, & Air, San Diego, CA. Oral Presentation presented March 24, 2015.

Zdon, A., A.H. Love (2015) "Legal and Regulatory Considerations for Land/Water Conservation Science." California Council of Land Trusts Land Conservation Conference, Sacramento, CA. Oral Presentation presented March 6, 2015.

Zdon, A. (2015). "Southern California Water: Issues Facing the Conservation Community." California Council of Land Trusts Land Conservation Conference, Sacramento, CA. Oral Presentation presented March 5,2015.

Zdon, A., W. Belcher, D. Sweetkind, M. Poff, C. Hopkins (2015) "Hydrologic Characterization: A Crucial Component for Protecting Wildlife Habitat along the Amargosa Wild & Scenic River." Abstract and Oral Presentation, 2015. Amargosa Vole Working Group Meeting, Western Section of the Wildlife Society, Santa Rosa, CA. January 27. (Joint paper with U.S. Geological Survey).

Zdon, A. (2014) "Baseline Hydrologic Characterization of Springs in the California Desert: A Critical Component for Water Resource Management." Abstract and Oral Presentation, Devil's Hole Conference, Death Valley National Park. Presented April 30, 2014.

Zdon, A. (2014) "Understanding Your Water Resources." Workshop, California Council of Land Trusts Land Conservation Conference, Sacramento, California. March 5.

Zdon, A. (2013) "In the Footsteps of Early Researchers: Evolving Hydrologic Understanding in the California Desert." The 2013 National Ground Water Association Summit: The National and International Conference on Groundwater, San Antonio, Texas. June 1, 2013. Oral Presentation with Abstract.

Love, A.H., Zdon A., Philipp, J.R. (2013) "Testing the Established Regional Hydrologic Conceptual Model in the Amargosa River Basin, California and Nevada." The 2013 National Ground Water Association Summit: The National and International Conference on Groundwater, San Antonio, Texas. June 1, 2013. Oral Presentation with Abstract.

Zdon, A. (2013) "Water: The Missing Element in Land Conservation." The 2013 California Land Conservation Conference, California Council of Land Trusts, Sacramento, California. March 19, 2013. Concurrent Session leader and presenter.

Zdon, A. (2013) "Baseline Hydrologic Investigation and Monitoring, Amargosa River Wild and Scenic River System, California and Nevada." The 2013 California Land Conservation Conference, California Council of Land Trusts, Sacramento, California. March 19, 2013. Oral presentation.