Case No. 84739

IN THE SUPREME COURT OF THE STATE OF NEVADA

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Elizabeth A. Brown
Clerk of Supreme Court

ADAM SULLIVAN, P.E., NEVADA
STATE ENGINEER, et al.

Appellants,

vs.

LINCOLN COUNTY WATER
DISTRICT, et al.

<u>JOINT APPENDIX</u>

VOLUME 17 OF 49

COYOTE SPRINGS INVESTMENT, LLC

RECEIVED
2019 AUG 16 PM 2:30
STATE ENGINEERS OFFICE

August 16, 2019

Via Hand Delivery
Mr. Tim Wilson, PE
Acting State Engineer
Department of Conservation and Natural Resources
Division of Water Resources
901 South Stewart Street, Suite 2002
Carson City, Nevada 89701-5250

Re: Report Submitted Pursuant to Nevada State Engineer Interim Order 1303

Dear Mr. Wilson:

Enclosed is Coyote Springs Investment LLC's Rebuttal to Order 1303 Reports, as called for in Nevada State Engineer Interim Order 1303.

Specifically, enclosed are three (3) copies of Coyote Springs Investment LLC's Rebuttal to Order 1303 Reports authored by Stetson Engineers Inc. and dated August 16, 2019, and a flash drive containing a PDF copy of the same.

Submittal of Coyote Springs Investment's Rebuttal to Order 1303 Reports does not constitute a waiver of any our rights to petition for administrative and judicial reviews of matters pertaining to our water rights.

Our July 3, 2019 Interested Stakeholder Report, and the enclosed Rebuttal to Order 1303 Reports, further validates that there is a sufficient and sustainable long-term supply of groundwater to allow Coyote Springs Investment LLC to exercise its water rights and commence development of the Coyote Springs Master Planned Community without causing detrimental impacts to groundwater resources in the Muddy River Springs Area.

Sincerely,

Emilia Cargill

Emilia K. Cargill
Chief Operating Officer
Senior Vice President & General Counsel

3100 State Route 168 • P.O. Box 37010 • Coyote Springs, Nevada 89037
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Rebuttal to Order 1303 Reports
Submitted to the Nevada State Engineer

August 16, 2019

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STATE ENGINEERS OFFICE

Prepared for:

Coyote Springs Investment, LLC

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STETSON
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COYOTE SPRINGS INVESTMENT, LLC

August 16, 2019

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AFY	Acre-feet per year
amsl	Above mean sea level
CBD	Center for Biological Diversity
CFS	Cubic Feet per Second
CNLV	City of North Las Vegas
COOP	National Weather Service Cooperative
CSAMT	Controlled Source Audio-frequency Magnetotellurics
CS Nevada	Coyote Springs Nevada, LLC
CSI	Coyote Springs Investment, LLC
CY	Calendar Year
CSV	Coyote Spring Valley
DOI	U.S. Department of the Interior
DRI	Desert Research Institute
ET	Evapotranspiration
FWS	U.S. Fish and Wildlife Service
GBWN	Great Basin Water Network
GIS	Geographic Information System
gpm	Gallons per minute
LWRFS	Lower White River Flow System
MBOP	Moapa Band of Paiute Indians
MRSA	Muddy River Springs Area
MVWD	Moapa Valley Water District
mya	Million years ago
NHD	National Hydrography Dataset
NPS	National Park Service
NRCS	National Resources Conservation Service
NSE	Nevada State Engineer
Ωm	Ohm-meters
PRISM	Parameter-elevation Regressions on Independent Slopes Model
SNWA	Southern Nevada Water Authority
USGS	United States Geological Survey
Vidler	Vidler Water Company, LLC
WRCC	Western Regional Climate Center

1.0 INTRODUCTION

The Nevada State Engineer's (NSE) Order 1303 requested interested stakeholders to submit reports that address the following issues:

a. The geographic boundary of the hydrologically connected groundwater and surface water systems comprising of the Lower White River Flow System;

b. The information obtained from the Order 1169 aquifer test, subsequent to the aquifer test, and from Muddy River headwater spring flow as it relates to aquifer recovery since the completion of the aquifer test;

c. The long-term annual quantity of groundwater that may be pumped from the Lower White River Flow System, including the relationships between the location of pumping on discharge to the Muddy River Springs and the capture of Muddy River flow:

d. The effects of movement of water rights between alluvial wells and carbonate wells on deliveries to senior decreed rights on the Muddy River; and,

e. Any other matter believed to be relevant to the State Engineer's analysis.

Parties that submitted reports include: Coyote Springs Investment, LLC (CSI); Southern Nevada Water Authority (SNWA); U.S. Fish and Wildlife Service (FWS); National Park Service (NPS); Moapa Band of Paiutes (MBOP); Lincoln County Water District and Vidler Water Company (Vidler); Technichrome; City of North Las Vegas (CNLV); Great Basin Water Network (GBWN); Center for Biological Diversity (CBD); Dry Lake Water, LLC, Georgia Pacific Corporation; Republic Environmental Technologies (Dry Lake); and Moapa Valley Water District (MVWD).

Because it is unlikely that twelve separate parties could independently develop a unique conceptual model that describe the occurrence and movement of groundwater through the LWRFS, this rebuttal report highlights the differences and agreements between fundamental issues discussed in the various reports, and provides evidence that will support the NSE to make his determination. This rebuttal report addresses key points of the NSE's request for information on the issues identified in Order 1303. Because of the large volume of information provided in each of the twelve Order 1303 reports, this rebuttal report's silence on any particular topic or statement does not represent either concurrence or opposition. We have been specific in our agreement on specific issues; and have offered evidence on issues when we have specified disagreement.

A fundamental issue that separates each of the parties' reports is their conceptual model of the Lower White River Flow System (LWRFS). The various components of the conceptual model that describes the LWRFS include recharge, geologic structure, hydrogeologic properties, and discharge. Recharge to the LWRFS is controlled by both regional groundwater flow and local precipitation that varies with climatic conditions. Geologic structure includes faults, folds, and geologic formations that may act as barriers or conduits of groundwater flow. Hydrogeologic properties include transmissivity, storage, diffusivity, and other parameters that affect the response of groundwater levels and streamflow to anthropogenic and natural forces. Finally, discharge includes spring flow, surface flow, evapotranspiration, pumping, and groundwater outflow that occurs in the LWRFS.

An example of a fundamental issue that forms the basis for the LWRFS conceptual model and varies widely among the Order 1303 reports is whether the geologic structure of the carbonate aquifer should be considered homogenous[1], or if folds, faults, and geologic formations affect the flow of groundwater. CSI presented geologic and geophysical[2] information in our July 3, 2019 Order 1303 Report (CSI Report) that highlighted the subsurface structure of the LWRFS. Northeast-southwest trending normal faults mapped by Rowley et al. (2017) and confirmed by April 2019 CSAMT geophysical data act as both conduits and barriers to groundwater flow. Typically, groundwater flows parallel to the normal faults from north to south; and groundwater flow from west-to-east is impeded by the normal faults.

Aquifer test data coupled with the 2017 geologic and April 2019 CSAMT geophysical data show that portions of the aquifer are compartmentalized from other areas. Addressed throughout the remainder of this rebuttal report, groundwater pumping signatures from MX-5 during the Order 1169 aquifer test were not observed in all the monitoring wells located in the NSE's LWRFS boundary. This data highlights that separate flow paths exist within the LWRFS, which should be managed differently under sustainable conditions.

The impact of long-term climatic variability should not be confused with annual response in groundwater level data. Long-term trends in climatic variability affect groundwater levels throughout the LWRFS. Rainfall data from the Pahranagat Wildlife Refuge show that following a very wet 2004-2005 winter, groundwater levels rebounded to recent historic highs before entering a long-term dry period that lasted from 2006 to 2013. Both wet and dry long-term conditions need to be addressed in long-term sustainable management. A second signature seen in groundwater level data is due to seasonal variation in pumping volumes: as pumping increases in the summer months, groundwater levels decline. Both long-term and seasonal variability in groundwater levels need to be considered when comparing groundwater level hydrographs and assessing available water resources.

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[1] Defined as uniform in structure or composition throughout Driscol, 1986.
[2] See Appendix C for final geophysical report by Zonge International, Inc.

These fundamental issues relate directly to the issues that the NSE raised in Order 1303. The amount of groundwater available under sustainable management conditions can be related to how much impact can be expected from pumping at various locations in the LWRFS. The development of a conceptual model allows for informed sustainable management decisions to be made. The evidence demonstrates that a structural block, located in the center of Coyote Spring Valley (CSV), separates or compartmentalizes pumping related impacts on the west side of CSV from resources located on the east side.

As stated in the CSI Report, the entire LWRFS cannot be described as being underlain by a homogeneous carbonate aquifer that is fed by constant recharge and discharges through springs and seeps in the MRSA. Rather, the LWRFS is affected by varying long-term recharge rates, which supply regional and local groundwater flow controlled by structural geology and geologic units which vary over hundreds of square miles.

Each of the 12 reports that have been submitted to the NSE's office provides evidence that supports each parties' conceptual model. One of the underlying themes in each of these reports is whether all pumping, regardless of location, impacts the resources along the Muddy River. While SNWA suggests that pumping in the MRSA has a 1:1 impact on resources of the Muddy River,[3] MBOP suggests that the only relationship between pumping in Garnet Valley and MRSA is long-term climatic and annual variability due to pumping.[4] We agree in part with both parties; alluvial and carbonate pumping and diversions within the MRSA affects resources along the Muddy River, while the only common link between groundwater level signatures in Garnet Valley and MRSA is climatic conditions and annual variability.

These points of difference, along with others, are discussed in detail in this rebuttal report to clarify data and analysis presented in the CSI Report. Sections of this report are dedicated to individual Order 1303 reports, with tables summarizing individual responses to the NSE's questions from more comprehensive reports. Shorter or less in-depth reports are combined in a single section. Key points of difference or agreement are highlighted and expanded upon for each report. Also included are discussions of potential alternative approaches which the NSE may take in the pursuit of sustainable management of the LWRFS. This includes a revised LWRFS boundary that would incorporate Lower Moapa Valley (LMV) in order to allow the NSE to take into consideration decreed rights along the Muddy River in that basin.

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[3] SNWA Order 1303 Report, page 8-3.
[4] Dry Lake Report, Section 4, Page 2.

2.0 SOUTHERN NEVADA WATER AUTHORITY ORDER 1303 REPORT

A summary of SNWA/LVWD's "Assessment of Lower White River Flow System Water Resource Conditions and Aquifer Response" (SNWA Report) as it relates to the Order 1303's request for information is provided in Table 1. New information introduced in the SNWA Report includes new geologic and geophysical maps and reports developed by Rowley et al. in 2017; the same maps and information were relied upon in the CSI Report. Specifically, the Rowley et al. (2017) report establishes the preferred southward flow of groundwater along northeast-southwest trending normal faults developed during basin and range tectonics. While we agree that the carbonate rock is an extensive aquifer that extends beyond the boundaries of the LWRFS, the SNWA Report does not discuss the impact that structural blocks and extensive faulting have on the relationship between groundwater pumping and observed impact on the Muddy River and MRSA springs. The following sections of this chapter discuss the SNWA Report and our opinion of their conclusions.

TABLE 1. SUMMARY OF SNWA ORDER 1303 REPORT

Order 1303 Issue	SNWA Report	Reference	Rebuttal Comments
Geographic Boundary	No Change from the NSE boundary. Carbonate aquifer is continuous across region.	Pg 8-1, Section 8.A	In order to assess impacts to decreed rights, LWRFS boundary should include Lower Moapa Valley.
Status of Aquifer Recovery	Lack of Significant Recovery since Order 1169 aquifer test. Recovery not possible without extraordinary hydrology similar to winter of 2004-2005.	Pg 8-1, Section 8.B	Extreme wet hydrology is part of a balanced hydrologic cycle.
Annual Quantity of Groundwater	4,000-6,000 AFY	Pg 8-4, Section 8.C	Lack of evidence provided by SNWA/LVWD to substantiate annual quantity.
Impact of Pumping on MR Flow	MRSA Alluvial Pumping reduces streamflow on a 1:1 basis. MRSA Carbonate Pumping reduces streamflow approaching a 1:1 basis Other Carbonate Pumping in LWRFS affects streamflow, but the effects cannot be readily detected.	Pg 8-3, Section 8.D	Alluvial and carbonate pumping in the MRSA has a direct impact on streamflow. The impact of carbonate pumping in other areas of the LWRFS may or may not affect streamflow due to structural geology and location.
Movement of Water Rights between Aquifers	Movement of groundwater production will not mitigate impacts, only delay their impact.	Pg 8-5, Section D	Structural geology creates boundaries which mitigate impacts of pumping in western CSV.

2.1 SNWA REPORT'S GEOGRAPHIC BOUNDARY

The SNWA Report finds that the "boundary of the LWRFS should be defined by the NSE in Order 1303." SNWA, as did CSI in its CSI Report, recommended to adopt the NSE's boundary for the LWRFS, however, we do not agree on SNWA's basis for the recommendation. Specifically, the SNWA Report states: "*The data presented in Section 5.0 demonstrate that the aquifer responds similarly to changes in both groundwater production and recharge throughout the six basins composing the LWRFS. Observed trends are uniform across the system, with only slight variations in the magnitude of the responses.*" [5] Based on water level data provided in the SNWA Report and previous analyses by SNWA,[6] the water level response to pumping is not uniform throughout the LWRFS.

The observation presented by SNWA suggests that the annual variation from an early springtime high to late summer-time low groundwater level is due to recharge. Specifically, the SNWA report states: "*The charts shown in Figures 5-5 and 5-6* [Groundwater Level Hydrographs] *illustrate the seasonal responses of groundwater levels to recharge pulses, with levels typically achieving their annual peak in April.*"[7] We disagree that the variation is due only to "recharge pulses," and suggest that the variation is a combination of both groundwater pumping and recharge affects groundwater levels.

Groundwater pumping in the southwestern United States is generally greatest during the summer months and least during the winter. The average monthly groundwater production in the MRSA from 1998 to 2018 is shown in Figure 1 as a percentage of annual production. This data indicates that peak groundwater production occurs in July, and minimum production occurs in February (Figure 1). Maximum groundwater levels would occur in response to minimum pumping. Conversely, minimum groundwater levels would occur in response to maximum groundwater pumping. Therefore, based on actual groundwater production in the MRSA, maximum groundwater levels would occur during February and March and minimum groundwater levels would occur in late summer.

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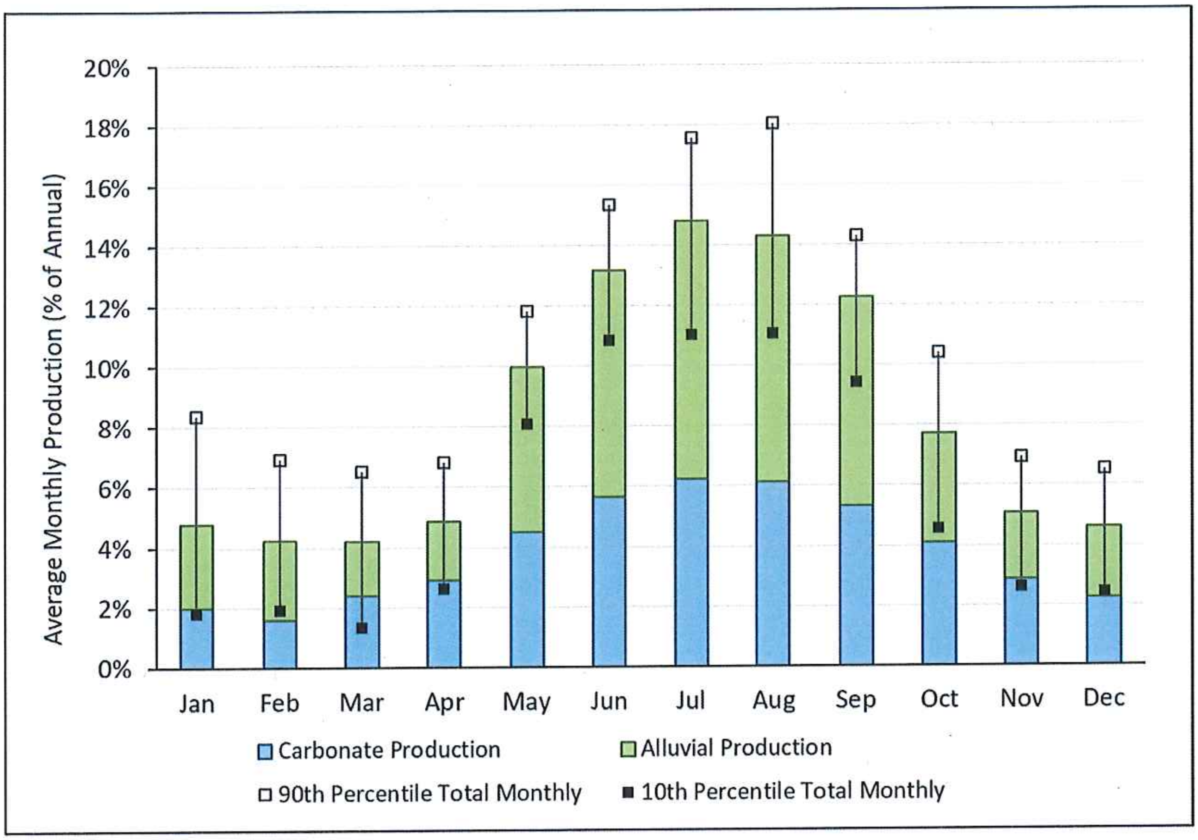
[5] SNWA Report, Section 8.A, Page 8-1.
[6] SNWA 2013 and 2018 reports.
[7] SNWA Report, Section 5.2.2, Page 5-11.

FIGURE 1. **MRSA AVERAGE MONTHLY GROUNDWATER PRODUCTION AS PERCENT OF ANNUAL, 1998-2018**



The differentiation between whether the annual variation is due to a recharge "pulse", as stated in the SNWA Report, or due to changes in pumping rates is important when considering regional flow and local recharge throughout the LWRFS. For example, it is likely that recharge from rainfall was zero or very little in 2002 when annual rainfall for Extreme Southern Nevada was less than 2 inches.[8] During the same year, monitoring well EH-4 in the MRSA showed a consistent variability in annual groundwater levels when compared to 2001 and 2003 when rainfall was almost 7 inches. A more plausible explanation of the annual variability of groundwater levels in the LWRFS is that they are controlled by pumping and that regional and local recharge is consistent with long-term drying and wetting trends measured over the period of years.

As described in the SNWA Report, groundwater levels reached their record high in the spring of 2006 following the winter period of 2004-2005, during which precipitation was 300% of normal rates.[9] The data presented in their report highlights two important factors that control the

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[8] SNWA Report, Figure 4-3, page 4-3.
[9] SNWA Report, Page 5-13.

availability of groundwater in the LWRFS: 1) long-term dry and wet cycles control the availability of groundwater in the LWRFS; and 2) groundwater pumping affects the annual variability of groundwater levels. Determination of sustainable pumping must be based on a balanced hydrologic cycle that includes both long-term and annual dry and wet cycles.

The annual variation in groundwater levels is not observed in monitoring well CSVM-3, KMW-1, CSVM-4, or CSVM-5, which is not consistent with SNWA Report's conclusion that annual variability is due to recharge pulses. Based on the assumption that these wells are affected by natural recharge, the only plausible explanation is that groundwater levels in these wells are isolated from groundwater pumping impacts due to structural barriers. As shown in the CSI Report, northeast-southwest normal faults that extend throughout the Coyote Spring Valley create a barrier to the impact of pumping wells located west of those faults.

Therefore, while we agree that the geographic boundary of the LWRFS that was established by the NSE is generally appropriate for establishing sustainable management criteria, we do not agree that "*Observed trends are uniform across the system*" as stated in the SNWA Report. Normal faulting mapped by Rowley et al. (2017) and identified in the CSI Report may appear as barriers to groundwater flow and effectively isolate impacts within an area defined by the faults.

2.2 STATUS OF AQUIFER RECOVERY

While we agree with the recorded spring flow and groundwater levels presented in the SNWA Report regarding aquifer recovery in the LWRFS, we disagree with the conclusion that "*Flow measured at the Warm Springs West gage will reach Trigger Ranges sooner and at lower production rates than contemplated in the 2006 MOA if pumping in Coyote Spring Valley resumed at levels commensurate with the Order 1169 aquifer test.*"[10] The basis for their statement is found in Section 5.2.3.1,[11] which relies only on a qualitative discussion of pumping at MX-5 and observed streamflow at Warm Springs West gage. Their conclusion lacks any discussion of other physical stresses that impact flow at Warm Springs West gage, including:

1. impacts from nearby alluvial and carbonate pumping in the MRSA;
2. long-term hydrologic variability that affects groundwater levels;
3. structural geology that affects the amount and direction of groundwater flow;
4. contributions of groundwater flow from areas other than Coyote Spring Valley; and,
5. a quantitative analytical analysis of storage depletion and recharge.

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[10] SNWA Report, Section 8.B, Page 8-2.
[11] SNWA Report, Page 5-13.

Previous data presented by CSI has shown that the Order 1169 Aquifer Test occurred at the end of a long-term extended dry period that began in 2006 and ended at the end of the Order 1169 aquifer test in 2012[12]. Under sustainable management conditions, based on a long-term balanced hydrologic cycle, pumping can be managed to mitigate impacts on both spring flow and surface flow in the MRSA. Accounting for the presence of structural faults and barriers, the quantity and direction of groundwater flow, and hydrologic conditions will allow operating wells in the future to protect water resources of the LWRFS.

2.3 ANNUAL QUANTITY OF GROUNDWATER

The SNWA Report does not cite a specific technical basis for the estimated groundwater pumping in the LWRFS of 4,000 AFY to 6,000 AFY.[13] Review of the SNWA Report indicates that the only basis for their estimate of groundwater pumping is found in Section 6.2.4 and Table 6-2, which specifies decrease in streamflow based on reduction in flow at Warm Springs West gage. Specifically, Table 6-2 identifies that flow at the Muddy River at Moapa will be decreased by 8.16 cfs (6,000 AFY), from its predevelopment level of 50.2 cfs, when flow at Warm Springs West is reduced by 0.62 cfs to 3.2 cfs. The basis for Table 6-2 is a statistical analysis of Muddy River streamflow, corrected for surface diversions and alluvial pumping, compared to observed flow at Warm Springs West. The average ratio between Warm Springs West and the Muddy River at Moapa is 0.078 (7.8%), as outlined in Section 6.2.3.1. Later in section 6.2.3.2, the SNWA Report cites a ratio of 7.6% based on measurements performed by Eakin (1964) during a 1963-1964 study.

The streamflow ratio analysis in the SNWA report does not provide a technical basis for estimating annual quantity of groundwater that may be pumped from the LWRFS. While the SNWA Report indicates "*As long as the hydraulic head in the carbonate aquifer is maintained at a level high enough to keep all springs and seeps flowing, each spring and seep contributes a constant proportion to the MRSA discharge.*"[14], physical properties of the MRSA do not support this assumption.

The elevation of the Warm Springs West gage is 1,771 feet (above NGVD29), while the elevation of the Muddy River near Moapa gage is 57.5 feet lower, at 1,710 feet (above NAVD88).[15] As groundwater levels decrease below 1,771 feet, it is likely that the flow at Warm Springs West will cease, but flow at Muddy River will continue to occur due to contributions from lower elevation springs and flow from the carbonate aquifer to the alluvium. The data presented in the SNWA

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[12] CSI Report, page 12.

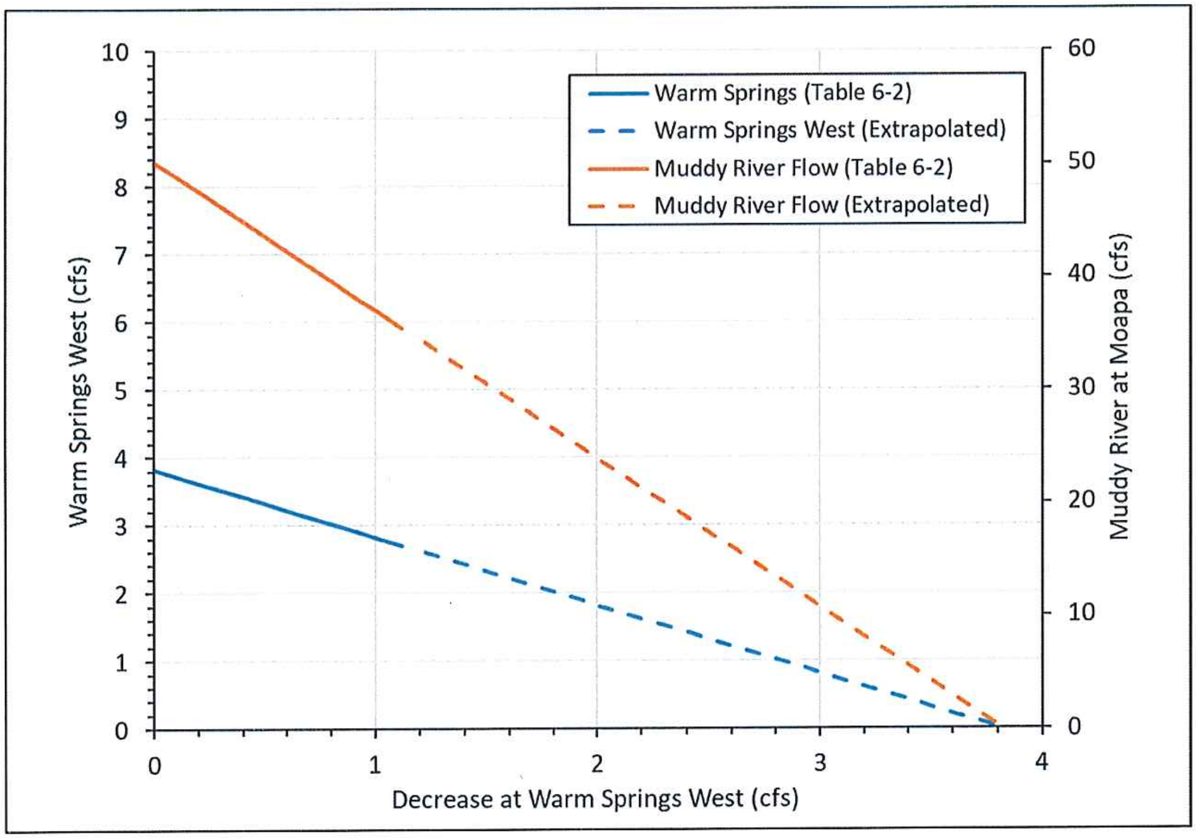
[13] SNWA Report, Section 8.C, Page 8-4.

[14] SNWA Report, Section 6.2.3.2, Page 6-8.

[15] The approximate vertical difference is calculated as NAVD88 = NGVD29 + 3.5 feet.

Report that suggests a 6,000 AFY reduction in predevelopment MRSA discharge would occur when Warm Springs West drops to 3.2 cfs is graphically depicted in Figure 2. The solid line represents the streamflow reduction presented in Table 6-2 of the SNWA Report, while the dashed line represents a continuation of their data based on their stated assumption that their ratio is sound as long as all seeps and springs continue to flow. As shown in the figure, their assumption would suggest that as groundwater levels drop below 1,771 feet, resulting in 0 cfs at Warm Springs West, the Muddy River near Moapa at 1,710 feet would cease to flow. Based on contributions of flow from the alluvium and lower elevation seeps, it is not likely that the Muddy River would cease to flow. Therefore, reductions in Muddy River flow should not be estimated based only on changes in flow at Warm Springs West.

FIGURE 2. GRAPHICAL REPRESENTATION OF SNWA REPORT TABLE 6-2 SHOWING RELATIONSHIP BETWEEN WARM SPRINGS WEST AND MRSA DISCHARGE



2.4 IMPACT OF PUMPING ON MUDDY RIVER FLOW

The SNWA Report states: "*The USGS Muddy River near Moapa, NV gage [...] measures the streamflow contributions from spring complexes, gaining reaches and intermittent flood flows.*"[16] However, the Moapa gage may only measures effects upstream of the gage, which offers a limited perspective on the characteristics of the rest of river and does not account for downstream contributions. SNWA later uses data from the Moapa gage to quantify potential negative impacts to their water rights in Lower Moapa Valley.

Analysis of Muddy River streamflow at the Moapa and Glendale gages indicate that there are contributions to streamflow downstream of the Moapa gage (Appendix A). Based on data from 1952 to 2018, the reach of river between the Moapa and Glendale gages is generally gaining during the months of November through March and losing during the months of April through October. The average decrease in flow between the two gages during April through October is approximately 2.9 cfs or 1,240 AF, a value less than the estimated 4,500 AFY of evapotranspiration that occurs in California Wash.[17] Therefore, contributions to the Muddy River occur below the Moapa gage, and impact the availability of surface water in the Lower Moapa Valley. The source of these contributions is likely supported by flow from the Lower Meadow Valley Wash.

Based on downstream contributions to the Muddy River from below Moapa, the Moapa gage should not be the only gage used to assess impacts on rights which are located downstream of the Glendale gage, due to myriad factors which affect the behavior of the stream between both gages. By only addressing flow at the Moapa gage, SNWA fails to consider, among other factors[18], significant flow contributions from Lower Meadow Valley Wash.

2.5 OTHER ANALYSES INCLUDED IN SNWA REPORT

We disagree with the SNWA Report statement that "*For the purposes of estimating long-term limits on carbonate aquifer production, a reduction in MRSA discharge from predevelopment conditions can be considered equivalent to a volume of groundwater withdrawn from the carbonate aquifer.*"[19] In order for this statement to be true, the authors would need to assume that all groundwater pumping in the LWRFS affects discharge at the Muddy River near Moapa, regional and local recharge do not contribute to sustainability, and long-term climatic variability does not affect available water resources. Based on observed groundwater and spring flow levels, extended dry and

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[16] SNWA Report, Section 3.4.1.
[17] CSI Report, Table 8, Page 41.
[18] Other factors may include contributions from California Wash and subsurface inflow to the Lower Moapa Valley.
[19] SNWA Report, Section 6.3, page 6-11.

wet cycles (ie. changes in regional and local annual recharge), affect the availability of groundwater and surface water in the LWRFS. The capture analysis provided in SNWA Report Appendix D, and relied upon in Section 6.2.4, indicates that there was 4,000 AF of aquifer capture in 2005 and 6,300 AF of aquifer capture in 2006. While there are variations of total groundwater in storage throughout the LWRFS based on location of pumping wells, the observed data in spring flow and monitoring wells in the MRSA show a significant recovery of groundwater in storage between 2005 and 2006. The SNWA report ignored recharge to the LWRFS and instead chose to recognize their results as approximate due to the uncertainty of effects of recharge variability.[20]

The LWRFS cannot be represented by a simplistic conceptual model that is based on an isotropic homogenous aquifer from which the only discharge is measured at the Muddy River near Moapa gage. Instead, the quantity and direction of groundwater flow in the LWRFS is controlled by long-term climatic cycles, regional and local recharge, and geologic faults and structures that support not only the surface flow in the MRSA, but also water availability in rivers, springs, and seeps throughout the LWRFS, the Black Mountain Area, and the Lower Moapa Valley.

The SNWA Report states that the SNWA holds decreed water rights within the Upper and Lower Muddy River that they have either purchased or leased.[21] The data presented in the CSI Report and supported by others[22] show that flow from the Lower Meadow Valley Wash supports Muddy River streamflow and groundwater subflow in the Lower Moapa Valley. In order to account for decreed rights held by SNWA and others in the Lower Muddy River, a modified LWRFS boundary is depicted in Appendix B of this report. This modified LWRFS boundary is an expansion of the NSE's existing LWRFS and is greater in area than that which was originally recommended in the CSI Report. Due to the importance of protecting the decreed rights on the Muddy River under sustainable management conditions, the NSE may consider adoption of a modified LWRFS boundary that accounts for inflow from Lower Meadow Valley Wash.

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[20] SNWA Report, Section 6.2, Page 6-10.
[21] SNWA Report, Section 7.1, Page 7-1.
[22] See: NPS Report, FWS Report, MBOP Report.

3.0 U.S. FISH AND WILDLIFE SERVICE ORDER 1303 REPORT

A summary of the U.S. Fish and Wildlife Service's Issues Related to Conjunctive Management of the Lower White River Flow System (FWS Report) is provided in Table 2. The FWS Report does not offer new data other than hydrologic and climatic data that has been gathered since the end of the Order 1169 aquifer test. Additional analyses in their report are focused on the relationship between groundwater levels in the carbonate aquifer and spring discharge. While the FWS Report provides evidence that there is a relationship between groundwater levels in the carbonate aquifer and some of the springs in the MRSA, the evidence shows that the cause of groundwater level decline in the carbonate aquifer is due to climatic conditions. The basis for the distinction is each parties' conceptual model of the LWRFS. Whereas the FWS Report suggest that the aquifer is homogeneous throughout portions of CSV, MRSA, Hidden, Garnet, and California Wash[23], the CSI Report shows that aquifer heterogeneities control the occurrence and movement of groundwater. The FWS Report does not provide an update to the SeriesSEE analysis that was introduced in their June 2013 Order 1169 report; so peer review or repeatability of the model cannot be performed.

3.1 FWS'S GEOGRAPHIC BOUNDARY

The FWS's geographic boundary is based on an assessment of geologic formations, observed groundwater levels, and a SeriesSEE analysis that results in general agreement with the NSE's LWRFS boundary, except for the addition of KSV and Lower Meadow Valley Wash. Groundwater levels are relied upon by the FWS as the basis for including KSV in the LWRFS, suggesting that water levels in KSV mirror those in CSV.[24] The basis for including Lower Meadow Valley Wash in the LWRFS includes alluvial inflow from Lower Meadow Valley Wash to the MRSA and California Wash that supports the flow of the Muddy River.

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[23] FWS Report, Page 17. Homogeneity inferred by the statement "Nevertheless, a remarkable uniform 1.5 to 1.6 ft of drawdown was induced by the MX-5 pumping during Order 1169 test across multiple basins in the regional carbonate aquifer, irrespective of distance from MX-5:..."

[24] FWS Report, Page 21.

TABLE 2. SUMMARY OF FWS ORDER 1303 REPORT

Order 1303 Issue	FWS Report	Reference	Rebuttal Comments
Geographic Boundary	The FWS recommends including Kane Springs Valley and most of Lower Meadow Valley Wash in addition to adjustments to some of the NSE's LWRFS.	Pg. 2	KSV and Lower Meadow Valley Wash should not be included in LWRFS boundary.
Status of Aquifer Recovery	High-elevation springs in the MRSA respond to fluctuations in carbonate water levels. Big Muddy Spring may be tied to climate variability.	Pg. 3	High elevation springs are impacted by varying hydrologic conditions.
Annual Quantity of Groundwater	9,318 AFY	Pg. 3	FWS did not provide evidence to support this quantity.
Impact of Pumping on MR Flow	The FWS suggest that steady-state conditions had not been reached at the end of the Order 1169 aquifer test and 1:1 impacts would have been observed at the Muddy River.	Pg. 3	Steady-state conditions are observed in groundwater monitoring wells CSVM-1 and UMVM-1 in early 2013, and had been reached at the end of the Order 1169 test.
Movement of Water Rights between Aquifers	Carbonate pumping should not be increased in the vicinity of the springs, and likewise alluvial pumping should not be increased in the vicinity of the river even in the overall pumping rate does not change.	Pg. 3	Carbonate pumping may be moved west of geologic flow barriers without adverse impacts to Muddy River flow.

The FWS relies on groundwater level response in CSVM-4 and KMW-1 to draw their conclusion that water levels in KSV mirror those in CSV, as shown by Figures 8a and 8b in the FWS Report. Although the vertical scale of Figure 8a was exaggerated by approximately a factor of 3, when compared to Figure 8b, the signature in both monitoring wells reflects changes in long-term climate. Maximum groundwater elevations were observed in 2006 following the very wet hydrologic conditions of 2004-2005. The groundwater level in CSVM-4 is predominantly characterized by climate and total pumping in CSV, while groundwater levels in KMW-1 are predominantly characterized by climate only. As described in the Vidler Report, the high groundwater gradient between CSVM-4 and KMW-1 is due to the presence of a fault.[25] The Vidler Report further indicates that for the Order 1169 aquifer test cone of depression to impact KMW-1, located approximately 15 miles from MX-5, hydraulic head changes would need to travel through en-echelon faulting north of the Kane Springs Wash Fault zone. KSV should not be included within the NSE's LWRFS boundary since it lacks hydraulic connectivity with CSV, similar to the lack of hydraulic connectivity that exists between Pahranagat/ Delamar Valleys and CSV.

While we agree with the FWS Report that Lower Meadow Valley Wash contributes to the groundwater resources in MRSA and California Wash,[26] we disagree that it should be included in the NSE's LWRFS boundary. Groundwater inflow to the Lower Meadow Valley Wash occurs from Panaca Valley, tributary basins to Panaca Valley, and local groundwater recharge surrounding the Lower Meadow Valley Wash. Due to lack of groundwater development in the Lower Meadow Valley Wash and upgradient basins that are administered separately by the NSE, Lower Meadow Valley Wash should be accounted for in a fashion similar to Pahranagat, Delamar, and Kane Springs valleys. Additionally, it is recommended that monitoring and test wells be installed in the southern portion of the Lower Meadow Valley Wash to define the complex geologic relationship between carbonate and alluvial aquifers.

3.2 STATUS OF AQUIFER RECOVERY

The FWS Report states that there is a time lag between pumping in either the carbonate or alluvial aquifers and the initial sign of impacts at distant wells due to high hydraulic diffusivity. Generally, high diffusivity (equal to the transmissivity divided by the storage coefficient) leads to high rates of propagation through an aquifer. While we agree that there is a time lag between observed impacts at an observation well associated with the initial start-up of a pumping well (MX-5), and a separate time lag associated with the start of recovery following pumping cessation, no

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[25] Vidler Report, Section 3.1.2, page 3-4

[26] FWS Report, Page 23.

distinction between recovery from MX-5 pumping, and other pumping in the LWRFS, is provided in the FWS Report.

Recovery data using the SeriesSEE analysis, originally introduced by the FWS (2013), was not updated in the 2019 FWS Report in order to assess impacts to groundwater level recovery since the cessation of the Order 1169 aquifer test in early 2013. Instead, the FWS Report suggests that because no-flow boundaries may not be simulated using SeriesSEE, "*MX-5 induced drawdowns were, if anything, underestimated by the 2013 analysis.*"[27] We disagree with their statement regarding the possible underestimation of impacts since it does not provide evidence that no flow boundaries would only affect MX-5 pumping and no other wells that contributed to groundwater level drawdown. A more plausible explanation may be that pumping impacts have been underestimated since the impact of no flow boundaries are included in the observed data that was used in the SeriesSEE calibration. The FWS explanation that EH-4 may be impacted by gouge-filled west-dipping normal faults located immediately downgradient of the monitoring well[28] would suggest that estimates of drawdown due to MX-5 would be less than measured farther upgradient from the fault. Analytical methods for estimating the impacts from no-flow boundaries typically include the use of image wells to simulate no-flow zones.

Similar to no-flow boundaries, recharge boundaries associated with groundwater flow along highly transmissive fractures may also affect the measured impact in observation wells. While the SeriesSEE analysis does not simulate either no-flow or recharge boundaries, the hydrogeologic parameters used to develop the SeriesSEE model in 2013 remain unknown. Based on the data provided by FWS in 2013 and 2019, the SeriesSEE analysis remains unreproducible. Additional data regarding transmissivity and storage coefficient values used in the 2013 analysis should be provided to substantiate the impacts and provide peer review of the model results.

3.3 ANNUAL QUANTITY OF GROUNDWATER AND IMPACTS TO MUDDY RIVER

The FWS Report proposes that the initial threshold for carbonate and basin-fill pumping be established at 9,318 AFY based on the average of 2015, 2016, and 2017 pumping in the LWRFS.[29] The FWS Report's estimate for the initial quantity of groundwater that may be pumped from the LWRFS is based on their observation that spring flow at Muddy River Springs and streamflow at the Muddy River near Moapa was relatively constant during those years.

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[27] FWS Report, Section 1.1.2, page 16.
[28] FWS Report, Footnote 19, page 16.
[29] FWS Report, Section 1.4, page 37.

The FWS Report's estimate of annual groundwater that may be pumped from the LWRFS is based on comparing 2010 streamflow at Moapa (36.3 cfs) to the 10,990 AFY of pumping that occurred between 2008 and 2010. They suggest that streamflow at Moapa would have been 3.99 cfs (2,890 AFY) less if the Order 1169 aquifer test pumping had continued beyond 2013,[30] based on an Order 1169 aquifer test pumping rate that was 2,890 AFY greater (13,880 AFY total) than what occurred from 2008-2010.

The FWS analysis is based on assuming that steady-state conditions would not occur until there was a 1:1 impact between Order 1169 pumping and streamflow at the Muddy River near Moapa gage. The observed data contradicts the FWS assumption that steady-state conditions had not yet been reached. Review of groundwater levels in CSVM-1 and UMVM-1 show that groundwater levels near MX-5 had reached steady-state conditions and were level or recovering in early 2013[31]. Additionally, the FWS Report does not account for changes in surface diversions or groundwater pumping in the MRSA that occurred between 2010, the Order 1169 Aquifer Test, and the 2015-2017 period used to establish their recommended pumping rate.

3.4 MOVEMENT OF WATER RIGHTS BETWEEN AQUIFERS

The FWS Report suggests that total carbonate pumping should not be increased in exchange for reductions in alluvial pumping, nor should carbonate pumping be moved closer to MRSA springs or the Muddy River[32]. While we agree that pumping in the MRSA near the springs and rivers have a direct impact on available surface water resources, the FWS Report does not account for structural blocks and faults that effectively isolate groundwater pumping in other areas of the LWRFS. For example, groundwater pumping in the northern and western portion of CSV are effectively isolated from impacts to the springs and the Muddy River in the MRSA. Groundwater pumping in these areas is not likely to affect resources in the MRSA as evident by pump tests and observed data that show these areas to be in separate "compartments".

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[30] FWS Report, Section 1.4, page 37.
[31] CSI Report, Appendix E.
[32] FWS Report, Section 1.5, page 38.

4.0 NATIONAL PARK SERVICE ORDER 1303 REPORT

A summary of the National Park Service's Prediction of the Effects of Changing the Spatial Distribution of Pumping in the Lower White River Flow System (NPS Report) is provided in Table 3. The NPS Report does not provide an updated calibration of their 2012 Model[33] or analysis presented at the end of the Order 1169 aquifer test[34]. The results presented in their report are based on performing three new predictive simulations without any changes made to the material properties of the 2012 Model[35]. New additional data submitted in the NPS Report includes a geochemical analysis of water quality at Rogers and Blue Point Springs[36]. The NPS Report suggests the most plausible flow path is a "*southern flow path from Garnet Valley, beneath California Wash and Black Mountain Area basins to discharge at Rogers Spring and Blue Point Spring.*"[37]

4.1 NPS'S GEOGRAPHIC BOUNDARY

The NPS Report indicates that the potential impacts from future pumping are migrating into or out of the existing boundaries of the five basins in Interim Order 1303, including Black Mountains, KSV, and Las Vegas Valley[38]. The NPS Report's recommendation to include all of the Black Mountains Area and KSV, but not Las Vegas Valley, in the NSE's existing LWRFS boundary is based on results from new future simulations using the 2012 Model. The groundwater budget and flow path information presented in the CSI Report show that currently excluded portions of the Black Mountains area may be managed separately from the current LWRFS.[39] Lack of groundwater level response and geophysical data show that the KSV is not impacted by MX-5 pumping and should not be included in the LWRFS. The construction of the 2012 model did not include geologic structures in the northern CSV that control the occurrence and movement of groundwater in this region.

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[33] Tetra Tech GEO, 2012. Development of a Numerical Groundwater Flow Model of Selected Basins within the Colorado Regional Groundwater Flow System, Southeastern Nevada (Version 1.0).

[34] Tetra Tech, 2013. Comparison of Simulated and Observed Effects of Pumping from MX-5 Using Data Collected to the end of the Order 1169 Test, and Prediction of the Rates of Recovery from the Test, Southeastern Nevada.

[35] NPS Report, Section 4.1, Page 14.

[36] NPS Report, Appendix A.

[37] NPS Report, Page 2.

[38] NPS Report, page 21.

[39] Appendix B provides a modified LWRFS boundary that would allow the NSE to sustainably manage Rogers and Blue Point Springs in the Black Mountains Area as part of the LWRFS. The modified LWRFS boundary also includes Lower Moapa Valley so the entire reach of the Muddy River may be managed to assure senior decreed water rights are accounted for in the future.

Table 3. Summary of NPS Order 1303 Report

Order 1303 Issue	NPS Report	Reference	Rebuttal Comments
Geographic Boundary	Include KSV and Black Mountains Area to the NSE's LWRFS boundary.	Page 22	KSV should not be included due to faults in northern CSV. See Appendix B regarding Black Mountains Area.
Status of Aquifer Recovery	Not Addressed	n/a	No comment
Annual Quantity of Groundwater	<14,500 afy	Page 23	Hydraulic barriers and separate flow paths may support pumping greater than 14,500 afy.
Impact of Pumping on MR Flow	Model shows short-term benefit to Muddy River by moving pumping from Northern Basins to Southern Basins.	Page 23.	The model does not account for heterogeneities in the aquifer that control the occurrence and moment of groundwater.
Movement of Water Rights between Aquifers	Model shows that moving pumping from alluvial to carbonate aquifer delays impact to the Muddy River.	Page 23	The model does not account for hydraulic barriers and conduits that would promote movement of water production between aquifers.

4.2 ANNUAL QUANTITY OF GROUNDWATER AND IMPACTS TO MUDDY RIVER

The NPS Report states that the annual sustainable quantity of groundwater available is less than 14,500 afy[40]. The 2012 Model does not account for heterogeneities in CSV and KSV that support pumping in areas that do not affect resources in the MRSA. The 2012 Model should be updated to include faults and structural barriers identified by Rowley et al. (2017), CSI (2019), and Vidler (2019). Updates to the 2012 Model should also account for long-term climatic cycles and consider refinement to cell size and stress periods to account for localized impacts.

4.3 MOVEMENT OF WATER RIGHTS BETWEEN AQUIFERS

The NPS Report states that moving alluvial and carbonate pumping from northern basins (CSV, MRSA) to southern basins (Garnet Valley, California Wash, and Black Mountains Area) would have a short-term benefit on the flows of the Muddy River Springs and Muddy River.[41] Although moving pumping from alluvial wells in the MRSA will have an immediate effect on Muddy River flows, the data do not support that moving carbonate pumping away from CSV will have an positive impact on spring and streamflow in the MRSA. The 2012 Model does not account for heterogeneities in the carbonate that control the occurrence and movement of groundwater in separate flow paths in the LWRFS. The NPS Report and MBOP Report both suggest flow may occur to Las Vegas Valley, as well as in the entire portion of the Black Mountains Area. Additional flow from Lower Meadow Valley Wash also supports groundwater and surface water resources in California Wash and Lower Moapa Valley. These data indicate that faults and structural blocks create barriers and conduits for groundwater flow that would prevent the characterization of the area as homogeneous. Therefore, groundwater production may be moved from the alluvial aquifer in the MRSA to specific areas of the carbonate aquifer without direct impact on the springs or streamflow of the Muddy River.

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[40] NPS Report, page 23.
[41] NPS Report, Page 23.

5.0 MOAPA BAND OF PAIUTE'S ORDER 1303 REPORT

A summary of Moapa Band of Paiute's "Water-Level Decline in the LWRFS: Managing for Sustainable Groundwater Development, Initial report of the Moapa Band of Paiutes in Response to Order #1303" (MBOP Report) is provided in Table 4. The report generally agrees with many of CSI's statements, but analyzes the data in different ways. Specifically, the MBOP Report emphasizes that previous reports did not properly separate pumping effects from climate effects, and as a result overestimated the drawdown and resulting cone of depression caused by the 2010 pump test. The MBOP Report also recognizes that most groundwater flow occurs through north-south fracture networks in the carbonate aquifer. Pumping in areas outside of these fracture networks where there is generally lower transmissivity, such as at CSI-3, would result in lower impact to the MRSA. Methods used by MBOP in their analysis include:

- Thermal modeling to estimate travel times and flow paths of groundwater through the carbonate aquifer.
- Examining 2006 pump test data from CSI-3 to determine whether CSI-3 is hydraulically disconnected from wells in eastern CSV.
- Quantification of recharge and ET rates.
- A "two-climate" model developed to analyze the MRSA flow response to climate and quantify the lag time between groundwater recharge and changes in spring discharge rates and EH-4 water levels by correlating the MRSA to the Humboldt and Virgin Rivers, and estimate a lag time of 16 years.

TABLE 4. SUMMARY OF MPOB ORDER 1303 REPORT

Order 1303 Issue	MBOP Report	Reference	Rebuttal Comments
Geographic Boundary	Boundary should not be based on hydrographic basin water budgets. Instead, boundary should be based on "capture zones" of the MRSA and Las Vegas Valley.	Pg. 11	The boundary should be based on definition of structural barriers such as faults and structural blocks.
Status of Aquifer Recovery	Recovery is impacted by 2-decade drought with intermittent wet cycles. Pumping signature overlies drought-induced trends.	Pg 14	Climate variability is predominant in groundwater level trends.
Annual Quantity of Groundwater	40,000 AFY	Pg 3; App I	MBOP estimate accounts for flow toward Las Vegas Valley. Not specific for LWRFS only.
Impact of Pumping on MR Flow	CSI-3 on the western side of CSV is isolated from MX-5 pumping effects.	Pg 21-22	CSI's April 2019 CSAMT survey[42] indicates that CSI-3 is isolated from MX-5.
Movement of Water Rights between Aquifers	Move MRSA alluvial rights to carbonate aquifer production in down-gradient basins to reduce adverse impacts to spring and stream flow.	Pg 23	Alluvial rights may be moved downgradient to minimize impacts to streamflow in the MRSA.

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[42] Appendix C.

5.1 MBOP'S GEOGRAPHIC BOUNDARY

Hydrographic basin water budgets, the standard approach to groundwater-resource development, are not reliable management tools if the groundwater resource is dominated by interbasin flow that cannot be estimated reliably at a hydrographic-basin scale; a regional process requires regional analyses. MBOP recommends that the capture zones of the Muddy River Springs Area and Las Vegas Valley be extended north to about the latitude of Panaca Spring, 39°15'. This expanded analysis region supplements and extend the LWRFS concept based on hydrodynamic and hydrochemical divides evident from a regional transmissivity model and isotope analyses.[43]

The MBOP Report's proposed LWRFS boundary ("capture area") includes KSV and Lower Meadow Valley Wash. While we agree that these valleys contribute to regional flow through the NSE's boundary, we disagree that they should be included in the LWRFS.

5.2 STATUS OF AQUIFER RECOVERY

The MBOP Report includes an aquifer analysis of the CSV, which discusses anisotropic conditions in the CSV. MBOP concludes that, "*there is very good hydraulic continuity between MX-4 and CSVM-6 along a NNW trend, but no connection or hydraulic continuity exists between CSI-3 and CSVM-6 along a NE trend. These relations suggest a strongly anisotropic system, and CSI-1 offers additional evidence.*"[44] We agree with the MBOP Report that there is no connection between CSI-3 and CSVM-6 due to the presence of a structural block located between the two wells.

The MBOP Report further suggests that CSI-1 may be hydraulically connected to the CSVM-6 with the statement "*We suspect that CSVM-6 responds to CSI-1 pumping.*"[45] We do not observe any connection between the two wells. The MBOP Report does not account for combined effects of pumping impacts from the MRSA and antecedent conditions following the 2004-2005 recharge event.

We agree with the MBOP Report that pumping effects on water levels were substantially over-predicted in both TetraTech MODFLOW and FWS SeriesSEE analyses.[46] The MBOP Report highlights the fact that the effects of long-term drought were not accounted for in order to estimate the impact of Order 1169 pumping on spring flow and groundwater levels in the MRSA.

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[43] MBOP Report, Page 12.
[44] MBOP Report, Page 78.
[45] MBOP Report, Page 78.
[46] MBOP Report, Page 26.

5.3 MOVEMENT OF WATER RIGHTS BETWEEN AQUIFERS

CSI generally[47] agrees with MBOP when they suggest that "*A move of the alluvial rights to carbonate-aquifer production in down-gradient basins (California Wash and basins to the south) where current production levels have demonstrated no impacts on MRSA flows, is the likely strategy to maximize the extent of development without unacceptable impacts on MRSA flows. Of course, such rights could be subject to curtailment if determined to cause unacceptable impacts to senior rights.*"[48] A decision by the NSE concerning the appropriate amount of recoverable water based on magnitude and location of allowable impacts will determine the appropriateness of moving points of diversion.

MBOP Report's assertion that "*Moving the MRSA alluvial water rights to carbonate-aquifer production will produce similar (proportional to pumping) levels of impacts on the MRSA flows as already documented for the carbonate-aquifer production in Coyote Spring Valley and Arrow Canyon Wells*" is not determinative. As shown in the CSI Report, groundwater pumping may be moved to the western side of the CSV without impact to spring flow and surface flow in the MRSA. Water level response data presented in Appendix V of the MBOP Report support the CSI conceptual model that normal faulting in the CSV effectively isolates pumping impacts from the eastern side of CSV that supports regional groundwater flow toward the MRSA.

5.4 OTHER COMMENTS TO THE MBOP REPORT

The MBOP Report suggests that carbonate wells may be completed in low-diffusivity areas to avoid significant impacts in the MRSA. Specifically, the MBOP Report states: "*The suggested management strategy of avoiding the highest-diffusivity fracture networks based on well-hydraulics tests is counterintuitive relative to the maximum discharge with minimum drawdown that is generally sought in groundwater exploration and development. Production wells could instead be restricted to locations where a recharge boundary has been demonstrated in a lower-T environment than the* 10^5 *m*^{2}*/day measured in the MX-5 area. Less-than-optimal production wells such as CSI-3 and ECP-1 pose much less risk to the MRSA environment than do MX-5 and RW-2, which cause far-reaching impacts, particularly southward (downstream) because they occupy the fracture system with the highest hydraulic diffusivity known in the area.*" [49] The MBOP Report has shown that pumping on the east side of CSV is isolated from groundwater resources on the west side of CSV,

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[47] Our general agreement is based on the premise that movement of rights to down gradient basins will not have a direct impact on streamflow in the MRSA, but will eventually impact the amount of recoverable water available in downstream basins such as the Lower Moapa Valley and Black Mountains Area.

[48] MBOP Report, Page 23.

[49] MBOP Report, Page 33.

but it also suggests that pumping can be located near recharge boundaries with a lower transmissivities then those that exist between MX-5 and EH-4. The MBOP Report identifies these recharge boundaries in the vicinity of CSI-3, KMW-1, and ECP-1.

6.0 VIDLER WATER COMPANY LLC'S ORDER 1303 REPORT

A summary of the Lincoln County Water District and Vidler Water Company's Lower White River Flow System Interim Order #1303 Report focused on the Northern Boundary of the Proposed Administrative Unit (Vidler Report) is provided in Table 5. The Vidler Report introduces new data that has not been previously considered by the NSE for the LWRFS, including geophysical and geochemical data sets. The geophysical data was used to map subsurface faults and structures, located in southern KSV and northern CSV, that control the occurrence and movement of groundwater. The location of the faults that were identified from the geophysical survey identify hydraulic boundaries that cause large changes in groundwater levels in northern CSV. In addition to geochemical data, the Vidler Report also introduces temperature data; both of which datasets are used to describe aquifer heterogeneities and various flow paths in the KSV and CSV area.

6.1 VIDLER REPORT GEOGRAPHIC BOUNDARY

The Vidler Report provides three specific recommendations regarding the boundary of the LWRFS: (1) continue to exclude KSV; (2) exclude the northern portion of CSV; and, (3) account for inflow from Lower Meadow Valley Wash. The Vidler Report relies on geophysical, geochemical, and groundwater level data to support structural barriers in northern CSV separates southern KSV from pumping wells located farther south in CSV. As stated in the Vidler Report, "*There is no indication from the water level data of either KMW-1 or CSVM-4 that there were any noticeable effects from the Order No. 1169 aquifer test.*"[50] Furthermore, the geophysical data show that en-echelon faults, located north of the Kane Springs Wash fault zone create a boundary area where groundwater flows from KSV to the northern LWRFS.

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[50] Vidler Report, page 7-1.

TABLE 5. SUMMARY OF VIDLER ORDER 1303 REPORT

Order 1303 Issue	Vidler Report	Reference	Rebuttal Comments
Geographic Boundary	Exclude northern portion of CSV from NSE Boundary	Pg. 7-1	The northern portion of CSV may be excluded due to the presence of a hydraulic barrier.
Status of Aquifer Recovery	Not directly addressed		No Comment
Annual Quantity of Groundwater	Not Addressed	Pg 5-2	No Comment
Impact of Pumping on MR Flow	All impacts due to pumping in the MRSA.	Pg 5-3	Alluvial and Carbonate pumping in the MRSA affects springs and Muddy River Flow.
Movement of Water Rights between Aquifers	Not Addressed	n/a	No Comment

Vidler's 2019 CSAMT geophysical survey identify faults that form a boundary of the LWRFS which separates the KSV from the CSV. We also agree that the northern portion of the CSV could be excluded from the NSE's LWRFS boundary for administrative purposes. The lack of a groundwater level signature in CSVM-4 and KMW-1, due to the Order 1169 aquifer test, indicates that these portions of the NSE's boundary does not have a direct impact on resources in the MRSA.

6.2 IMPACTS FROM PUMPING ON MUDDY RIVER FLOWS

The Vidler Report indicates "*...that pumpage from the MRSA completely explains the reductions in flows of the Muddy River and associated springs.*"[51] The basis for their conclusion is SNWA's assessment of flow depletion of the Muddy River (SNWA, 2018) that shows that flow depletion mimics MRSA alluvial and carbonate diversions. As total MRSA diversions increase, the calculated flow deficit of the Muddy River increases; as total MRSA diversions decrease, the deficit also decreases. The SNWA analysis provides strong evidence of the relationship between MRSA surface and groundwater diversions and streamflow of the Muddy River, but does not necessarily provide the complete picture. Analytical solutions using the Theis equation (CSI, 2019) suggest given specific values of transmissivity and storativity, there is hydraulic connection between MX-5 and the Pederson Spring Complex.

In order to initiate sustainable pumping in the LWRFS, the CSI Report recommends that the initial pumping from CSV be limited to the west side of the basin due to its isolation from the east side of the valley that may be in the MRSA capture zone. As recommended in the MBOP Report, pumping from CSI-3 and other wells located near recharge boundaries will have minimal impact since the propagation of the pumping cones of depression will be limited by these recharge boundaries[52]. Additional long-term aquifer testing using MX-5 and CSI-2 pumping wells can be used to assess sustainability levels of the eastern portion of CSV.

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[51] Vidler Report, page 5-3.
[52] MBOP Report, page 16.

7.0 MOAPA VALLEY WATER DISTRICT'S ORDER 1303 REPORT

The Moapa Valley Water District submitted a letter report (MVWD Report) to the NSE that is summarized below in Table 6. Although no new information was provided in the MVWD Report, the authors introduced uncertainty between manual and automatic spring flow measurements at the Pederson East Spring. While we were not able to confirm the disparity between manual and automatic measurements, the MVWD Report introduces evidence that physical characteristics (i.e. elevation datum, gage condition) of the Pederson East, and possibly other spring flow gages, may have changed over time.

7.1 MVWD REPORT'S GEOGRAPHIC BOUNDARY

The MVWD Report recommends that the KSV should be included in the NSE's LWRFS since it is part of the interconnected system of carbonate rock aquifers that make up the White River Flow System[53]. The basis for their recommendation is observation of a 0.5-foot decline in water levels at KMW-1 during the Order 1169 aquifer test. CSV should not be included in the NSE's LWRFS. First, the groundwater gradient between KMW-1 and downgradient wells in the CSV, such as MX-5, suggests a hydraulic barrier exists between KSV and CSV. This observation is supported by the 2019 CSAMT geophysical data obtained by Vidler that shows a series of en-echelon faults, located in the vicinity of KMW-1 and CSVM-4, that create a structural boundary[54]. Second, the decline in groundwater levels observed in KMW-1 is due to a general drying trend that began after the recharge pulse associated with 2004/2005 wintertime precipitation and extended through 2013. KSV should be administered in a similar manner as Pahranagat, Delamar, and Lower Meadow Valley Wash, all of which may be described as containing both local recharge and regional groundwater flow.

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[53] MVWD Report, Page 1.
[54] Vidler Report, Pages 4-8, 4-9.

TABLE 6. SUMMARY OF MVWD ORDER 1303 REPORT

Order 1303 Issue	MVWD Report	Reference	Rebuttal Comments
Geographic Boundary	Include KSV	Page 1	No hydraulic connection exists between MX-5 pumping area and Northern CSV/Southern KSV.
Status of Aquifer Recovery	Spring discharge and [ground] water levels trends are affected by climate and pumping.	Page 3	Spring discharge and groundwater levels are affected by many factors, including climate and select pumping.
Annual Quantity of Groundwater	No value provided.	Page 4	No comment.
Impact of Pumping on MR Flow	Alluvial wells are in direct hydrologic communication with the Muddy River.	Page 4	Alluvial wells and other hydrogeologic factors affect the Muddy River.
Movement of Water Rights between Aquifers	Transfer of alluvial water rights to the carbonate aquifer will increase/accelerate spring depletions.	Page 5	Impact to springs from carbonate wells is dependent upon location.

7.2 STATUS OF AQUIFER RECOVERY

The MVWD Report states that hydrographs for Pederson Spring, Pederson Spring East and Warm Springs West exhibited an increase in spring discharge after above average precipitation in 2004 and 2005[55]. Similarly, the MVWD Report states that the Lewis North well showed rise in groundwater levels water the 2004-2005 event, but a similar rise was not observed in either Lewis 1 or Lewis 2. In summary, the MVWD Report states "*Climate and climatic cycles are an important part of any long-term aquifer recovery. Recharge is episodic, not a constant, annual occurrence.*"[56]

Although recharge may be episodic and not constant, this is true on a short-term basis and does not describe a long-term period used for sustainability. The MVWD Report's statement highlights the importance of choosing a balanced hydrologic cycle to establish sustainable management in the LWRFS. The balanced hydrologic cycle should include both wet and dry cycles so that average annual recharge can be estimated for use in managing both diversions and impacts. Diversions during some years may be greater than average recharge, while in other years, it will be less. The goal is to establish long-term sustainable pumping based on acceptable impacts that will also vary from dry to wet conditions. As pointed out in the MVWD Report, spring flow in the MRSA also varies from dry to wet conditions.

7.3 ANNUAL QUANTITY OF GROUNDWATER AND IMPACTS TO MUDDY RIVER

While the MVWD Report does not quantify the amount of annual groundwater pumping that can be extracted from the LWRFS, it repeats the NSE's statement in Interim Order 1303 that, "*the current amount of pumping corresponds to a period of time in which spring flows have remained relatively stable and have not demonstrated a continuing decline." Order 1303, p10*[57]. They then draw the conclusion that "*it is possible that the carbonate aquifer system is reaching somewhat of a steady-state condition at current pumping rate*", but caution that additional data is required to verify their conclusion.

MVWD Report's statement regarding steady-state conditions at the current pumping rate does not account for aquifer heterogeneities, so it does not provide a complete understanding of the occurrence and movement of groundwater in the LWRFS. Steady-state may occur at different pumping rates based on multiple factors that may be established by a water manager. Generally, steady-state is reached when the quantity and direction of flow in the aquifer is constant over time.

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[55] MVWD Report, Page 3.
[56] MVWD Report, Page 3.
[57] MVWD Report, page 4.

More specifically, steady-state may be reached when the change in gradient between two observation wells does not change over time. Therefore, a pumping well can reach a steady-state condition at various pumping rates and may be limited by the hydraulic properties of the aquifer. The MVWD Report's statement that the carbonate aquifer system may possibly be is in a steady-steady condition assumes that all pumping wells in the LWRFS affect spring flow in the MRSA.

Data provided in the CSI Report indicates that there are barriers and conduits to groundwater flow in the CSV along normal faults. These faults may act as barriers to groundwater flow in the east-west direction that result in isolation of pumping impacts. Analysis and data presented in the MBOP Report show that impacts from MX-5 pumping during the Order 1169 aquifer test were hydraulically disconnected from CSI-3 on the west side of the CSV.

No party has presented conclusive evidence that all carbonate pumping wells in the LWRFS negatively affects spring flow in the MRSA. There was minimal change in the decreased rate of spring discharge at Pederson Springs East and Pederson Springs from 2006 to 2009, when compared to the period 2009 through 2013. The decline in spring flow at Pederson Springs East was 0.023 cfs/yr (16.9 AFY/yr), and at Pederson Springs was 0.013 cfs/yr (9.7 AFY/yr) from October 2006 to October 2009.[58] The decline in spring flow at Pederson Springs East and Pederson Springs from October 2009 to October 2013 was 0.015 cfs/yr (10.9 AFY/yr) and 0.033 cfs/yr (23.5 AFY/yr), respectively.[59] While the rate of change increased at Pederson Springs, it decreased at Pederson Springs East (Figure 3 and Figure 4). Observed spring flow increases following the high precipitation years of 2005 and 2010 and decreases during below normal years such as the 2006-2009 and 2011-2013 periods.

During the earlier 2006 to 2009 period, total carbonate pumping in the LWRFS ranged from 6,500 AFY to 7,500 AFY, averaging 7,000 AFY; while during the 2010 to 2013 period, carbonate groundwater pumping ranged from 7,400 AFY to 10,500 AFY, averaging 9,000 AFY[60]. These data support the conclusion that the change in spring flow at Pederson Springs East and Pederson Springs is closely tied to climatic conditions and not to carbonate groundwater pumping. Increasing average annual pumping from 7,000 AFY (2006-2009) to 9,000 AFY (2010-2013) had no conclusive measurable impact on spring flow at the Pederson Springs complex.

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[58] Pederson Springs East spring flow was 0.23 cfs in October 2006; Pederson Springs flow was 0.24 cfs in October 2006. Pederson Springs East spring flow was 0.16 cfs in October 2009; Pederson Springs flow was 0.20 cfs in October 2009.

[59] Pederson Springs East spring flow was 0.10 cfs in October 2013; Pederson Springs spring flow was 0.07 cfs in October 2013.

[60] SNWA Report, Figure 4-7, page 4-8.

Figure 3 Annual Precipitation and Spring Flow at Pederson Spring East Near Moapa (USGS Station No. 09415908), 2002-2018

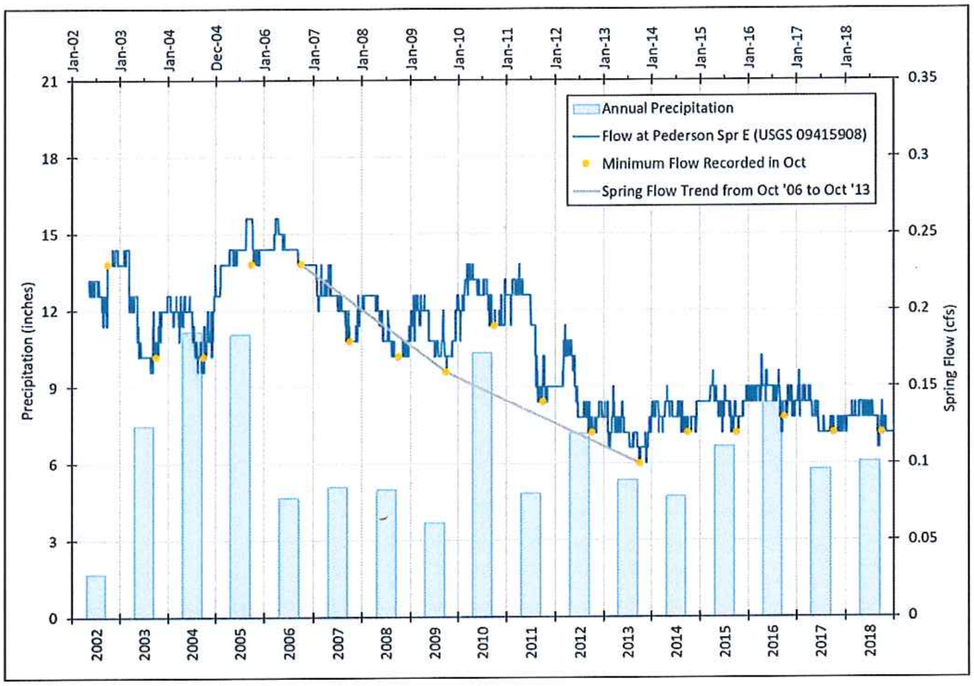
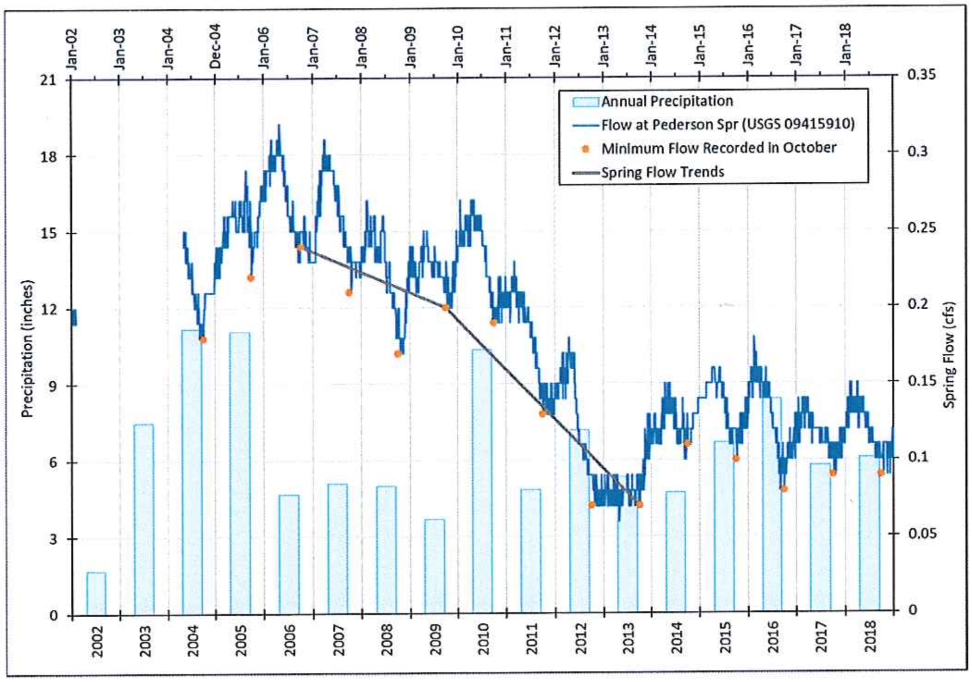
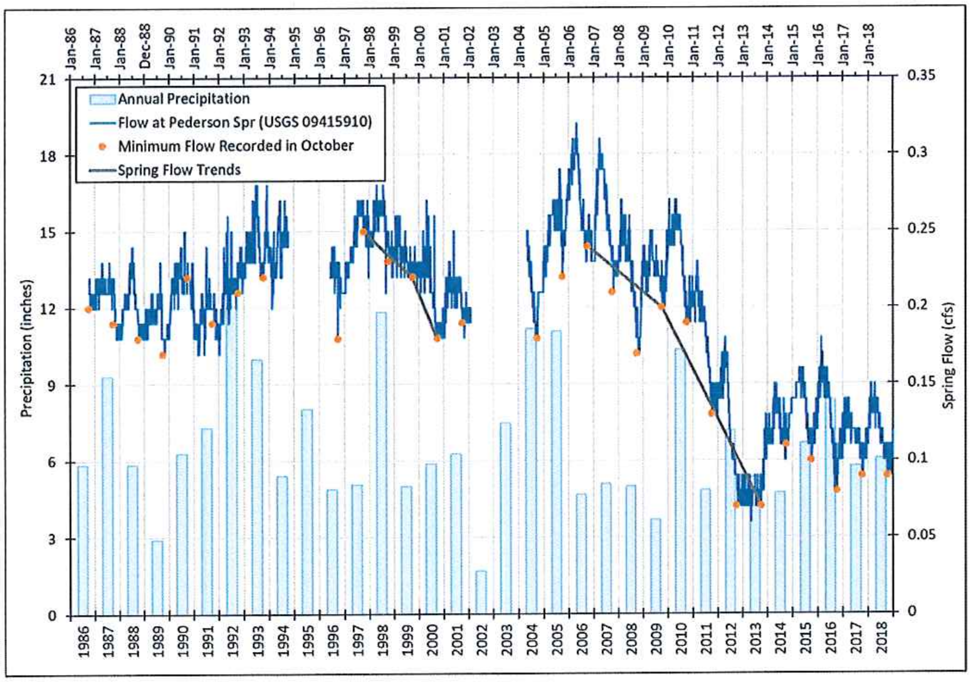


Figure 4 Annual Precipitation and Spring Flow at Pederson Spring Near Moapa (USGS Station No. 09415910), 2002-2018



2006 to 2009 is a period of hydrologic significance because it represents a time of relatively dry hydrologic conditions following a relatively long period of normal to very wet conditions. October water levels were compared in this analysis because the springs generally reach their minimum flow rate at that time, and there are generally no antecedent flood events which would affect the natural flow of the springs. The pattern of spring flow decline during this time is very similar to decline observed after similar hydrologic conditions occurring in 1998. The period of record for daily streamflow observations at the Pederson Springs Gage near Moapa (USGS Station No. 09415910) is shown in Figure 5. The similarity between spring flow decline from 1998-2003 and 2006-2013 is comparable by the two gray colored trend lines. Although the spring flow trend would likely have continued downward in 2002 and 2003, data from February 2002 through April 2003 was excluded from the analysis since there was leakage occurring under the V-notch weir.

Figure 5 POR Annual Precipitation and Spring Flow at Pederson Spring Near Moapa (USGS Station No. 09415910), 1986-2018



The long-term climate and spring flow data at the Pedersen Spring complex show that spring flow is closely tied to precipitation. Prior to the initiation of groundwater pumping in CSV in 2005, as well as the start of the Order 1169 aquifer test, spring flow at Pederson Spring near Moapa declined from 0.25 cfs to 0.10 cfs. Because the rate of decline of spring flow at Pedersen Springs differed from that observed at Pedersen Springs East after 2009, other factors such as the impact of local carbonate and alluvial pumping in the MRSA should be investigated.

7.4 MOVEMENT OF WATER RIGHTS BETWEEN AQUIFERS

The MVWD report states "*Transfer of alluvial water rights to the carbonate aquifer will increase and accelerate spring depletions Pumping from the carbonate aquifer in volumes greater than currently being pumped will increase and accelerate spring depletions and adversely impact dace habitat.*"[61] The MVWD Report offers no data to substantiate that all carbonate groundwater pumping throughout the LWRFS will adversely affect spring flow in the MRSA. CSI's analysis of spring flow and groundwater pumping presented in the previous section demonstrates that spring flow is closely tied to hydrologic conditions and not pumping. Additionally, data and analyses presented in the CSI and MBOP Reports show that barriers exist and isolate drawdown impacts from groundwater pumping in in the CSV. While we agree that surface diversions and alluvial pumping in the MRSA affect the flow of the Muddy River, we disagree that all wells in the LWRFS that pump from the carbonate aquifer impact the flow of the Muddy River.

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[61] MVWD Report, Page 5.

8.0 OTHER REPORTS

The Order 1303 reports described in this section were focused on a particular topic or were incomplete in addressing each of the major issues requested to be addressed in Order 1303.

8.1 TECHNICHROME

Technichrome submitted a Response to Interim Order #1303 that agreed with the Joint administrative basin as proposed by the NSE, but raised questions regarding its extent. Specifically, the Technichrome submittal requests the NSE "....*consider at least Basin 205, the Meadow Valley Wash, for inclusion into the Joint Administrative Basin since it is clearly part of the LWRFS.*"[62] Although we agree that the Meadow Valley Wash contributes to water resources in the LWRFS, we believe the NSE can account for Lower Meadow Valley Wash is a similar fashion that Pahranagat, Delamar, and KSV are accounted for as regional groundwater inflow to the LWRFS.

The Technichrome report also raises questions as to the NSE's ability to administer water rights based on priority if a Joint Administrative unit is formed. While we agree that the NSE may lose some ability to control diversions on a priority basis (i.e. distant junior water rights would be curtailed before nearby senior rights), we acknowledge that the intent of assessing sustainable yield of the LWRFS was to develop sustainable management criteria for the entire LWRFS. One key to sustainably managing resources in the future is to include threshold values and actions on specific wells and diversions based on their location and impact on water rights and water resources.

8.2 CITY OF NORTH LAS VEGAS

The City of North Las Vegas provided a letter report regarding Interim Order 1303 Report Submittal (CNLV Report). The CNLV proposes to develop a conjunctive water supply strategy that includes artificial recharge of Colorado River water in Garnet Valley and development of locally pumped groundwater. Although conjunctive use of local and imported water supplies is widely applied throughout the west, our comments regarding the CNLV's Report are limited to the issues raised by the NSE.

The CNLV Report suggests that portions of the LWRFS east of the Dry Lake Thrust Fault should be considered for exclusion from the LWRFS boundary. Cross-section K-K' (Rowley, 2017) provides detail of the Dry Lake Thrust fault between Garnet Valley and California Wash that shows offset within the carbonate aquifers. Rowley (2017) further describes the Dry Lake Thrust fault

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[62] Technichrome, Page 1.

which "carries Cambrian rocks over Silurian through Permian carbonate rocks", but does not address groundwater flow through the fault zone. Rowley (2017) however does refer to the north trending normal faults located east of the Dry Lake Thrust fault that show evidence of Pleistocene springs. Although previous studies[63] indicate groundwater flows from Hidden and Garnet Valley towards the Black Mountains Area and California Wash, additional investigation of groundwater levels and geochemistry data may be warranted.

The CNLV Report suggests that the concept of transferring senior water rights out of the MRSA to Garnet Valley has merit for the overall LWRFS water management objectives.[64] We disagree that the purpose of the formation of the LWRFS administrative unit is to transfer points of diversion from one basin to another. Rather, the purpose of the LWRFS administrative unit would be to cooperatively manage existing permitted water rights to protect the public's interest.

8.3 DRY LAKE WATER, LLC, GEORGIA PACIFIC CORPORATION, AND REPUBLIC ENVIRONMENTAL TECHNOLOGIES

Dry Lake Water, LLC, Georgia Pacific Corporation, and Republic Environmental Technologies submitted a letter report to the NSE regarding Response to Nevada State Engineer Interim Order 1303 (Dry Lake Report). Comments in the Dry Lake Report focus on the Garnet Valley/Black Mountain Area. The Dry Lake Report suggests that groundwater levels in CSV, Garnet Valley, and California Wash "*show similar seasonal groundwater trends occurring in the decade preceding the carbonate-rock aquifer test with no discernible signal delay or diminishing amplitude with distance from the pumping centers suggesting that regional climatic conditions may be the driving force in water level fluctuations.*"[65] The Dry Lake Report further suggests that the groundwater level trends in the LWRFS are a combination of seasonal variability due to pumping and regionally dry climatic conditions, rather than from the effects of pumping and aquifer connectivity.

We agree with the Dry Lake Report's observation that groundwater level responses throughout distal areas of the LWRFS exhibit both an annual variation due to seasonal pumping and a downward trend due to regionally dry climatic conditions. Seasonal groundwater pumping, previously shown above in Figure 1, is a common pumping pattern throughout the LWRFS and has a negative impact on groundwater levels during peak month pumping. Similarly, long-term climatic trends have been identified and acknowledged by multiple respondents to Order 1303.

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[63] CSI Report, Section 4.2, Page 40 and Appendix C of July 3, 2019.
[64] CNLV Report, Page 4.
[65] Dry Lake Report, Section 4, Page 2.

8.4 GREAT BASIN WATER NETWORK

The Great Basin Water Network submitted a letter report regarding GBWN Report on Order 1303 (GBWN Report). The GBWN Report does not offer new data since the Order 1169 aquifer test, but it does generally address each of the NSE's issues outlined in Order 1303. The basis for GBWN's comments is that all interconnected basins in the White River Flow System (WRFS) should be sustainably managed over the long term.[66] The GBWN Report is specific in stating that "*every WRFS basin with a hydrologic connection with the Muddy River*"[67] should be included in Order 1303. The data presented in the CSI Report and Vidler Report indicate that hydraulic barriers and aquifer heterogeneities exist throughout in CSV and KSV that preclude the need to include the entire WRFS in Order 1303. The Pahranagat Shear Zone and Las Vegas Shear Zone (Rowley, 2017) may act as boundaries that may be used to define the LWRFS. Therefore, the boundary of the LWRFS should not be expanded to include the entire WRFS.

8.5 CENTER FOR BIOLOGICAL DIVERSITY

The Center for Biological Diversity submitted a Technical Memorandum regarding Groundwater Management and the Muddy River Springs, Report in Response to Nevada State Engineer Order 1303 (CBD Report). The CBD Report suggests that the KSV should be included in the LWRFS. The CBD report does not account for structural boundaries[68] in Northern CSV that effectively isolate KSV from portions of CSV, therefore eliminating the need to include the KSV in the LWRFS boundary. Based on supporting geophysical studies conducted by Vidler (2019), the presence of the fault boundary may be inferred in Figure 12 of the CBD Report that shows a 50-foot offset between northern and southern CSV; and the CBD Report's observation that the pump test did not propagate into northern CSV[69].

The CBD Report suggests "*that the NSE should not allow any carbonate pumping in the LWRFS to prevent further decreases and to allow recovery in the flow to Muddy River Area Springs.*"[70] The CBD Report's conclusion is based on its assumption that all carbonate pumping intercepts spring flow although no analyses have been presented to substantiate that all carbonate wells affect spring flow in the MRSA. The CSI Report (2019) and data presented above in this

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[66] GBWN Report, Page 2.
[67] GBWN Report, Page 3.
[68] See Vidler Report.
[69] CBD Report Page 19.
[70] CBD Report Page 25.

submittal show that long-term climatic conditions, structural features, location, and hydrogeologic properties affect each well's impact on resources in the MRSA.

The CBD Report introduces the concept of sustainably pumping groundwater from the basin fill aquifer in CSV. The CBD Report suggests that the basin fill water is likely disconnected from the carbonate and not responsible for substantial recharge[71]. Data presented in Figure 7 of the CBD Report show that the vertical hydraulic gradient is downward from the basin fill toward the carbonate aquifer; suggesting that the basin fill aquifer in CSV is not a discharge area for the carbonate aquifer. The CBD Report's recommendation to further investigate the impacts of basin fill pumping in the CSV could be investigated by the NSE to support sustainable management practices in the LWRFS.

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[71] CPD Report, Page 26.

9.0 SUMMARY AND CONCLUSIONS

The CSI Report describes the geologic framework that controls the occurrence and movement of groundwater in the LWRFS. In order to understand and quantify the availability of water, a fundamental understanding of the geologic framework is required. The basis for requiring this understanding is best described by Rowley et al. (2017):

> *"From middle Miocene to the present time, extensional tectonics resulted in the dominant north-south high-angle faults of the Great basin. This deformational regime and the rocks deposited as a result of it had by far the greatest effect on groundwater resources and their movement. The north-striking structures are excellent conduits to north or south groundwater flow. Gouge in the core zone of these faults acted as partial to complete barriers, however, to east or west flow"*

The LWRFS consists of various types of faults and structural features that act as both barriers and conduits to groundwater flow. CSAMT geophysical surveys presented in the CSI Report and Vidler Report provide the same evidence of the existence of these faults that was used by Rowley et al. (2017). These data were presented to the NSE to provide the basis for understanding the heterogeneities in the regional carbonate aquifer of the LWRFS.

The development of a conceptual model forms the basis for managing water resources in the LWRFS in a sustainable manner. A conceptual model includes a clear understanding of the geologic framework and the various fluxes that control the movement of water. The evidence provided in the CSI Report, as well as other reports described in this rebuttal, provides the necessary information to initiate sustainable management. Future monitoring and reporting of existing and new observation points will provide the basis for adaptively managing the system to protect the public's interest in developing water resources in the LWRFS.

Both geophysical and groundwater level datasets are used to identify and confirm mapped and known faults that act as both barriers and conduits to groundwater flow. Stable isotope analysis of water budgets provides general flux terms for understanding regional groundwater flow in and out of the system. Modern precipitation raster data provides an up-to-date analysis of local recharge from surrounding mountains. Evapotranspiration data provides an estimate for groundwater loss from phreatophytes. Each of these datasets provides the information required by the NSE to develop their own conceptual model and water budget.

The information provided in the CSI Report and within this rebuttal report show the importance of understanding the long-term climatic cycle that drives the availability of water resources. Above average precipitation years like 1998 and 2005 reset the groundwater and spring flow levels throughout the LWRFS and the MRSA, respectively. Similarly, downward trending hydrographs follow extended dry periods that were characteristic between 2006 and 2013. These trends should be considered when developing a planning period for which to determine cause and effect of pumping under sustainable conditions. How much water can be developed is not necessarily based on each year's recharge, but rather how much during a balanced hydrologic cycle. Long-term climatic cycles control the availability of groundwater and must be considered when quantifying resources under sustainable management.

The Order 1169 aquifer test coincided with the end of a long-term dry cycle that occurred between 2006 and 2013, with the exception of one wet year in 2010. Although previous investigators have suggested that spring depletion in the MRSA was due to carbonate pumping in the CSV, the data indicate that other factors, such as hydrologic conditions and local pumping, contribute a much larger impact. A simple analysis, such as plotting spring flow from Pedersen Springs on a linear scale, shows that declines in spring flow occurred prior to the development of groundwater in CSV.

The LWRFS cannot be described as a massive homogeneous aquifer where the effects from one pumping center can impact groundwater levels throughout a 1,000+ square mile area. Nor can the LWRFS be described as having a single discharge point at the MRSA measured only by a single stream gage and surrounding springs. Rather, the LWRFS is a complex system of faults and folds that control the movement of locally and regionally derived groundwater in multiple directions to multiple areas of discharge, and sustainable management must account for this complexity.

10.0 REFERENCES

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U.S. National Park Service, July 3, 2019. Prediction of the Effects of Changing the Spatial Distribution of Pumping in the Lower White River Flow System. Prepared by Tetra Tech.

Appendix A

Muddy River Streamflow Analysis

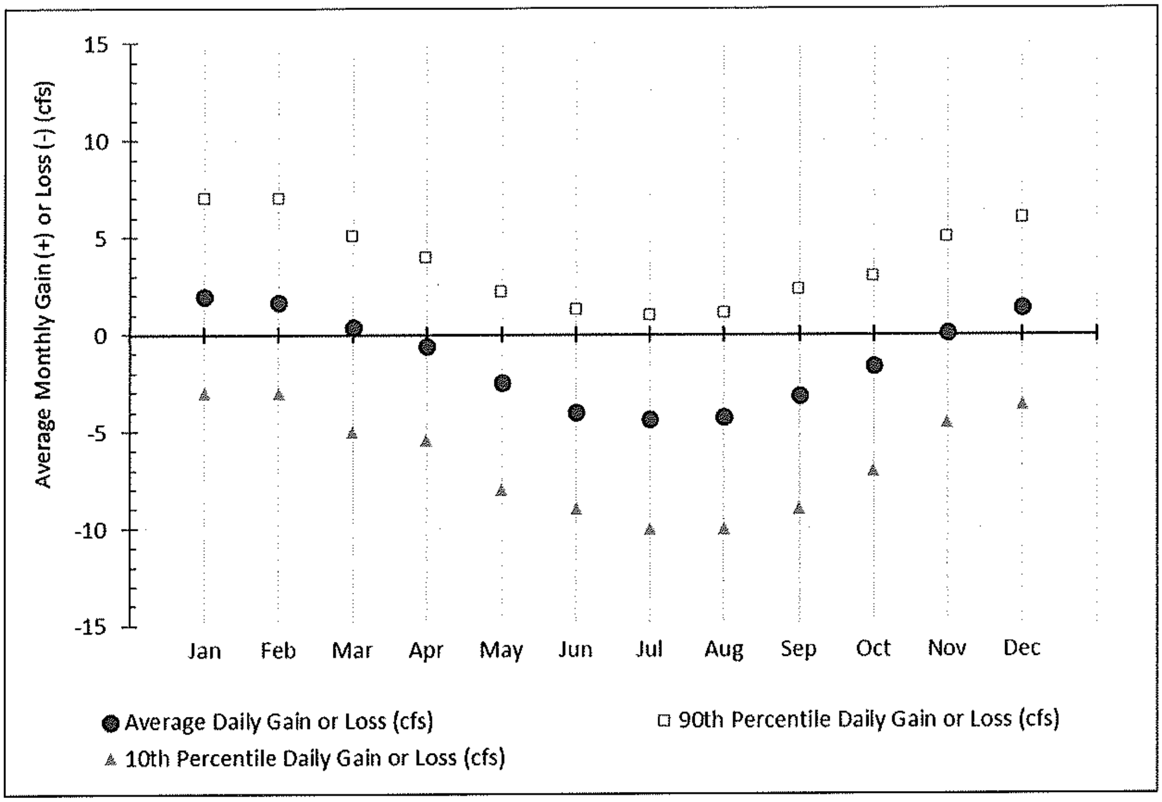
Muddy River Streamflow Analysis

The two primary gages used to measure flow in the Muddy River are the gage at Muddy River near Moapa (USGS No. 09416000) and the gage at Muddy River near Glendale (USGS No. 09419000). The Moapa gage can generally be used to characterize the headwaters of the Muddy River in Muddy River Springs Area and Coyote Springs Valley. The drainage area for the Moapa gage is 3,820 square miles (sq. mi.), and it is located at an elevation of 1,710 ft. It has a continuous period of record from October 1944 to the present. The Glendale gage is more representative of the Muddy River within Lower Moapa Valley and further downstream toward Lake Mead. Its drainage area is considerably larger, at 6,870 sq. mi., and it is located at an elevation of 1,460 ft. It has a continuous period of record from February 1950 to the present. The two gages are located roughly 12 river miles apart. Discharge at the Moapa gage is mostly influenced by spring flow, while at Glendale, recharge from Lower Meadow Valley Wash plays a significant role.

Figure A-1 shows the average monthly difference in daily discharge between the gage at the Moapa and the gage at Glendale during non-storm periods from February 1950 through June 2019. Periods during which storm runoff occurred at either gage were ignored so that the analysis reflects trends in baseflow. The 10th and 90th percentile values for each month are also shown on the graph. Discharge between the two gages has a seasonal pattern in which the river is, on average, gaining discharge during November through March, and losing discharge from April through October. The low and high percentile values (blue triangles and pink squares, respectively) demonstrate that although there is significant variation in gains and losses in one month, the same seasonal pattern emerges. During each month of the year, gains and losses may vary due to different hydrologic conditions: for example, during a drought period, this reach of the Muddy River may be a losing reach for all of February, but during a wet period, the reach may be gaining for all of February. What the figure shows, though, is that the long-term average trend in baseflow between the two gages is to lose water in the summer and gain water in the winter.

Gains and losses between the two gages may be affected by groundwater pumping, surface diversions, evapotranspiration, and contributions of baseflow from other groundwater sources. These sinks and sources of water have not been quantified. It is likely that higher evapotranspiration rates during the warmer summer months contribute to larger losses on this reach in the summer. During wet hydrologic periods, the Muddy River gains significant baseflow between the two gages. Development of groundwater resources in Muddy River Springs Area occurs almost exclusively between the Moapa and Glendale gages, resulting in a high amount of evapotranspiration along that reach of the river. The exact amount of evapotranspiration between the gages has not been identified, but it most likely makes up a majority of the entire 5,990 AF of ET from Muddy River Springs Area.

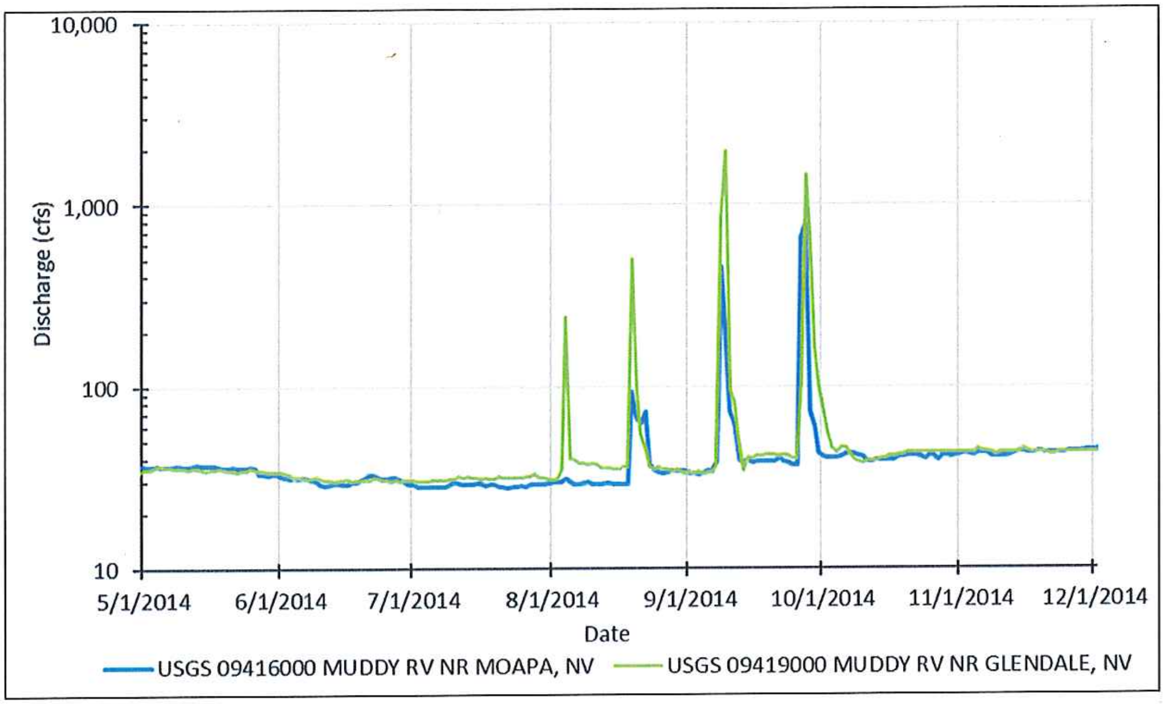
FIGURE A-1. AVERAGE MONTHLY GAIN OR LOSS FROM NON-STORM DAILY DISCHARGE BETWEEN MUDDY RIVER AT MOAPA AND GLENDALE GAGES



*Periods with storm runoff at either gage were ignored in this analysis.

Figure A-2 is an example daily hydrograph of the two gages on the main stem of the Muddy River. It demonstrates the typical variation in baseflow and storm flows on this reach of the river. During May and part of June 2014, this reach of the river was losing water. From July through December 2014, the reach was generally gaining water. Storm peaks were higher at the gage near Glendale, which is expected since it has a larger drainage area. However, the gage near Moapa often does not measure any peak storm runoff (i.e. the first peak in August), which indicates that peak runoff at the Glendale is coming from contributing areas downstream of the Moapa gage. Meadow Valley Wash is likely contributing to peak flows at the Glendale gage.

FIGURE A-2. EXAMPLE OF DAILY HYDROGRAPH FOR MUDDY RIVER NEAR MOAPA AND GLENDALE, OCTOBER 1, 2013 THROUGH SEPTEMBER 30, 2014



Appendix B

Modified LWRFS Boundary and Water Budget

Modified LWRFS Boundary Water Budget

Numerous studies have been performed to assess the quantity of local and regional groundwater flow in each of Nevada's basins. SNWA (2007) assessed local and regional flow in southeastern Nevada and found regional inflow to Coyote Spring Valley was 50,700 AFY, of which Pahranagat Valley contributes 22,440 AFY, Delamar Valley contributes 24,070 AFY,[72] and Kane Springs Valley contributes 4,190 AFY. Interbasin groundwater recharge from Lower Meadow Valley Wash into the LWRFS was estimated by SNWA (2007) to be 9,200 AFY. Local recharge into the LWRFS was estimated to be 2,340 AFY, with 2,130 AFY from the Sheep Range into Coyote Spring Valley, 40 AFY into Muddy River Springs Area, 40 AFY into Hidden Valley, 100 AFY into Garnet Valley, 0 AFY into both California Wash and Black Mountains Area, and 30 AFY into Lower Moapa Valley. These local recharge estimates seem low in comparison to other estimates for the area.[73] Total recharge to the Modified LWRFS boundary based on SNWA (2007) is estimated to be 62,240 AFY (Table B-1).

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[72] Thomas and Mihevc, 2011, estimated outflow from Delamar Valley to be 24,900 AFY. (See CSI Report)

[73] Thomas et al. (2001) estimated total local recharge in the LWRFS to be 6,800 AFY based on a deuterium mass-balance model. See Appendix C (July 3, 2019) for range of estimates from literature review. Local Recharge from Coyote Spring Valley was estimated to be 5,280 AFY. (CSI Report)

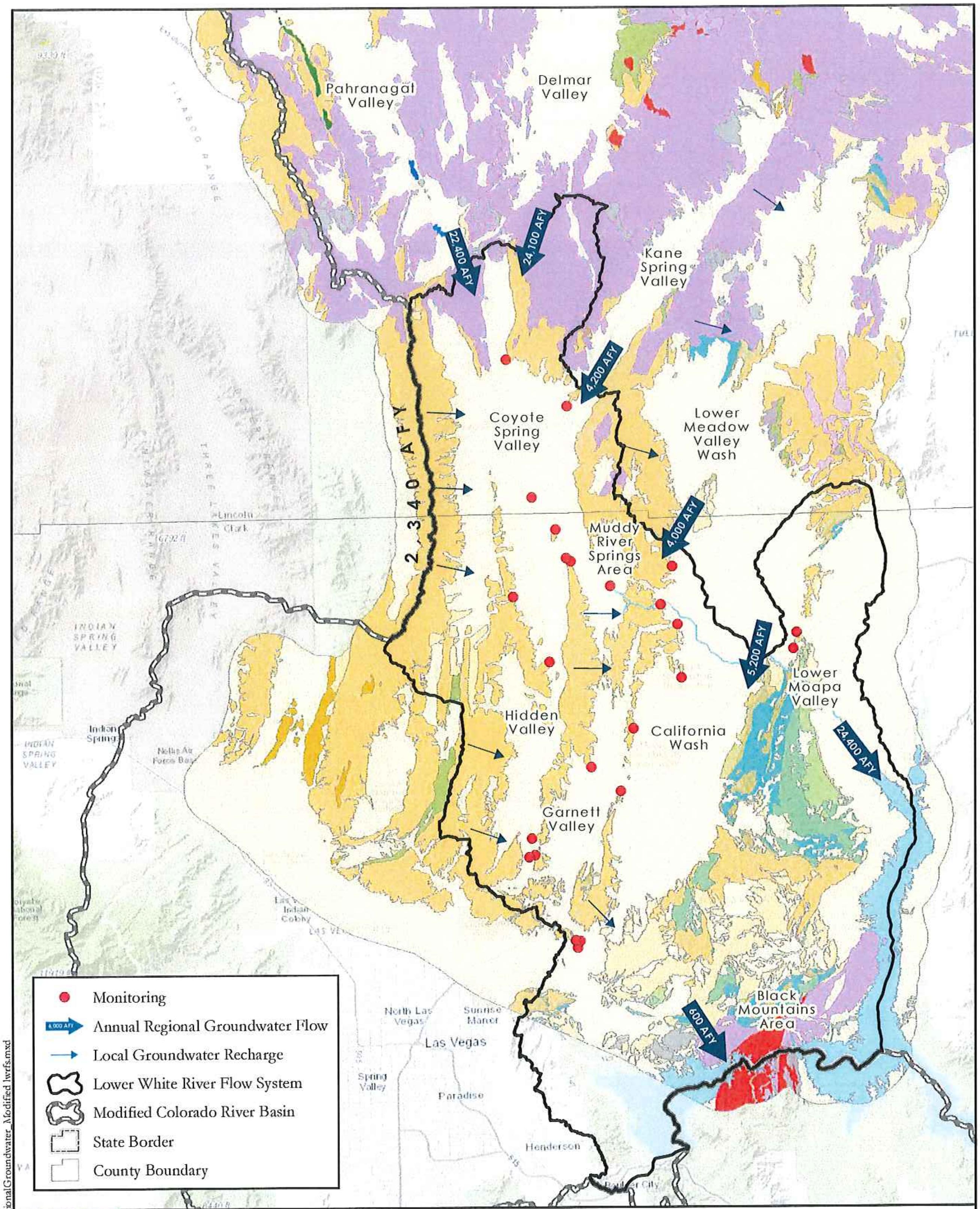
TABLE B-1. Pre-Development Water Budget for the Modified LWRFS Based on SNWA (2007) Cave, Dry Lake, and Delamar Hydrogeologic Report

Flux Term	Annual Flux (AFY)
Inflow	
Groundwater	
Pahranagat Valley	22,400
Delamar Valley	24,100
Kane Springs Valley	4,200
L. Meadow Valley Wash to MRSA	4,000
L. Meadow Valley Wash to Cal. Wash	5,200
Local Recharge[(a)]	2,340
Total Inflow	62,240
Outflow	
Groundwater	
Lower Moapa Valley to Lake Mead[(b)]	24,400
Black Mountain Area to Lake Mead	600
Evapotranspiration	
Lower Moapa Valley	25,310
California Wash	4,510
Muddy River Springs Area	5,990
Black Mountains Area	1,430
Surface Water[(b)]	Incl.
Total Outflow	62,240

Notes: (a) 2,130 AFY (CSV) + 40 AFY (MRSA) + 40 AF (Hidden) + 100 AFY (Garnet) + 30 AFY (Lower Moapa)

(b) Lower Moapa Valley to Lake Mead occurs as spring discharge from Muddy Springs, Rogers, and Blue Point springs and subsurface outflow from Lower Moapa Valley.

FIGURE B-1



Document Path: I:\n2674\RegionalGroundwater_Modified lwrfs.mxd

STETSON ENGINEERS INC.

REGIONAL GROUNDWATER FLOW AND LOCAL RECHARGE IN THE MODIFIED LWRFS

Source: SNWA, 2007

N

0 6.5 13 Miles

Pre-development outflow from the LWRFS was estimated based on reported values in SNWA (2007). Groundwater flow out of Lower Moapa Valley into Lake Mead was estimated to be 24,430 AFY, while flow from the Black Mountains Area to Lake Mead was estimated to be 570 AFY. Evapotranspiration from Lower Moapa Valley, California Wash, Black Mountains Area, Muddy River Springs Area, and Coyote Spring Valley was estimated to be 37,240 AFY. Surface flow from spring discharge to the Muddy River and other springs in the LWRFS is included in the ET and groundwater outflow estimates. Based on groundwater outflow, evapotranspiration, and surface flow, the estimated discharge from the Modified LWRFS is estimated to be 62,240 AFY. The water budget developed based on SNWA (2007) is shown graphically in Figure B-1.

The term "Pre-Development" has been used in this report to establish a water budget that does not account for existing alluvial and carbonate groundwater pumping or surface diversions. Thomas et al. (2001) based the deuterium mixing model on "pre-development" ET rates and relied on water samples collected over many decades in eastern Nevada. While samples may be impacted by pumping, the intent of the water budget analysis is to show recharge and discharge estimates based on the best available data. The authors of this report acknowledge that pumping and water development in eastern Nevada prior to the collection of water samples may influence the water budget.

The water budget provided in Table B-1 and shown in Figure B-1 presents an initial budget that may be used for groundwater sustainability in the Modified LWRFS. The authors of this report acknowledge that estimates of interbasin groundwater flow vary among the studies and that the conclusions of these studies may be in conflict. The proposed budget accounts for local recharge, surface water flow, and groundwater flow that supports decreed water rights on the Muddy River in Muddy River Springs Area, California Wash, and Lower Moapa Valley. A conservative estimate of groundwater available for appropriation is one-half the evapotranspiration, or 18,620 AFY.

Appendix C

Controlled-Source Audio-Frequency Magnetotelluric Survey

By Zonge International, Inc.

Zonge
TRUSTED GEOPHYSICS™

CONTROLLED-SOURCE AUDIO-FREQUENCY MAGNETOTELLURIC SURVEY

Final Report
Coyote Spring Project
Coyote Spring Valley
for
Coyote Springs Nevada, LLC
Clark County, Nevada

Prepared for:
Coyote Springs Nevada, LLC

August, 15, 20198
Zonge Job# 19012

TABLE OF CONTENTS

CSAMT SURVEY
Coyote Spring Valley Project
for
Coyote Springs Nevada, LLC

Introduction and Executive Summary

At the request of Steve Reich of Stetson Engineers, Inc., Zonge International, Inc. conducted a Controlled Source Audio-frequency Magnetotelluric (CSAMT) geophysical survey from April 2nd through April 8th, 2019 on the Coyote Spring Valley Project in Clark County, Nevada. The project included three geophysical CSAMT survey lines, as shown in Figures 1 and 2 below. The objective of the survey was to provide electrical resistivity data of the subsurface in order to better understand subsurface structure as it pertains to site hydrology. CSAMT is a well-established electromagnetic method for acquiring resistivity data, and is commonly used in the minerals, groundwater, and environmental industries. A description of the methodology and equipment specifications are included in the Appendix to this report.

Data were acquired along the three CSAMT lines using stations spaced 200 feet apart at a total of 370 stations, for a total coverage of approximately 14 miles. The line locations were selected in consultation with Stetson to provide information on the subsurface relative to Stetson's background information on the area. The survey progressed normally with no unusual delays due to weather, safety issues, or equipment problems. The survey results are realistic given the local environment and based on Zonge's prior work in Coyote Spring Valley as well as nearby Kane Springs Valley. Although most of the survey data were clean and repeatable, large power lines and infrastructure did create noise problems on parts of the lines.

This report includes a brief discussion of the CSAMT geophysical methodology, a summary of data acquisition, instrumentation, processing and a discussion of our interpretation of the geophysical results. Cross sections of smooth-model inversion resistivity for each line are included.

The majority of the study area is covered with basin-fill material, thus subsurface structural features that may influence groundwater flow are not evident at the surface. The survey results show good line-to-line correlation, good correlation with the few geologic features at the surface, and appear to provide detail on suspected, hidden subsurface features such as faults shown on geologic maps as "approximately located" or "concealed". Numerous hidden faults and contacts that are not shown on surface geologic maps are also indicated in the CSAMT data.

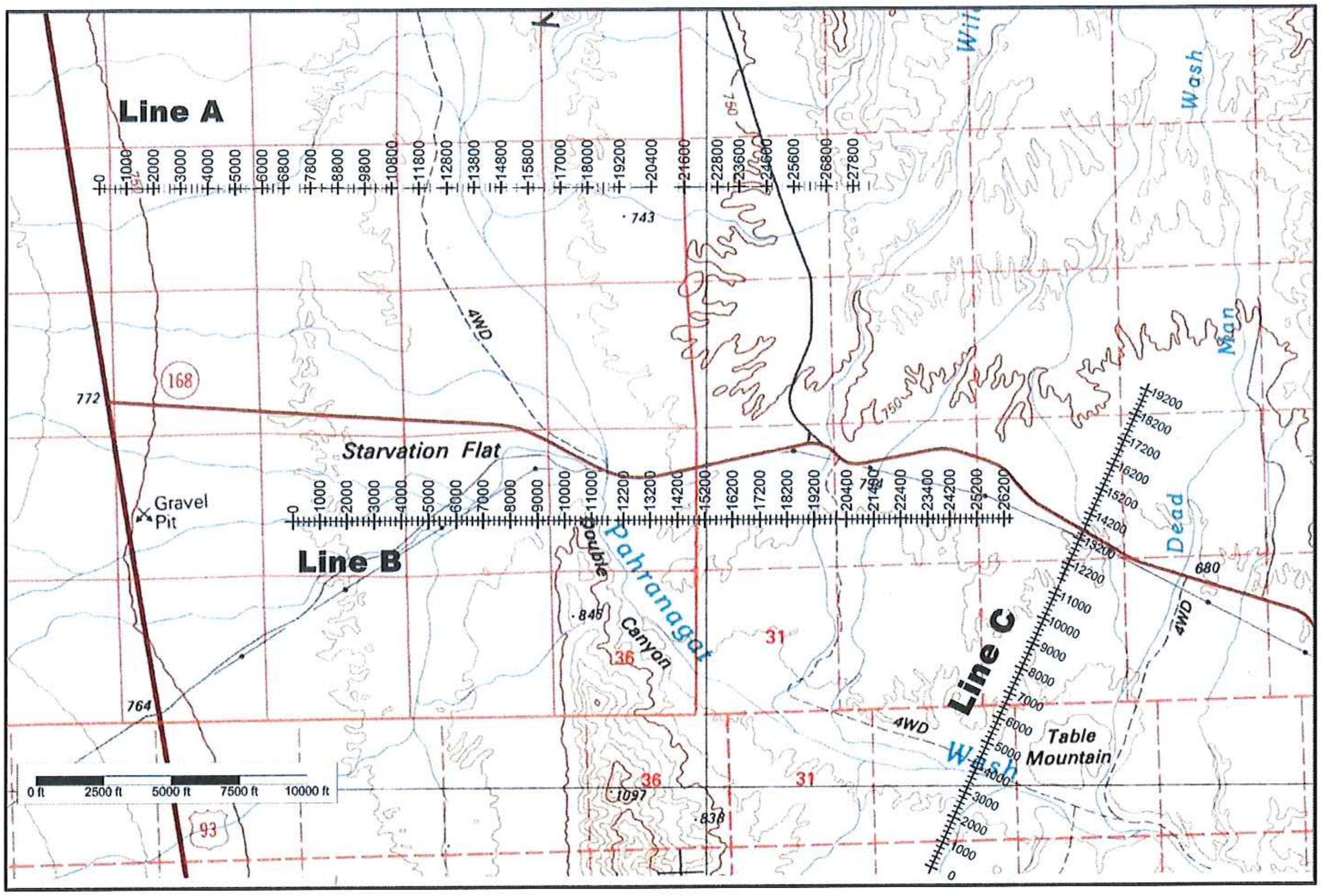


Figure 1. CSAMT station locations for Lines A, B, and C on the USGS topographic map relative to the intersection of Highway 93 and Highway 168.

For example, Line A crossed a small, isolated mapped exposure of Mississippian limestone, showing very high resistivities compared to the surrounding basin-fill material. Similarly, Line B crossed a narrow exposure of the same limestone, bounded by concealed faults on the geologic map, at the northern extent of the Arrow Canyon Range, and showed very similar, very high resistivities. Line C was located southeast of Lines A and B, and crossed two faults concealed by the alluvial cover. The CSAMT results do indicate buried faults very close to the mapped locations, though the southern fault is mapped as a strike-slip fault, but the CSAMT data indicates substantial offset on both faults, similar to a horst and graben feature.

Figure 2. CSAMT station locations for Lines A, B, and C on an aerial photograph of the study area.

In general, the CSAMT survey provided realistic, useful results that should aid in understanding the subsurface structure in this study area. Logistical problems were relatively minimal, and the survey proceeded very efficiently.

Line-by-Line Discussion of the Data

The survey results are included as resistivity cross sections of one-dimensional smooth-model inversion results, with station numbers in feet across the top and elevation in feet down the left side of the cross section, as well as elevation in meters down the right side of the cross section. Pertinent culture and reference points such as fences or power lines are shown along the top of the line topography, as well as major features from the Rowley, et. al., 2017 Plate 2 map. Resistivity values are shown in ohm-meters (o-m) with low resistivities shaded toward the red end of the spectrum and high resistivities shaded toward the blue end of the spectrum. The smooth model inversion cross sections for each line are included below as Plates 1, 2, and 3. Resistivities in this area generally range from less than 10 o-m to as much as 10,000 o-m. Figure 3 below shows the survey lines plotted on part of the Rowley 2017 map.

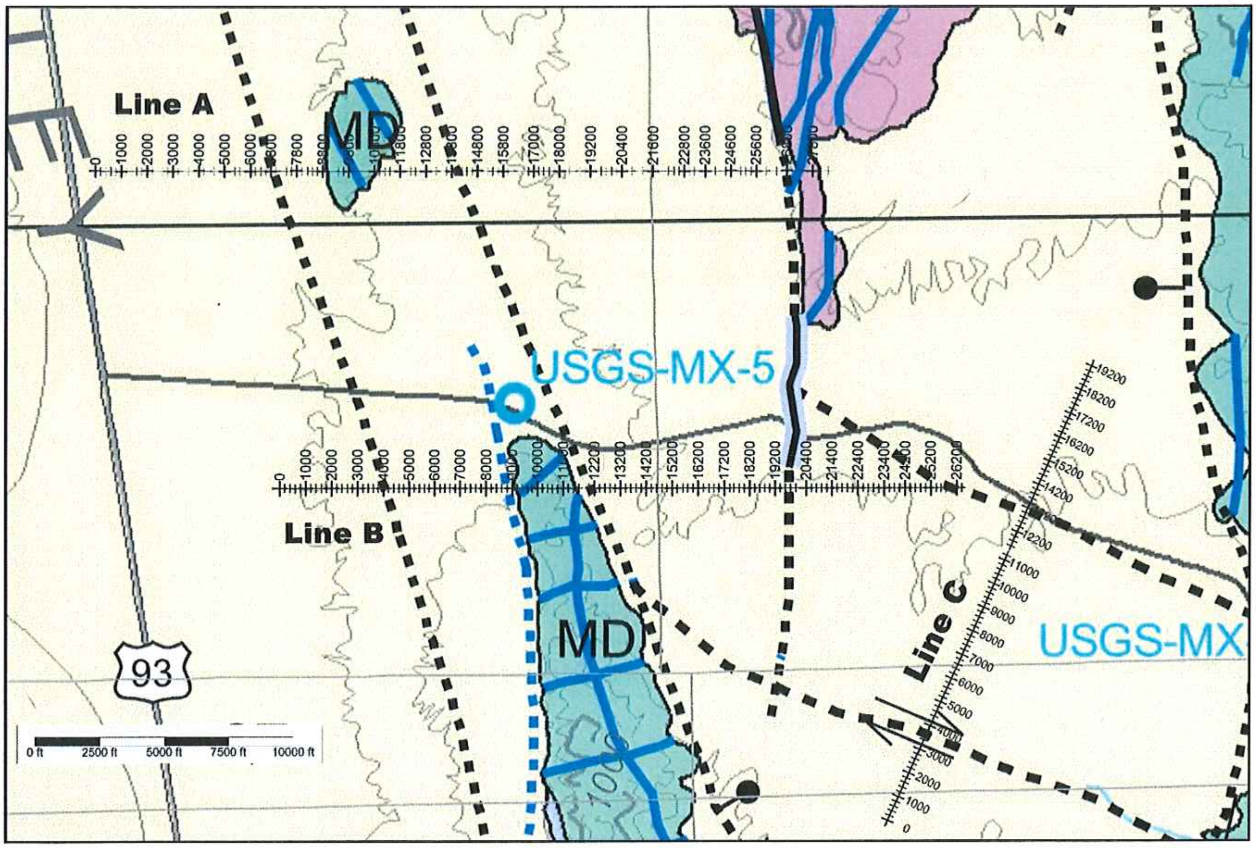


Figure 3: CSAMT station locations for Lines A, B, and C on the 2017 Rowley, et. al. geologic map.

Line A: The resistivity cross section for Line A is shown in Plate 1. This line began on the west approximately 500 feet east of Highway 93; very large power lines are located 2300 feet west of station 0. In addition, infrastructure is being built in the vicinity of stations 2000 to 3000, and the field crew suspects buried man-made culture, as these stations were very noisy. The very unusual resistivity data near the west end of the line in the upper 1000 feet of the section, centered at station 2100 is likely the result of noise, and is not likely a valid geologic structure. East of approximately station 3300, the data appear reasonable.

The dominant feature on this line is a block of very high resistivity material from station 8800 to 10800, which is in very good agreement with the Rowley 2017 map that shows an isolated outcrop of Mississippian limestone (MD on the Rowley map) at that location. The CSAMT data and the Rowley map differ, however, in that concealed faults on the map are shown on each side of the outcrop approximately 2000 feet west of the outcrop and 3000 feet east of the outcrop. The CSAMT data suggests these faults are likely much closer to the outcrop than shown on the map.

It is interesting to note that the basin-fill and underlying material are very different west of the outcrop than east. On the west, two distinct low resistivity layers (shaded orange to red) are evident in the upper 1500 feet of material. The shallowest layer likely represents basin-fill (saturated and/or fine-grained), while the deeper layer appears to be lower in resistivity, thicker, and plunging to the west slightly more steeply than the shallower, weaker layer. This deeper layer is more likely saturated carbonates. In contrast, east of the outcrop, two low resistivity layers are also seen, but they are almost identical in resistivity, and are both almost horizontal from the limestone outcrop to the east for almost two miles, where they appear covered by very high resistivity material beginning at about station 19700. In addition, moderate resistivities extend up from depth to shallower levels east of the outcrop relative to west of the outcrop.

Near the east end of the line, at station 26800, the CSAMT line crosses a concealed fault shown on the geologic map; an abrupt change to high resistivities is seen at that location consistent with Ordovician dolomite mapped as outcropping in that vicinity. The Rowley map shows a very narrow outcrop of dolomite from station 27200 to 28000, though station 28200 (the end of the line) is also very high resistivity, suggesting the basin-fill is extremely shallow there at the end of the line.

Also on the eastern half of this line is a section of the line where a very high resistivity surface layer (shaded blue) is seen, beginning at about station 19700, and thickening very gradually to the east toward the dolomite outcrop. This high resistivity layer may represent large grained, dry, eroded material from the dolomite outcropping on the east end of the line. Beneath the high resistivity layer, the low resistivity layers discussed above are distorted, and the deeper layer thickens substantially, with low values extending to depths of 2500 feet in the cross section. This thick zone of low resistivities could indicate that the area centered on station 22900 was at one time a topographic low, such as a narrow valley, and has been filled in with a substantially thicker layer of fine-grained basin-fill than the other areas of these lines. An alternate interpretation would be that the CSAMT line crosses a substantial, broad fault zone, centered approximately on station 22900 and as much as 6000 feet wide. A north-south fault is shown on the geologic map approximately 1000 feet north of the line, as the contact between the Ordovician dolomite of the Meadow Valley Mountains on the east and the basin-fill on the west. A broad fault zone is not specifically labeled on the geologic map in this area, though one is labeled in Kane Springs Valley further to the north. If this thicker, deep low resistivity zone represents a broad fault zone, this may could be interpreted to be a preferred flow path for groundwater. If however the low resistivities are the result of a much thicker "deposit" of very fine-grained basin-fill material such as clay, the area may represent a flow barrier.

Line B: The smooth-model inversion cross section for Line B is shown in Plate B. Like Line A, Line B is oriented east-west, and used the same transmitter as Line A. Although the west end of Line B is 6000 feet east of Highway 93, the large power lines that were west of the highway in the vicinity of Line A jog to the east as they go south, and are only 1100 feet west of station 0 on Line B. In addition, smaller, single-pole power lines cross the line near station 5300, and large, double-pole powerlines cross the line roar station 6100. Data at station 5700, 5900, and 6100 were too noisy to use in modeling.

Similar to Line A, the dominant feature on Line B is a very high resistivity block in the middle of the line, centered at station 10300; the geologic map shows Mississippian limestone from station 9000 to 11500, and is the northernmost edge of the Arrow Canyon Range. It is possible that the resistive block in the center of Line A is a continuation of the resistive block on Line B, and that if CSAMT lines had been run between Line A and Line B, the resistive limestone block would be evident as well. The basin-fill material and possible underlying volcanics that are west and east of the limestone block show similar resistivity levels to Line A, but unlike like A, multiple low resistivity layers are not seen on Line B. The concealed faults on the geologic map on each side of the outcrop are very close to the outcrop on this line, in good agreement with the CSAMT data. A buried fault is also evident in the CSAMT data in the vicinity of station 18300, which may be the actual location of a concealed fault on the map at station 19600. Near the west end of the line, another buried fault is indicated by the CSAMT in the vicinity of station 2500; again, this may be the actual location for a concealed fault on the map at station 4000.

Moderately high resistivities are seen extending from depth up to within 1000 feet of the surface on the east half of the line from the buried fault at station 18300 to the east end of the line. A thick, low resistivity zone similar to what was discussed above on Line A is not seen on the eastern half of Line B.

Line C: The resistivity results for Line C are shown in Plate 3. Line 3 was oriented N 24 E, and therefore a different transmitter location was needed. Powerlines and Highway 168 intersect this line in the vicinity of station 13300. According to the geologic map, all of this line was on basin-fill material, with no mapped outcrops. The map indicates that this line crossed a concealed strike-slip fault in the vicinity of station 3500, and a second, roughly parallel concealed fault in the vicinity of station 13200. The CSAMT data definitely indicate faults near those two locations, though both faults appear to be normal faults, and the line as a whole has the appearance of a horst-and-graben feature. The fault on the southwest near station 3500 has high resistivity material southwest of the fault, across the fault from moderately low resistivity toward the center of the line. The fault on the northeast near station 13200 has high resistivity northeast of the fault, across the fault from moderately low resistivity toward the center of the line. The line is thus divided into three segments: high resistivity from the southwest end to station 3500, moderately low resistivity from station 3500 to 13200, and high resistivity from 13200 to the northeast end of the line.

In the center segment of the line, several very small, anomalous, isolated areas are seen in the deepest data; these features are likely noise in the low frequency data, and are not necessarily valid geologic anomalies. These features are seen at stations 10500, 12100, and 12900, for example. In the near-surface, upper 500 feet of the section, this line is very similar to the others, with low resistivity basin-fill material hiding deeper structure. The southwest end of the line has lower resistivities in the near surface than the northeast end, with the low resistivity near-surface material weakening and becoming thinner as the moves to the northeast. The east end of Line B approaches, but does not cross Line C. The general appearance of the resistivity structure on the two lines in this area is very similar.

Survey Method

CSAMT is an electromagnetic survey method. The primary measured quantities in a CSAMT survey are the magnitude and phase of the electric and magnetic fields along an array of grounded receiver dipoles. The receiver measures the magnitude of the received signal and the absolute phase difference between the received signal and the transmitted signal, which is known via synchronization of the transmitter and receiver. From the measured signals, estimates of Cagniard resistivity (related to the ratio of orthogonal components of the electric and magnetic fields) and impedance phase (phase difference between the electric and magnetic fields) can be computed for each frequency. A geophysical inversion algorithm can then be used to compute an estimated earth resistivity model from the frequency based data. No induced polarization (IP) or chargeability information is obtained from this CSAMT survey. One advantage of the CSAMT method is that it provides much higher resolution, both laterally and at depth, than other deep sounding electrical resistivity methods. Generally CSAMT provides the most efficient, cost-effective method for obtaining high resolution subsurface resistivity structural information. For this reason, it is employed in mineral exploration, environmental, and engineering applications.

A schematic setup diagram for CSAMT field measurements is shown in Figure 4. CSAMT may be collected in either scalar or vector mode. Scalar mode measures only the along-line electric field, Ex, and the across-line magnetic field, Hy. In vector mode CSAMT both components of the electric field and magnetic field are measured: the along- line components, Ex and Hx, and across-line components, Ey and Hy. By design, the transmitter is oriented so that electric current is directed parallel to survey lines and perpendicular to the assumed geologic strike. Given that survey grids are generally located perpendicular to strike, critical information for this type of survey is generally found in the Ex and Hy components (scalar CSAMT). The assumptions are that (1) geology within the grid is strongly 2D and (2) the survey layout is optimized with regards to geology. In areas of very complex geology, measuring the complimentary components (vector mode) may allow better resolution of 3D features; however, the increase in survey cost is significant.

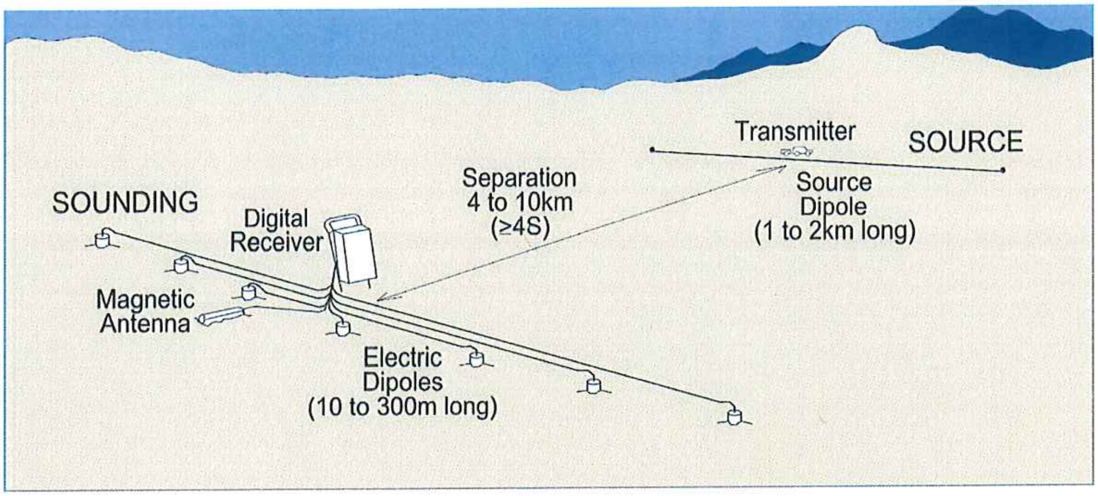


Figure 4: Schematic CSAMT survey layout.

INSTRUMENTATION

Two Zonge 8-channel GDP-3224 multi-purpose geophysical receivers were used for this survey (SNs 3252 and 32326). The GDP-3224 instrument is a backpack-portable, 24 bit, microprocessor-controlled receiver. The electric-field signals were measured using non-polarizing ceramic porous-pot electrodes connected to the receiver with insulated 14-gauge wire. Magnetic field data were acquired with Zonge ANT/6 magnetic field sensors (SNs 2486 and 2496).

The signal source for this project was a Zonge 10 kilowatt GGT-10 transmitter, serial # 537. Transmitter power was provided by a Zonge ZMG-9 motor-generator (SN #11). The transmitter was controlled by the XMT-G transmitter controller. Data collection requires time and frequency synchronization between the GDP-3224 receivers and GGT transmitter which was achieved via GPS timing.

Data Acquisition

Zonge Crew Chief John Phelps supervised the field operations for this project and operated one of the GDP receivers, while Ryan Petroco operated the second receiver. Tim Nordstrom operated the transmitter, with Ryan Petrocco, Neith Crowder, Juan Renteria, Mark Sperry, and James Vansant as Field Technicians. Chief Geophysicist Norman Carlson was responsible for the general oversight, processing, and modeling of the data. Steve Reich of Stetson Engineering was the primary client contact during this project.

Table 1. Daily Production Log

Date	Activity	Hours	Crew
Apr 01	Arrive Coyote Spring; Site Specific Safety Training	6 (travel)	7
Apr 0 2	Install transmitter 1; Begin reading Line B; very windy	10.5	7
Apr 03	Continue Line B; very windy	10.5	7
Apr 04	Finish Line B; Begin Line A; very windy	10.5	7
Apr 05	Finish Line A	9.5	7
Apr 06	Remove Transmitter 1; install transmitter 2.	7.25	7
Apr 07	Read Line C	10.75	7
Apr 08	Remove Transmitter 2; re-organize and prep for mobilization	5	7

Positioning:

All GPS coordinates were collected in NAD83, UTM Zone 11 North, meters. The field crew acquired GPS readings for electrode locations as the survey progressed.

Transmitter Dipole:

Current electrodes at the transmitter site were constructed using approximately 30 aluminum conduit stakes for electrodes at each end. The stakes are usually pounded into the ground approximately one foot deep in a circle approximately 15 feet in diameter. The ground proximate to the stakes is soaked with salt water to reduce electrical contact resistance. Each electrode was connected to the transmitter using 14 gauge insulated copper wires laying on the surface of the ground between the electrode and the transmitter truck. The transmitter truck remained on established dirt roads at all times, and no off-road driving was done. The transmitter electrode locations are listed in Table 1 below.

Table 2. Transmitter Locations

	Transmitter Endpoint Locations*					
	West End		East End		Tx Length	Orient.
Tx	Easting*	Northing*	Easting*	Northing*		
A, B	687247	4082733	688819	4082733	1572m	N90E
C	686387	4075090	687003	4076474	1516m	N24E

*NAD83, UTM Zone 11 North, meters

Receiver Spreads:

Electric field measurements were made at the receiver site along spreads of potential electrodes consisting of grounded, non-polarizable porous pots filled with copper sulfate solution. The pots were partially buried in small pits approximately two inches deep and tap water was added to reduce contact resistance with the ground.

Data were collected using up to 6 channels per setup, or spread. The measurement spread consisted of 6 Ex E-field dipoles and 1 Hy magnetic field measurement. In this configuration, Ex is the electric field measurement made in the along-line x-direction (parallel to the transmitter dipole), and Hy is the magnetic field measurement in the across-line or y-direction. Coordinates for each of the stations are included in files with the digital delivery of this report.

CSAMT frequencies from 2 Hz up to 8192 Hz were acquired. The suite of frequencies used for 1D resistivity modeling was from 2 Hz to 8192 Hz, plus the 3rd and 5th odd harmonics of the fundamental frequencies (8 Hz, 16 Hz, 32 Hz…).

DATA PROCESSING

Software

All raw, averaged and inversion model data and images are included on the Report Archive Disk. Zonge in-house software was used for processing and modeling the CSAMT survey data using the following programs:

• Zonge CSAVGW	v1.20r	(visualizing, averaging and editing raw data)
• Zonge ASTATIC	v3.70i	(visualizing and static corrections of averaged data)
• Zonge SCSINV	v2.20p	(1D inversion modeling)
• Zonge SCSPLOT	v3.21k	(plotting 1D model sections)
• Geosoft/Surfer	v8.5.1	(final database, plotting, visualization models)

Processing Flow:

A brief outline of data processing and modeling steps is given below:

- Prepare *.mde (Survey configuration and processing control file) and *.stn (station coordinate) files.
- Process raw data files (.cac) using the *CSAVGW* program. CSAVGW is a CSAMT/NSAMT data averaging and quality-control utility program, displaying the data in pseudosection,

sounding curve or data point graphs to allow skipping of outlier data. Data are saved as averaged data in *.avg files.

- Process averaged data with the *ASTATIC* algorithm using the ASTATIC program. Individual sounding curves are viewed and final removal is made of individual measurements that are considered to be affected by noise. Static corrections, or corrections high contact resistance are also made using the program ASTATIC. Static corrections were tested on the Coyote Springs project data, but very little static effects were evident, and the static corrections resulted in little to no change in the results. No static corrections were included in the final plots.
- Perform 1D inversion modeling using *SCSINV* smooth model inversion programs. Run *SCSINV* using *Ex.avg files to get 1D model resistivity cross-section (depth profile) models.
- Model results (*.mtm files) were imported into Geosoft of Surfer for plotting with the in-house Zonge scripts in *SCSPLOT.GX.*

DATA QUALITY

Data quality is monitored in the field by the operator. Real-time standard-error values are displayed during acquisition. In addition, multiple measurements at a range of frequencies are displayed graphically as resistivity versus frequency curves with error bars showing the data scatter. This allows a visual evaluation of the data quality and remedial action to be taken if necessary. Data are further evaluated for quality during the standard data reduction process whereby spurious data are removed if necessary.

Standard Zonge field procedure requires that the receiver operator make multiple measurements (stacks) of each data point while monitoring receiver displayed real-time standard-error values. Provided sufficient stacks are collected in the field, the averaged sounding curves may be manually edited by removing outliers and noise that remain in the data after the automated, robust averaging technique is applied. Repeatability of the stacks was very good, with the exception of the section of Line B discussed above.

Transmitter current levels for the transmitter ranged from 3 to 10 amps for this project, depending on frequency.

One important influence on electrical geophysical data quality is the electromagnetic noise generated by human activity, commonly referred to as culture. Typical culture-related noise sources include radio frequency noise (RF) and electrical power line transmissions, cathodic protection on pipelines, metal fences, and buried or surface pipelines in the area. A large power transmission line ran just east of the survey area as shown on Figure 1, and a chain link fence surrounded the facility. The workflow includes deletion or down-weighting of outliers where cultural electrical noise was apparent.

CSAMT DATA PRESENTATION

Observed and modeled data for the project are presented in several types of plots and maps in this report. All plots and maps are included as digital images in JPG format. Numeric observed and modeled data are included on the Report Archive Disk as ASCII CSV files, Excel files (tables). The CSAMT data are presented graphically as inverse models showing 1D depth cross-sections of resistivity.

The CSAMT survey data have been modeled using a 1-D inversion algorithm to generate model cross-sections of the estimated subsurface resistivity. The resistivity inversion cross sections are computed using Zonge's SCS2D, which contains the program SCSINV for the 1D inversion.

The 1D inversion model makes the assumption that subsurface resistivity varies only vertically, and stations are inverted individually, with no influence from adjacent stations or off-line effects. This inversion process often detects narrower features than 2D or 3D models, which tend to smooth through narrow features. While the 1D inversion is robust and preserves detail, often illuminating sharp vertical features, 1D-modeled results can also be distorted when data are strongly controlled by 2D and 3D geology.

SCS2D inverts observed apparent resistivity and impedance phase data from a line of frequency-based CSAMT or natural source MT soundings to determine resistivities in a model earth cross-section. Either TM mode data, defined in this case as line parallel E-field, or TE-mode data, line perpendicular E-field, may be inverted. The starting model for the 1-D inversion is generally computed from either a moving average of the apparent resistivity data over the section.

During the inversion, model-section-pixel resistivities are adjusted iteratively until calculated apparent resistivity and impedance phases are as close as possible to observed data, consistent with model constraints. Model constraints include background-model constraints, which restrict the difference between the inversion, and background model sections, which represent known geology, and smoothness constraints, which limit resistivity variation from pixel to pixel. To calculate apparent resistivity and impedance phase for a given model section, SCS2D uses a two-dimensional, finite-element algorithm to calculate far-field CSAMT or natural-source MT data. To model the terrain, the finite-element mesh is draped over an along-line topographic profile. Either TM- or TE-mode data can be calculated for scalar, vector or tensor survey configurations for frequencies ranging from less than 0.01 to 10 kHz. For this project, a TM-mode inversion was performed on the CSAMT data.

Geophysical inversion models always represent a non-unique earth model from an infinite number of models that fit the observed data equally well. The 'smooth-model' inversion cross-sections are unique in the sense that they represent a unique average of the entire solution space of models, subject to the particular user-imposed constraints.

For interpretive purposes, inversion resistivity models are presented in this report as color-contoured cross sections. In the model sections, cool colors (blues, greens) represent high resistivity and warm colors (orange, red, pink) represent low resistivities.

The 1D inversion models for this project are sensitive to a depth of about 3000 feet, though resolution decreases with increasing depth and "near-field" effects complicate the interpretation at depths greater than about 1500 feet in this case. Depth of investigation for the CSAMT method is a function of frequency, background resistivity, the distance from the transmitter to the receiver and on the geology between and around the transmitter and receiver dipoles

HEALTH, SAFETY AND ENVIRONMENTAL ISSUES

No accidents or near-miss incidents occurred during the course of the survey. Survey areas were kept clean and all materials such as wire, stakes, and flagging that were used during the survey were removed at the completion of the project.

GEOLOGIC MAP REFERENCE

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Respectfully Submitted,

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Plate 1

Coyote Spring Project

CSAMT Survey

Line A

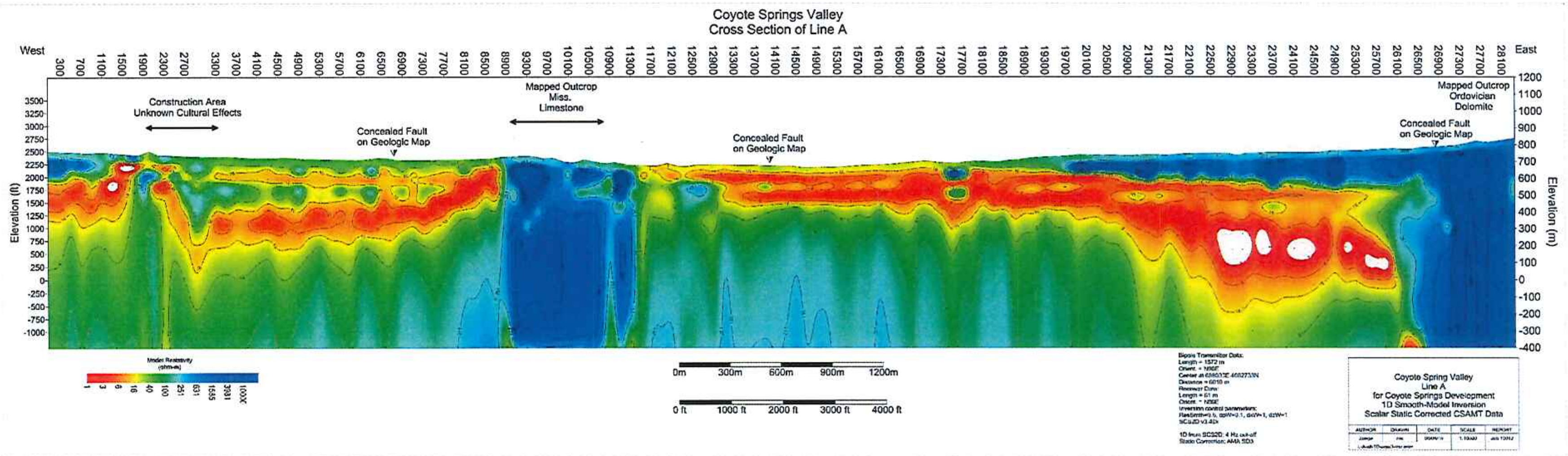


Plate 2

Coyote Spring Project

CSAMT Survey

Line B

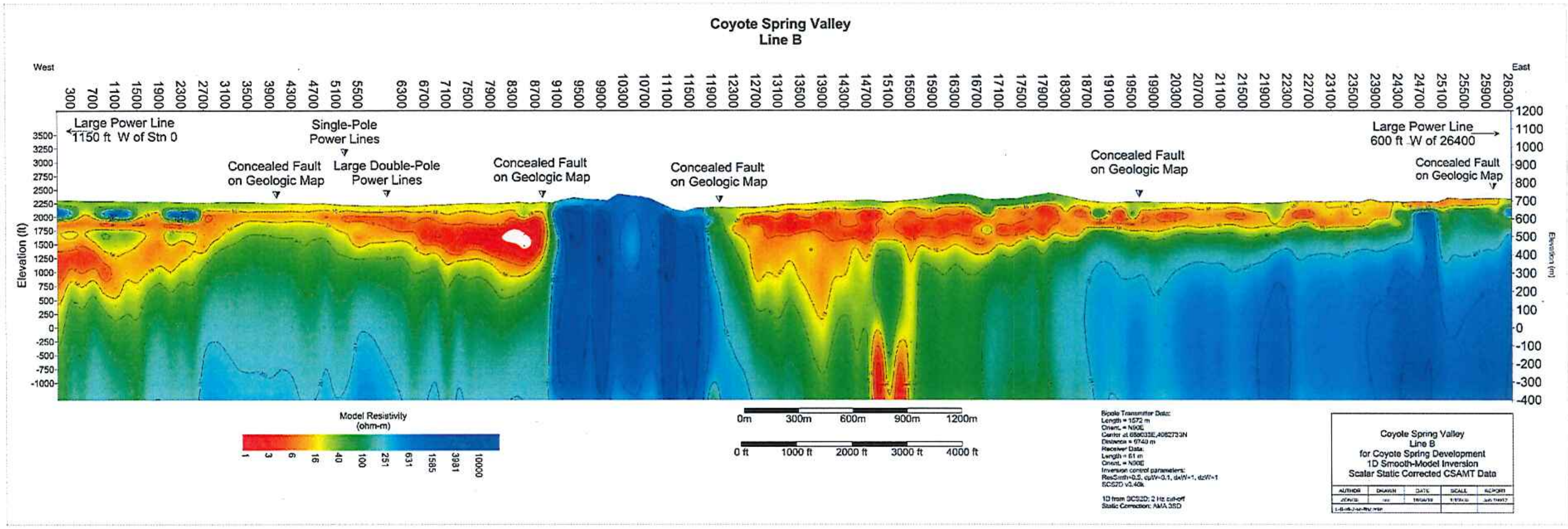


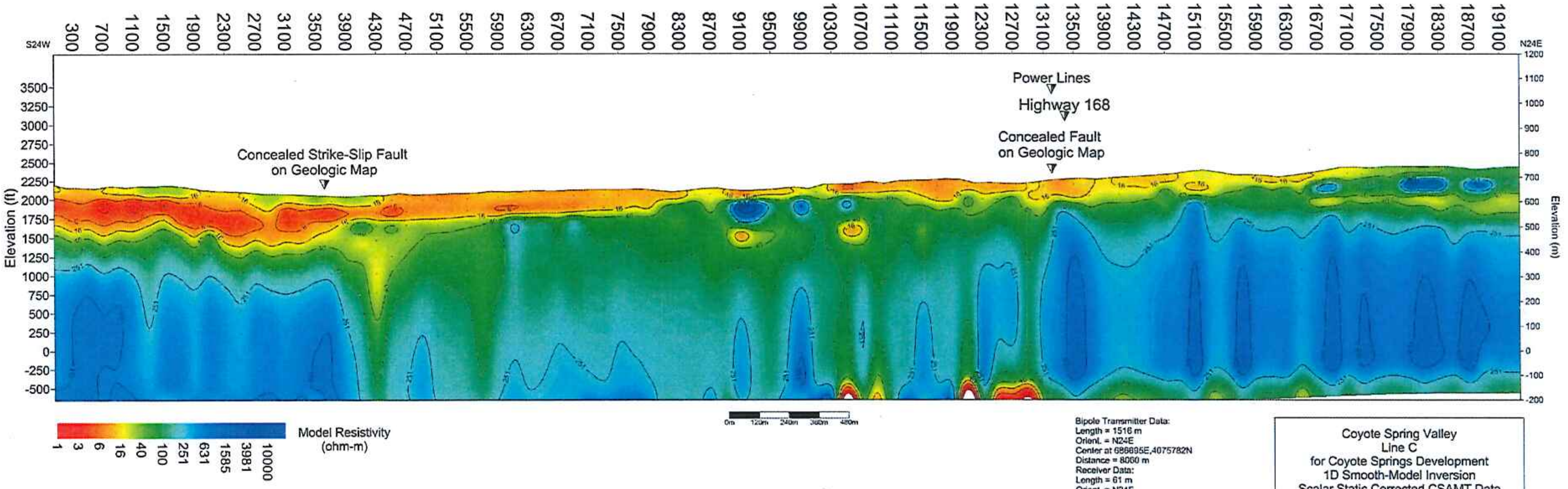
Plate 3

Coyote Spring Project

CSAMT Survey

Line C

Coyote Spring Valley
Cross Section of Resistivity- Line C



Bipole Transmitter Data:
Length = 1516 m
Orient. = N24E
Center at 686695E,4075782N
Distance = 8060 m
Receiver Data:
Length = 61 m
Orient. = N24E
Inversion control parameters:
ResSmth=0.5, dpW=0.1, dxW=1, dzW=1
SCS2D v3.40k

1D from SCS2D; 4 Hz cut-off
Static Correction: AMA 3SD

Coyote Spring Valley
Line C
for Coyote Springs Development
1D Smooth-Model Inversion
Scalar Static Corrected CSAMT Data
by Zonge International

AUTHOR	DRAWN	DATE	SCALE	REPORT
ZONGE	nrc	08/04/18	1:10000	Job 19012
L-C-AllSC3-1D-4Hz.mtn				

Zonge

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APPENDIX:
Survey Methodology and Equipment Specifications

CONTROLLED-SOURCE AUDIO-FREQUENCY MAGNETOTELLURIC SURVEY

Coyote Spring Valley Project
for
Coyote Springs Nevada, LLC

CSAMT Field Surveys

Summary: CSAMT (controlled source audio-frequency magnetotellurics) is a commonly-used, surface-based geophysical method which provides electrical resistivity information of the subsurface, usually at greater depths and better lateral resolution than other resistivity methods such as Schlumberger soundings, dipole-dipole, or gradient arrays. CSAMT has been used extensively by the minerals, geothermal, hydrocarbon, and groundwater exploration industries since 1978 when CSAMT equipment systems first became commercially available. It is a low-impact, non-intrusive technique, usually involving only 3 or 4 people with one or two pick-up truck-sized vehicles. No trenching, drilling, road-making, or blasting is involved, and the majority of the survey can be done on foot using backpack-able equipment. For complete, published, peer-reviewed discussions of the CSAMT method and its common applications, see the Zonge and Hughes (1991) and Zonge (1992) references.

Details of the CSAMT Methodology- Briefly, the CSAMT method can be described as follows: Electrical signals are transmitted into the ground through a long wire, grounded at each end, called a transmitter dipole. This dipole is usually 3000 to 5000 feet in length, and is usually located three to five miles from the area where the measurements are to be made (the target area, also called the receiver area; see Figure App-1).

Physically, this transmitter consists of thin, 14-gauge insulated wire laying on the ground, grounded at each end usually using ½ inch diameter conduit stakes pounded about ½ to 1 foot into the soil (this part of the dipole is called an electrode). The wire is laid out by walking along the ground, and vehicle access along the length of the transmitter is not necessary. The wire does not need to be straight, and can be angled or bent around areas where access or walking is not permitted. At a convenient location somewhere between the end electrodes, the transmitter electronics are connected to the wire. This equipment is usually in a pick-up truck with a generator mounted in the back or on a small trailer behind the truck. This equipment transmits a very carefully controlled signal at specific frequencies into the ground.

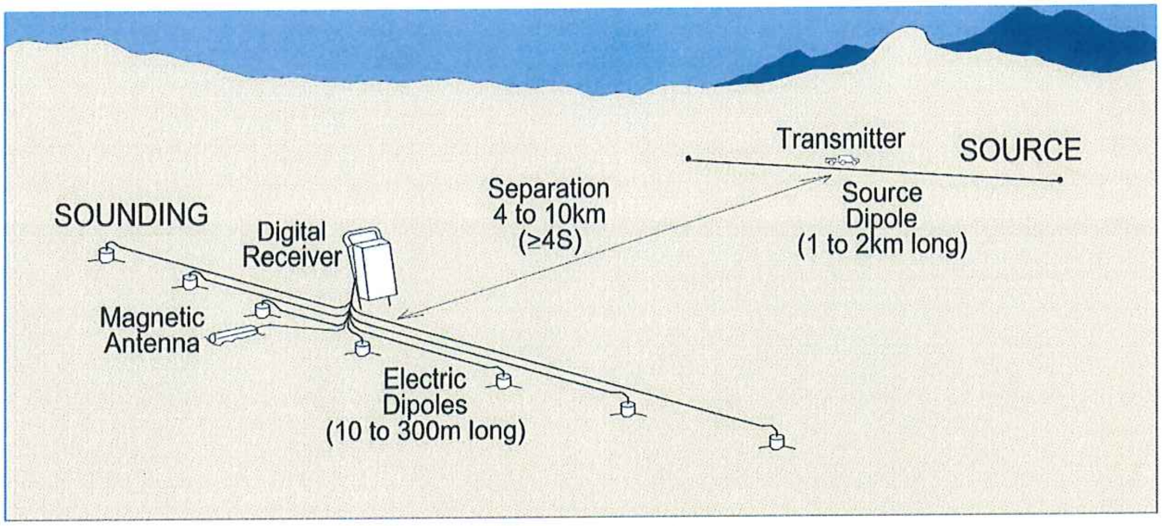

Figure App-1: General field lay-out of a scalar CSAMT survey.

At the receiver site, which is the area to be studied, the signal that is being transmitted is detected with short grounded dipoles and magnetic field detectors. The grounded dipoles at the receiver are also simply wires laying on the ground, but in this case they are grounded using small porous ceramic "pots" about 6 inches tall and two inches in diameter, buried about an inch in the soil. The wires are usually from 50 feet to 200 feet long. The magnetic field detectors are cylindrical coils of wire, usually about 3 to 4 feet long, laying on the ground. All of the equipment at the receiver site can be carried by backpack if necessary.

Usually, the receiver equipment can make measurements simultaneously at several different stations. To make the measurements, signals are transmitted at different frequencies, and the receiver measures properties of the signal (amplitude and phase), storing the results in computer memory. Once the receiver operator determines that he has enough measurements at that location to provide clean data, the receiver equipment is picked up and moved to a new location, and the measurement process begins again. By making measurements at numerous stations along a line, a cross section of the earth's electrical resistivity properties can be produced, providing information about subsurface faults, fractures, geologic structures, mineralization, and groundwater (see example in Figure App-4 below).

Depending on terrain, obstacles, and vegetation, a CSAMT crew will usually cover from 3,000 to 6,000 line feet of data per day, either as one long line, or several shorter lines. Since the crew is relatively small, the survey costs are less than for many other geophysical surveys. In most recent groundwater surveys, for example, the typical total cost (including personnel, equipment, expenses, processing, modeling, and final report) has been approximately $5,000 to $7,000 per line mile of data.

Figure App.-2: Preparing CSAMT transmitter electrodes.

Figure App.-3: The backpack receiver system set up on line in an agricultural field during a groundwater survey in Utah.

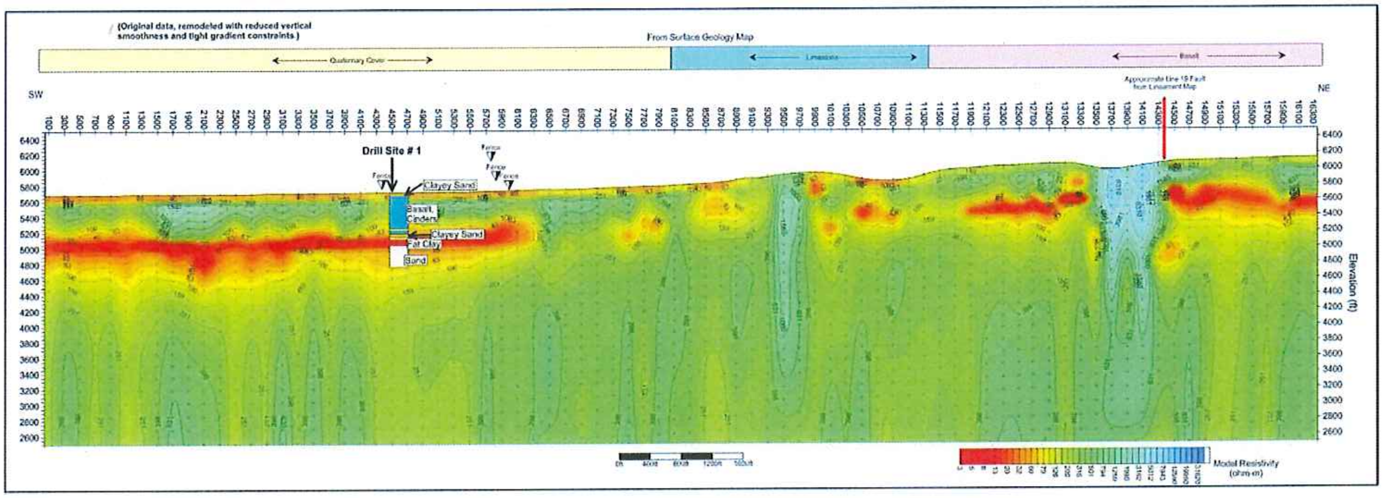

Figure APP-4: Example line of CSAMT resistivity data in cross section form. Station numbers (in feet) are across the top, and decreasing elevation (in feet) is down the side. Low resistivities are shown shaded toward red, and high resistivities are shaded toward blue. A thin, flat-lying low resistivity layer was confirmed as a 100-foot thick clay layer at Drill Site # 1.

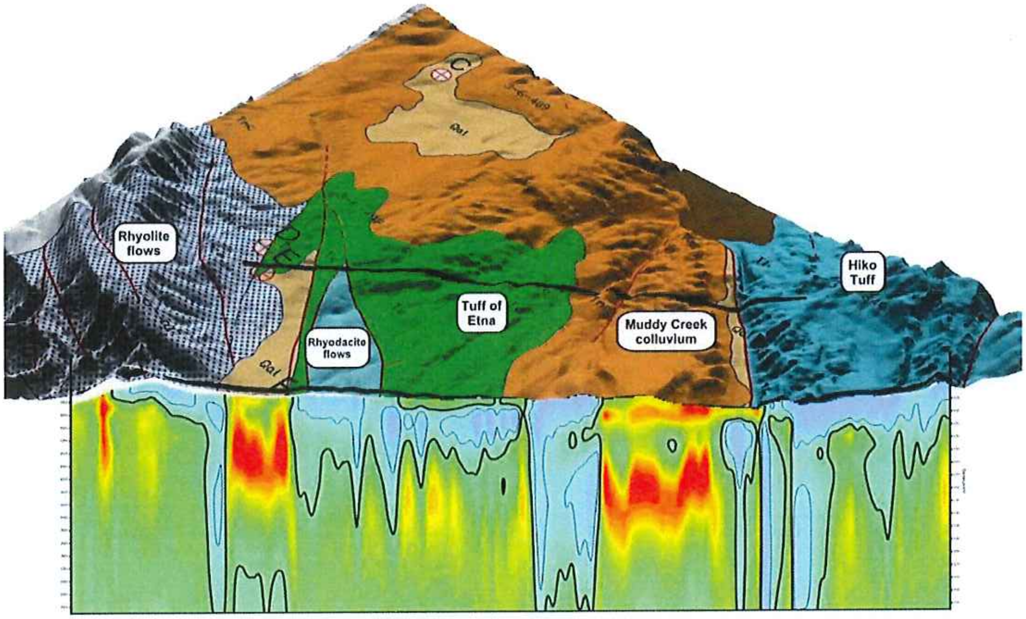

Figure APP-5: Surface geologic mapping draped on USGS elevation data, with a CSAMT resistivity cross section hung below to show the subsurface. A mapped graben structure on the left side of the line is clearly evident as a low resistivity zone (shaded red) in the CSAMT, and a second, larger buried graben is also seen on the right, covered by Muddy Creek colluvium.

CSAMT Reference Material

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Zonge, K.L. and Hughes, L.J., 1991, "Controlled source audio-frequency magnetotellurics", **in** Electromagnetic Methods in Applied Geophysics, ed. Nabighian, M.N., Vol. 2, Society of Exploration Geophysicists, pp. 713-809.

Zonge, K. L., 1992, "Broad Band Electromagnetic Systems", **in** Practical Geophysics II for the Exploration Geologist", ed. Richard Van Blaricom, Northwest Mining Association, pp. 439-523.

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Get maximum use from your equipment investment

The Zonge GDP-3224™ is an integrated, 24-bit multi-channel receiver for acquisition of controlled- and natural-source geoelectric and EM data.

- 24-bit analog system
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- 100BaseT Ethernet port
- GPS timing, plus high-accuracy quartz clock
- Multiple, selectable data storage modes in a single data cache
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FEATURES

- 1 to 16 channels, user expandable
- 133 MHz 586 CPU
- Alphanumeric keypad
- Real-time data and statistics display
- Easy to use menu-driven software
- Resistivity, Time/Frequency Domain IP, CR, CSAMT, Harmonic analysis CSAMT (HACSAMT), AMT, MT, TEM & NanoTEM®
- Screen graphics: plots of time-domain decay, resistivity and phase, complex plane plots, etc., on a 480x320 ½-VGA, sunlight readable LCD
- Internal humidity and temperature sensors
- Time schedule program for remote operation with Zonge XMT-32S transmitter controller
- Optional GPS time synchronization with transmitter Use as a data logger for analog data, borehole data, etc.
- Full compatibility with GDP-32 series receivers.
- 0.015625 Hz to 8 KHz frequency range standard, 0.0001 Hz minimum for MT and 10240 Hz maximum for AMT
- One 24-bit A/D per channel for maximum speed and phase accuracy
- 512 MB Compact Flash Card (up to 4 GB) for program and data storage, sufficient to hold many days' worth of data
- 128 MB dRAM (up to 256 MB) for program execution
- Optional data storage device (up to 40 GB) Anti-alias, powerline notch, and telluric filtering
- Automatic SP buckout, gain setting, and calibration
- Rugged, environmentally sealed
- Modular design for upgrades and board replacement
- Complete support, field peripherals, service network, software, and training

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Specifications for the GDP-3224™ Integrated Multi-Function Receiver

General
Broadband, multichannel, multifunction digital receiver.
Frequency range: 1/64Hz - 8KHz (0.0001Hz - 8KHz for MT and 1Hz to 10240Hz for AMT)
Number of channels: Large case, 1 to 16 (user expandable) Small case, 1 to 6 (user expandable).
Standard Survey capabilities: Resistivity, Frequency- and Time-Domain IP, Complex Resistivity, CSAMT (scalar, vector, tensor), Harmonic Analysis (CSAMT, Frequency-Domain EM, Transient Electromagnetics, NanoTEM®, MMR, Magnetic IP, Magnetotellurics, Downhole Logging.
Software language: C++ and assembly.
Size: Large case 43x41x23cm (17x16x9")
Small case 43x31x23cm (17x12x9")
Weight: (including batteries and meter/connection panel):
Small case 13.7 kg (29 lb)
Large case
8 channel, 10 amp-hr batteries, 16.6 kg (36.5 lb)
8 channel, 20 amp-hr batteries, 20.5 kg (45 lb)
16 channel, disk, 10 amp-hr batteries, 19.1 kg (42 lb)
Enclosure: Heavy-duty, environmentally sealed aluminum
Power: 12V rechargeable batteries (removable pack)
Over 10 hours nominal operation at 20°C (8 channels and 20 amp-hr batteries). External battery input for extended operation in cold climates, or for more than 8 channels.
Temperature range: -40° to +50°C (-40° to +122°F)
Humidity range: 5% to 100%
Internal temperature and humidity sensors
Time base: Oven-controlled crystal oscillator; aging rate <$5x10^{-10}$ per 24 hours (GPS disciplining optional)

Displays & Controls
High-contrast sunlight readable ½-VGA (480x320) DFT-technology LCD graphics display, with continuous view-angle adjustment (optional heater for use down to –40°C).
Sealed 80-key keyboard
Analog signal meters and analog outputs
Power On-Off

Standard Analog
Input impedance: >10 MΩ at DC
Board Dynamic range: 212 db
Minimum detectable signal: 0.03 μV
Maximum input voltage: ±32V
SP offset adjustment: ±2.25V in 69μV steps (automatic)
Automatic gain ranging in binary steps from 1/8 to 1024
Common-mode rejection at 1000 Hz: >80 db
Phase accuracy: ±0.1 milliradians (0.006 degree)
Adjacent channel isolation at 100 Hz: >90 db
Filter Section. Quadruple-notch digital telluric filter (50/150/250/450 Hz, 50/150/60/180 Hz, 60/180/300/540 Hz, specified by user)
Analog to Digital Converter (Standard Channel)
Resolution: 24 bits
Conversion time: 30 μ sec
One A/D per channel for maximum speed and phase accuracy

NanoTEM® Analog
Input impedance: 20 KΩ at DC
Dynamic range: 120 db
Minimum detectable signal: 4 μV
Automatic gain ranging in binary steps from 10 to 160
Analog to Digital Converter: 14 bits ± ½ LSB, 16 bits optional
Conversion time: 1.2 μsec
One A/D per channel for maximum data acquisition speed

Digital Section
Microprocessor: 133 MHz 586
Memory: 128 MB dRAM (up to 256 MB)
Mass Storage (program & data storage):
512 MB Compact Flash Card (up to 4 GB).
Data storage device with capacities to 40 GB optional
Serial ports: 2 RS-232C ports (16650) standard
Network Adapter: Ethernet adapter standard (100BaseT)
Mouse, CRT (VGA), and standard keyboard ports
Optimized Operating System

Additional Options
Number of channels: (maximum of 3 NanoTEM® channels) Large case: 1-16, Small case: 1-6
External battery and LCD heater for –40°C operation

OTHER ACQUISITION SOFTWARE

External RPIP/TDIP/CR Control: Remote control through serial port on GDP-3224 for electrical resistance tomography (ERT).

Streaming RPIP/TDIP: Continuous acquisition of TDIP or RPIP data (time domain or resistivity/phase IP) using a towed electrode array.

Borehole TEM: Remote control through GDP-32/24 serial port for efficient logging of borehole TEM and MMR data. Compatible with Crone and Geonics 3-component probes.

Extended Broadband Time Series Data Recording: Continuous recording of up to 5 standard analog channels sampling at 32 K samples/sec (bandwidth 8 KHz with 2x oversampling) with no loss of data. Developed for recording broadband magnetotelluric measurements.

Equal-Interval Mode TEM (TEME): Uniform sampling and storage of TEM transients as time series. Used for LOTEM data acquisition and any application that requires uniformly sampled TEM transients.

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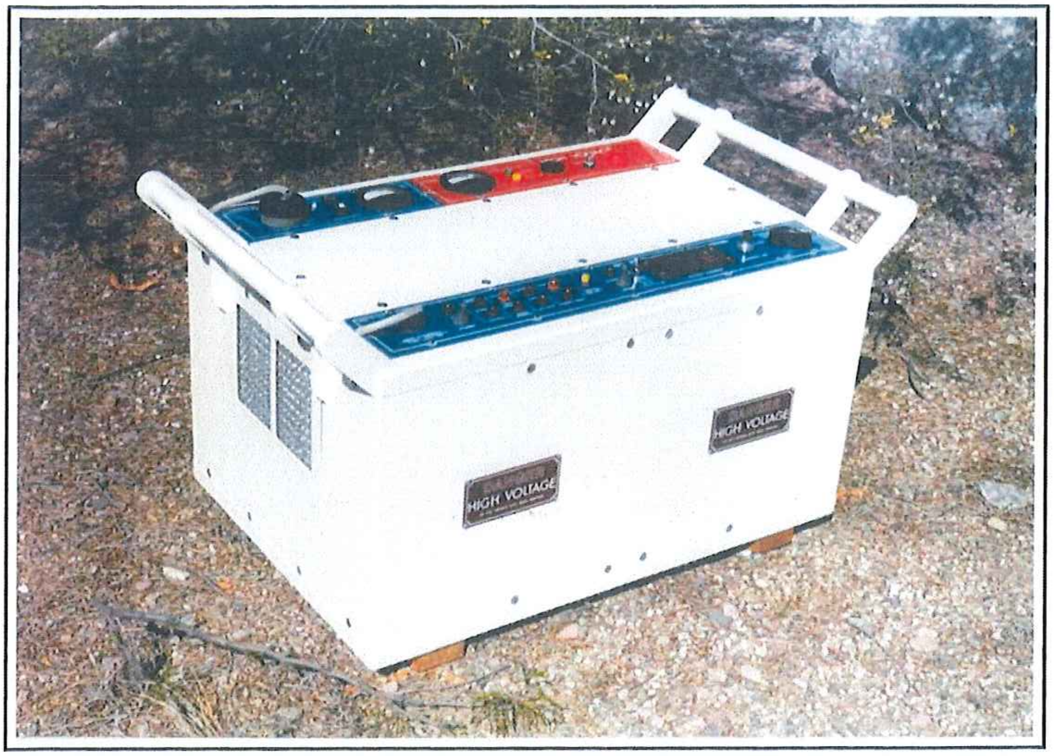
GGT-30 Geophysical Transmitter

High Power and Fast Turn-off



FEATURES

- Constant current supply
- Used for time/frequency domain IP, Resistivity, CR, TEM, FEM, CSAMT
- Broad-band: DC to 8 kHz (standard)
- Output up to 1000 V, 45 A
- Fast turn-off time: 125 μsec (300 x 300 m loop)
- Drives a loop or grounded dipole
- Efficient, modular design
- Rugged design reliable in all climates

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SPECIFICATIONS FOR THE GGT-30 TRANSMITTER

General

Description: Broadband, constant-current, time and frequency domain, high-power geophysical transmitter
Enclosure: Welded, hardened aluminum frame with removable side panels, non-conducting paint
Size: 78 x 46 x 45 cm (31 x 18 x 18 in)
Weight: 93 kg (205 lb)
Operating temperature: -40° to +55°C (-40° to +130°F)
Operating humidity: 0 to 90%, non-condensing

Electrical Characteristics

Drives a loop or grounded dipole
Turnoff time: Under 10 μsec for a resistive load; 125 μsec for a 300 x 300 m loop (16 ohms resistance, full current)
Maximum input: 30KVA @ 30°C
Output voltage range: 50 to 1000V
Output current range: 0.2 to 45A
Current stability: ±0.2%
Frequency range: DC to 8 kHz

Switching Control

Switching controlled by external device
Recommended transmitter controller:
Zonge XMT-32
Waveform type: Capable of virtually any type of pulse waveform, limited by external controller device

Controls

Power ON / OFF
Transmit / Reset switch
Current adjust pot, continuously adjustable, locking
Voltage range switch (50-250V, 200-500V, 450-750V, 700-1000V)
Loop / Dipole select switch

Displays

Analog input voltage meter, 0-150 V
Analog output voltage meter, 0-1000 V
Power On / Off lamp, transmit lamp, output lamp
Selectable LCD meter:
- Output current (±0.01A)
- Input power (0-30 KW)
- Transformer temperature
- Loop turnoff time (microseconds)

Indicator lamps: control power on, transmit on, transmit polarity
Fault indicator lamps: output and input overcurrent, output and input overvoltage, end of regulation, alternator overvoltage, open circuit

Output Jacks

Current calibrate terminals (50 mV/A)
Output current terminals
Grounding jack

Power

Three-phase, 120 VAC, 400 Hz
Recommended motor generator set:
Zonge ZMG-30
Power connector: four-pin military screw-type with locking ring

Options

Spare parts kit (standard and extended kits available)
LCD heater for temperatures below −15°C (+5°F)
Current monitor isoamp module
Resistor load bank
Switch box for rapid switching of dipole pairs

Specifications subject to change without notice

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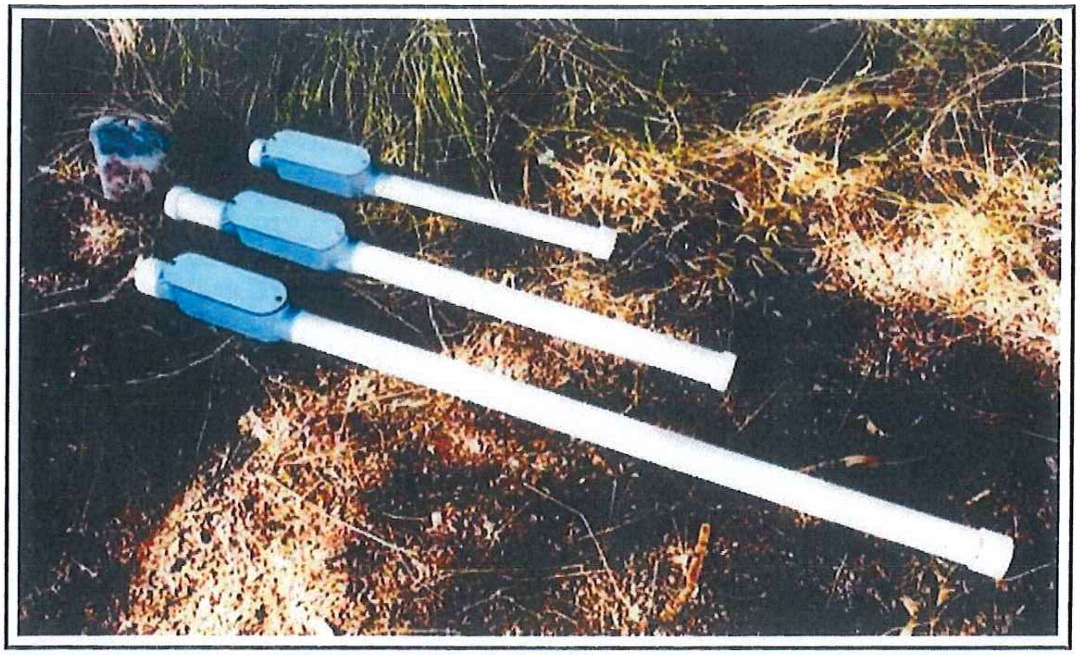
ANT/5, 6, 4
Magnetic Antennas



DESCRIPTION

The ANT/4, ANT/5 and ANT/6 magnetic field sensors are extremely low noise instruments. Using feedback amplifier technology and including carefully designed mu-metal cores, these antennas are each designed with specific purposes in mind. Each antenna is designed to be a highly flexible instrument, built to withstand the difficult conditions encountered in the field environment.

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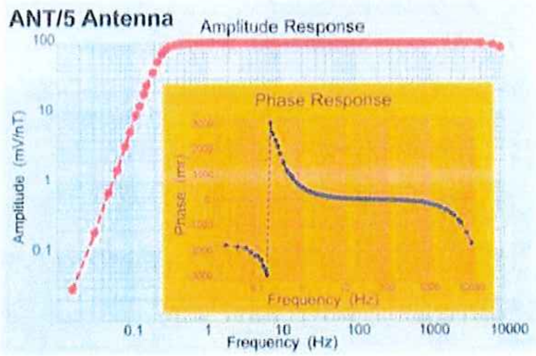
SPECIFICATIONS FOR THE ANT/5, 6, 4 MAGNETIC ANTENNAS

General
Power: Two internal 9V alkaline batteries
Battery Life at 12 hours per day:

Alkaline:	10 days
Lithium:	20 days
Carbon Zinc:	4 days (temporary use only)

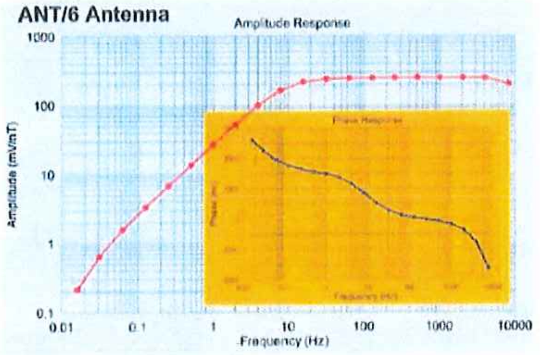
Core: mu-metal

ANT/5 *(smallest and lightest)*
Length: 61.0 cm (24.5 in)
Diameter: 3.6 cm (1.625 in)
Weight: 1.5 kg (3.5 lb)
Frequency Range: 0.25 – 10,000 Hz
Sensitivity in Passband: 100 mV/γ (100 mV/nT)
Noise Level:
1200 $\mu\gamma$ (1200 fT) per √Hz at 1 Hz
20 $\mu\gamma$ (20 fT) per √Hz nominal > 60 Hz
Application: CSAMT



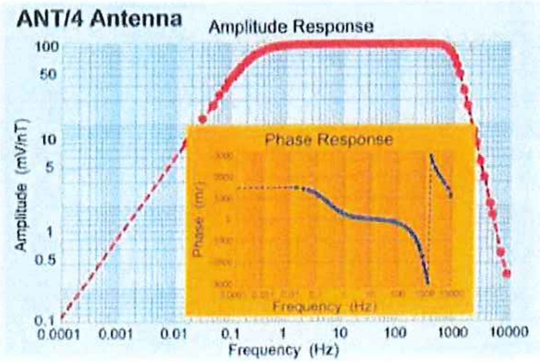
ANT/5 Antenna

ANT/6
Length: 91.0 cm (36.0 in)
Diameter: 4.8 cm (1.875 in)
Weight: 3.2 kg (7.0 lb)
Frequency Range: 0.1 – 10,240 Hz
Sensitivity in Passband: 250 mV/γ (250 mV/nT)
Noise Level:
200 $\mu\gamma$ (200 fT) per √Hz at 1 Hz
1 $\mu\gamma$ (1 fT) per √Hz nominal > 200 Hz
Application: MT / CSAMT



ANT/6 Antenna

ANT/4
Length: 138.0 cm (54.0 in)
Diameter: 4.8 cm (1.875 in)
Weight: 6.2 kg (13.5 lb)
Frequency Range: 0.0001 – 1000 Hz
Sensitivity in Passband: 100 mV/γ (100 mV/nT)
Noise Level:
100 $\mu\gamma$ (100 fT) per √Hz at 1 Hz
20 $\mu\gamma$ (20 fT) per √Hz nominal > 1 Hz
Application: MT



ANT/4 Antenna

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CONCEPT PAPER

FRAMEWORK FOR SUSTAINABLE GROUNDWATER MANAGEMENT IN THE LOWER WHITE RIVER FLOW SYSTEM

October 4, 2018

1.0 Introduction

The purpose of this concept paper is to present a framework for developing a sustainable groundwater management plan (Plan) for six groundwater basins located in the Lower White River Flow System (LWRFS) of southeastern Nevada. The Nevada Division of Water Resources (State Engineer) distributed a Draft Order[1] for review on September 19, 2018 that assigns the administration of water rights in the six basins as a single hydrographic basin, limits groundwater pumping, and holds review of final subdivision maps in abeyance. While the Draft Order states that a Groundwater Management Plan may be employed as an alternative to the limit on groundwater pumping, it fails to provide a process and schedule on how to combine groundwater management and water rights administration. The following framework incorporates provisions of the State Engineer's Draft Order to identify a process that allows for concurrent sustainable groundwater management and administration of water rights to protect existing water rights and endangered species; and a schedule on how that process may be employed.

The process presented is this framework for sustainable groundwater management would result in development of groundwater sustainability plan at a date agreed upon by the stakeholders. The Plan would rely on adaptive management techniques to combine improved technical understanding with administration of water rights, thus allowing the State Engineer to effectively administer the use of water rights in the LWRFS and allow controlled development of the State's natural resources. In the interim, implementation of existing protective measures[2] would allow for valid water right holders to continue to exercise their rights as the Plan is developed.

---

[1] September 19, 2018 Draft Order Designating the Administration of All Water Rights Within Coyote Springs Valley Hydrographic Basin (210), Black Mountains Area (Basin 215), Garnet Valley (Basin 216), Hidden Valley (Basin 217), California Wash (Basin 218), and Muddy River Springs Area (A.K.A. Upper Moapa Valley) (Basin 219) as a Single Hydrographic Basin, Limiting Groundwater Pumping, and Holding in Abeyance Review of Final Subdivision Maps.

[2] 2006 MOA. See page 2.

The LWRFS is part of the larger Basin and Range carbonate rock aquifer that extends from the Great Salt Lake to Death Valley. Developable groundwater resources within the LWRFS occur in both alluvial and carbonate aquifers; surface water resources, which include springs, creeks and rivers, are physically connected to both aquifers. The relationship between groundwater and surface water resources has been extensively studied, but uncertainties due to complex geology and short-term or incomplete hydrologic records remain. Based on the level of scientific uncertainty between groundwater development and surface flow in southeastern Nevada, the LWRFS is a location where adaptive management techniques can be used to achieve sustainable groundwater management goals.

There are currently up to 40,000 acre-feet of permitted or vested groundwater rights in the six-basin area that includes: Coyote Springs Valley (Basin 210), the northern portion of Black Mountain Area (Basin 215), Garnett Valley (Basin 216), Hidden Valley (Basin 217), California Wash (Basin 218), and the Muddy River Springs Area (Basin 219). Recent (2015-2017) groundwater pumping from the carbonate and alluvial aquifers in the six-basin area has averaged approximately 9,318 AFY[3], a value less than the face value of the appropriated groundwater rights.

Although water use from both the alluvial and carbonate aquifers has been documented since the beginning of the last century, more than 300,000 acre-feet per year (AFY) of applications to appropriate groundwater were filed with the State Engineer in the 1980s. In 2002, the State Engineer issued Order 1169 that held all pending applications in abeyance until further investigation of the resource could be completed. Following a long-term aquifer test performed in 2011 and 2012, the State Engineer issued eight rulings[4] finding that there were no unappropriated water rights in the six-basin area.

Diversions from the carbonate and alluvial aquifers in the LWRFS are believed to affect surface flow of the Muddy River and contributing tributary spring flow. While senior decreed water rights rely on the flow of the Muddy River, the federally listed endangered Moapa dace (*Moapa coriacea*) is dependent on the discharge from the springs in the Muddy River Springs Area (Basin 219). Due to the complex geology that defines the six-basin area, the temporal and spatial relationship between groundwater extractions and surface flow is poorly understood.

The first attempt to develop a groundwater management plan between pumping and surface flow was developed by the United States Fish and Wildlife Service (FWS), the Southern Nevada Water Agency (SNWA), the Moapa Band of Paiute Indians (MBOP), Coyote Springs Investments (CSI), and the Moapa Valley Water District (MVWD) in April 2006. Their plan was outlined in a Memorandum of Agreement (MOA) that developed a series of conservation measures based on thresholds established from measured streamflow. The conservation measures, which remain valid today, include: 1) establishment of a Recovery Implementation Program; 2) Dedication of Water Rights; 3) Habitat Restoration and Recovery Measures; 4) Protection of Instream Flows; 5) and formation of a Hydrologic Review Team (HRT). The conservation measures were triggered when measured streamflow in the Warm Springs West Near Moapa gage (USGS 09415920) reached specified threshold values.

---

[3] Draft Order, page 8.

[4] Rulings 6254, 6255, 6256, 6257, 6258, 6259, 6260, and 6261.

The following concept paper builds upon current scientific understanding, existing water rights, and the MOA to propose a framework for developing a sustainable groundwater management plan for the six-basin area. The 2006 MOA provides for a trigger (streamflow), threshold values, and action items, but falls short of establishing a sustainable groundwater management plan that includes adaptive management. As proposed in this concept paper, sustainability goals, undesirable results, minimum thresholds, and measurable objectives must first be identified and either qualitatively or quantitatively described. The basis for establishing goals and objectives relies on defining the basin setting (geology/hydrogeology), inventorying available data sets, identifying data gaps, and developing hydrogeologic tools (models) to describe the occurrence and movement of groundwater. Sustainable groundwater management applies these tools through adaptive management so goals can be met and undesirable effects can be avoided. The process for establishing sustainability goals, developing hydrogeologic management tools, and implementing adaptive management techniques is performed through a transparent cooperative process with interested stakeholders.

2.0 Sustainability

Sustainability as it relates to natural resources in the LWRFS can be simply stated as a condition when the basin is not experiencing undesirable results. The **Sustainable Yield** associated with sustainability of the basin can be describes as "the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from the groundwater supply without causing an undesirable result."[5] Sustainability in the six-basin area of the LWRFS can be determined and managed through the adaptive management process.

2.1 Adaptive Management Process

Adaptive Management of natural resources is commonly referred to or defined as "learning by doing" without postponing action until enough is known[6]. Unfortunately, this definition fails to fully explain the process to successful adaptive management that includes goal setting, stakeholder involvement, and policy recognition. Risk and uncertainty are inherent to adaptive management and should be recognized when setting goals and objectives. For the purpose of this concept paper, adaptive management recognizes two major components[7]: 1) integration of interdisciplinary scientific information for use in prediction of impacts; and 2) design of a specific management experiment.

The State Engineer also recognizes the importance of adaptive management in managing Nevada's water resources:

> *"It is a structured process for decision making in the face of uncertainty with the focus being the reduction in that uncertainty as the understanding of the particular*

---

[5] California Code of Regulations §10721

[6] Stankey, et al, 2005

[7] Ibid.

> *system improves. You learn from what you do and then change management practices accordingly. The aim of the process is to allow the approval of water right applications, with the idea that over time, as information is collected and analyzed, the diversion under the subject water rights can be moved and/or decreased such that conflicts are avoided."* [State Engineer, April 2016][8]

The State Engineer recognizes the importance of Adaptive Management in the administration of water rights further suggesting that it is a tool that can be "employed in the appropriation, development and use of Nevada's waters"[9]. As further suggested by the State Engineer, adaptive management may employ mitigation to avoid conflict with existing right holders to allow the full development of the available water resources.

2.1.1 Stakeholder Involvement

In sustainability-focused management, affected stakeholders are involved in the formation and development of sustainability goals and management objectives. Within the six-basin area of the LWRFS, the water-related stakeholders include: NDWR, United States Department of the Interior (DOI), MBOP, SNWA, MVWD, and CSI. Other water rights holders within the region are represented by the State Engineer. These stakeholders would be relied upon to identify constraints that currently exist in managing resources; as well as called upon to describe the action items that are employed to meet sustainability goals.

The stakeholder group would be represented by managers and policy makers who are supported by technical staff. For example, DOI may be represented at the stakeholder level, but rely on FWS for biological expertise related to the Moapa dace and the USGS for hydrologic expertise related to groundwater flow.

2.1.2 Sustainability Goals

The first component to adaptive management includes creating common goals and objectives among the stakeholders. Typically, these goals define the boundary of the plan and are based on consensus among scientists, policy makers, and resource users. This is typically the most important part of the adaptive management process since it provides a pathway for determining reasonable boundaries of the actual plan. For example, the LWRFS Sustainable Groundwater Management Plan may include goals that:

1) Maximize groundwater production.
2) Protect water supply to decreed water rights holders.
3) Reduce or eliminate impact to federally listed species.
4) Protect the aquifer(s) from irreversible negative impacts

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[8] April 19, 2016 Memorandum from State Engineer to Alysa Keller Regarding: Legislative Commission Sub-Committee to Study Water, Page 7.

[9] Ibid, page 8.

Goal-setting should consider the impact of goals on policy making and whether they affect the policy making process. Does a future management goal of the groundwater resources affect how existing water rights are managed by the State Engineer? Management scenarios investigated during the adaptive management process may result in goals that are either consistent or inconsistent with existing policy.

2.1.3 Identification of Triggers, Thresholds, and Action Items

The groundwater sustainability plan will require stakeholders to identify a set of triggers, thresholds, and related action items. Triggers may be based on parameters such as groundwater levels, spring discharge, and streamflow rates. Other important triggers may be based on environmental requirements, including project-related Biological Opinion (BO) requirements; while additional triggers may be based on legal issues associated with water rights or decree responsibilities. Thresholds are numerical values that are placed on those triggers that result in execution of action items. For example, if a groundwater level (trigger) drops below a minimum elevation (threshold), then pumping is shifted to alternative wells (action item).

The LWRFS Sustainable Groundwater Management Plan should include triggers and thresholds developed in consideration of groundwater flow and biological habitat needs of the Moapa dace. The 2006 MOU may be considered a set of initial conditions for triggers and thresholds, which the adaptive management process could refine over time. The wells, flow measurement points, flow thresholds, and pumping levels described in the MOU are initial conditions that would be evaluated and expanded upon as part of the Sustainable Groundwater Management Plan.

2.1.4 Web-Based Geographical Database and Monitoring System

Transparency of all available datasets is fundamental in providing an inventory of available legal, hydrologic, hydrogeologic, and biologic related data available to stakeholders. The LWRFS Sustainable Groundwater Management Plan should include a web-based geographical database to store, share, and map information in the basin. Legal datasets include a location and description of existing water rights and whether they are active or inactive. In addition to legal and physical datasets, the tools and models relied upon to manage resources should be included in the database to assure institutional knowledge is not lost. The database should also include a library of relevant policy documents, studies, and technical reports.

2.2 September 19, 2018 Draft Order for Managed Pumping

The Draft Order indicates that to avoid conflict with senior decreed rights of the Muddy River and spring discharge that supports the Moapa dace, the State Engineer finds it necessary to "limit pumping to a small percentage of the more than 40,000 acre-feet of appropriated groundwater rights in the LWRFS"[10]. The Draft Order's basis for suggesting curtailment of appropriated groundwater rights is based on Order 1169[11] aquifer test results that found the six basins may share a similar supply of water[12]. Reports generated from the 2011/12 aquifer test and recent groundwater and spring flow data were used by the State Engineer to propose limiting groundwater pumping in the six-basin area to 9,318 AFY based on 2015-2017 average groundwater withdrawals.

Although it is not the purpose of this framework document to assess the analyses or data relied upon by the State Engineer in the Draft Order, there is a great deal of uncertainty that exists in understanding the relationship between groundwater pumping and effects on surface flow and spring discharge within the six-basin area. The Draft Order states that it is the intent of the State Engineer "to develop a more precise understanding of the amount of sustainable groundwater pumpage that may occur within the LWRFS over the long-term without adverse impacts to the Muddy River and the Springs that serve as the headwaters of the Muddy River.[13] Furthermore, the Draft Order indicates that through continued monitoring of the LWRFS during the pendency of the public workshop process a more precise understanding of the amount of sustainable groundwater pumpage will be determined[14].

Based on the content of the Authority and Necessity[15] of the Draft Order and proposed Order #6, the State Engineer recognizes the need for sustainable groundwater management to manage the administration of water rights. Proposed Order #6 states that the State Engineer may consider: "(1) a Groundwater Management Plan ... as an alternative to any prohibition of out of priority junior groundwater pumping; or (2) allowing additional groundwater pumping over the 9,318 acre-foot limit if it can be demonstrated to the satisfaction of the State Engineer that an alternative source of water will be substituted to replace the additional the additional groundwater pumping…."[16] The State Engineer's Draft Order recognizes two important aspects of adaptive management as it relates to a groundwater sustainability plan, including both reducing uncertainty through continued analysis and implementing mitigation measures, the latter of which is analogous to an action item.

The State Engineer has provided the vehicle for sustainably managing water resources in the six-basin area, but does not provide the process or time-line for implementation. The Draft Order should clearly state the process of how the administration of water rights can be combined with sustainable groundwater management. If combined, there would not be a need to set an artificial limit to pumping based on an arbitrary 2015 to 2017 pumping and hydrologic record. As currently proposed in the Draft Order, a limit on groundwater pumping at 9,318 AFY would preclude the collection of data required to define the occurrence and movement of groundwater

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[10] Draft Order, page 9.

[11] Order 1169 aquifer test occurred during 2011 and 2012, averaging 13,880 AFY from the carbonate and alluvial aquifers.

[12] The boundary conditions that describe recharge, discharge, and interflow within the six-basin area have not been defined.

[13] Draft Order, Page 10

[14] Ibid. Draft Order conditionally states that pumpage will not exceed 9,318 AFY during the public workshop process.

[15] Draft Order, page 9 and partially summarized in previous paragraph.

[16] Ibid, page 12.

in the six-basin are and thus prevent maximizing the water resources of the State. The following sections of this framework document provide a plan and schedule for implementation groundwater sustainability and administration of water rights.

3.0 Sustainable Groundwater Management Plan Implementation

The implementation of a groundwater sustainability plan for the six-basin area of the LWRFS would include formation of both a management and technical group. The Management Group is intended to include managers and policy makers that can guide the development and implementation of the sustainability plan. The Technical Committee would be formed to respond to technical tasks and questions raised by the Management Group to support their decision-making process. Specific roles and responsibilities for each group are described below.

3.1 Management Group and Technical Committee

The Management Group and Technical Committee would be implemented to separate policy from science. Generally, the Management Group would be focused on decision making based on information provided by the Technical Committee. The Technical Committee would support the Management Group by analyzing data and providing responses to the specific questions raised by the Management Group.

3.1.1 Management Group

The Management Group would be chaired by the State Engineer and include management-level representatives from SNWA, MVWD, DOI, MBOP, and CSI. The initial role of the Management Group would be to establish sustainability goals and objectives. The future role of the Management Group would be to implement management actions that result in meeting goals and objectives. The following is an example list of responsibilities that may be assigned to the Management Group:

a) Assign technical tasks and studies to support Adaptive Management

b) Identify goals and objectives for sustainability

c) Adopt recommended triggers, thresholds, and action items used to meet goals

d) Implement operation policy to meet sustainability goals

e) Secure funding sources for studies, reports, and management

3.1.2 Technical Committee

The Technical Committee would also be chaired by the State Engineer and include technical representatives appointed by members of the Management Group. Policy makers and management-level decision makers should not be represented on the Technical Committee;

rather scientists and engineers who are experts in their fields of study should be assigned to the Technical Committee. Experts from the USGS (as appointed by the DOI as a stakeholder) should sit on the Technical Committee to provide objective hydrologic and geologic expertise. Participation should be limited to two experts per stakeholder. The role of the Technical Committee would be to respond to tasks assigned by the Management Group. The following example tasks may be assigned to the Technical Committee:

a) Inventory hydrologic and legal datasets.

b) Inventory and describe existing tools and analyses.

c) Create a web-based geographical database and library.

d) Develop a Hydrogeologic Conceptual Model (HCM), that includes:
    i. Boundary conditions for all flow and no-flow boundaries
    ii. Faults and geologic structure within the model
    iii. Alluvial and carbonate layer features
    iv. Known pumping well locations
    v. Groundwater budget

e) Describe Moapa dace habitat requirements quantitatively.

f) Identify data gaps.

g) Develop triggers, thresholds, and action items based on goals and objectives provided by the Management Group.

3.2 Phased Approach to Developing a Sustainable Groundwater Management Plan

Development of a groundwater sustainability plan requires both a set-up phase and an iterative phase. The set-up phase has several structural elements including research, data collection, stakeholder involvement, management objectives, potential management actions, predictive models, and monitoring plans. The iterative phase uses these elements in an ongoing cycle of learning about system structure and function, and managing based on what is learned[17].

3.2.1 Set-up Phase

The Set-Up Phase identifies goals and established constraints that dictate the process for meeting sustainability goals.

1) Identify Issues and Constraints – this step involves researching issues, assessing (and determining gaps in) resource inventories, and compiling a list of problems and opportunities. The desired outcome: understanding of the water resource issues influencing the six-basin area.

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[17] Thomas, 2004 and 2009; Williams et al., 2009

2) Assess Water Resource Conditions – Inventory historical and existing datasets that describe hydrologic, geologic, and legal resources.

3) Assess Biological Resource Conditions – Inventory historical and existing datasets that describe biological resources in the basin, specifically with respect to Moapa dace habitat.

4) Establish Common Goals – This step involves development of the Goals and Objectives for managing the resources in the six-basin area. The desired outcome: shared vision for water and biological resources management and a commitment to the vision and goals.

5) Set Objectives and Milestones This step involves the stakeholders reexamining the information from Step 1 relative to the shared vision and goals developed in Step 3, determining the conditions necessary to support those goals based upon information gleaned from studies and plans, setting and prioritizing objectives to achieve the goals, developing a goal maintenance system to keep the plan on track, and developing shared strategies for meeting the sustainability goals and objectives.

6) Document Hypotheses/Assumptions for system behavior, establish monitoring and experimentation programs at various scales, establish a modeling program, and set policy and a review cycle for a "lessons learned" process. The desired outcomes: understanding of system dynamics, establishment of modeling, monitoring, and experimentation programs guided by hypotheses about system behavior, and a foundation to promote institutional learning.

7) Develop a Groundwater Sustainability Plan – This step involves simulating or testing various management scenarios, using available models and tools to determine when and if action is needed. Based on this process, the stakeholders would develop possible actions within political, economic, regulatory, water rights, and biological contexts, and develop a course of action for future management.

SET-UP PHASE

- Organize Stakeholders
- Assess Resources
- Establish Goals and Objectives
- Set Milestones
- Document Hypotheses
- Develop a Sustainable Groundwater Management Plan

3.2.2 Iterative Phase

Following completion of the Set-up Phase, the stakeholders would supervise adaptive management of water resources in an annual Iterative Phase wherein data are collected while water resource management operations are occurring. Monitoring and assessment of data would be relied upon to determine whether goals established in the Set-up phase are being met. The iterative phase includes the following steps:

1) Implement Course of Action – This step involves performing management activities to implement sustainability goals. Desired outcomes include measurable actions that support program objectives.

2) Monitor - This step involves monitoring and data collection designed to test hypotheses and assumptions about the system's water and biological resources. Desired outcomes include an updated dataset to support analysis, evaluation and the lessons learned process.

3) Analyze Data – This step involves the Technical Committee tabulating data, comparing monitoring and experiment results to hypotheses and models, revising or generating new hypotheses as appropriate, and evaluating the validity of the monitoring and experimentation. The outcomes of this step include collection and review of data, validation and updating of monitoring and experimentation programs, and an enhanced understanding of system dynamics.

4) Evaluate Progress – This step involves the Management Group reviewing the analysis of monitoring and experiment results, evaluating appropriateness of metrics, discussing various interpretations of the data, assumptions and models, and publishing lessons learned. This step also entails charting progress toward meeting objectives and goals, and amending objectives, goals, and strategies as necessary. The desired outcomes include an enhanced understanding of system dynamics, critical examination of monitoring and experimental programs, and measurable progress toward goals and objectives.

5) Adjust Actions – This step entails revising management actions based on lessons learned in order to achieve the goals and objectives.

6) Update the Set-up Phase – In this step the Management Group re-initiates the steps within the Set-up Phase in a streamlined fashion in order to reset what is known about the system and what has been learned as a result of the previous cycle's operations and evaluation of monitoring results. A new set of management operations is developed for the ensuing year.

7) The Iterative Phase is progressive, with each step flowing from a previous one. From time to time, the Management Group will reexamine and update this process to improve the effectiveness of the Sustainable Groundwater Management Plan.

ITERATIVE PHASE

- Implement
- Monitor
- Evaluate
- Assess and Adjust

3.3 Sustainable Groundwater Management Plan Schedule

The time-frame required to develop a groundwater sustainability plan relies on participation and dedication by each stakeholder. The set-up phase is mostly technical in nature and relies on the Technical Committee to provide science based results using the best available data. The following is a potential schedule for completing the set-up phase required to support a sustainable groundwater management plan.

MANAGEMENT GROUP TASKS AND SCHEDULE FOR SET-UP PHASE

Set-Up Phase	Deadline
1. Form Management Group and Assign Technical Members	To Be Determined
2. Identify Initial Technical Tasks	To Be Determined
3. Establish Common Goals	To Be Determined
4. Adopt Triggers and Thresholds	To Be Determined
5. Adopt Sustainability Plan	To Be Determined

TECHNICAL COMMITTEE TASKS AND SCHEDULE FOR SET-UP PHASE

Set-Up Phase	Example Tasks/Datasets	Estimated Deadline (or to be agreed upon)
1. Data Inventory	Geology, Groundwater, Surface water, Climate, Biology, Water Rights, Documents	To Be Determined
2. Hydrologic Tools Inventory	Aquifer Tests, geophysics, analytical and numerical models	To Be Determined
3. Create Website	Post data/documents for Stakeholder Review	To Be Determined
4. Develop HCM	Recharge, discharge, boundary conditions, budget	To Be Determined
5. Identify Data Gaps	Hydrologic, Biologic, and Legal	To Be Determined
6. Develop Triggers and Thresholds	Hydrologic, Biologic, and Legal	To Be Determined
7. Identify Monitoring Requirement	Hydrologic, Biologic, and Legal	To Be Determined
8. Draft Sustainability Plan	Pumping, Action Items, Monitoring	To Be Determined

Completion of the Set-Up phase will allow for development of a Sustainable Groundwater Management Plan and implementation of the Iterative phase of adaptive management. Using available data and hydrologic tools, including a conceptual hydrogeologic model, a Sustainable Groundwater Management Plan could be developed. While setting up such a plan would rely on the use of existing data and tools, on-going studies and investigations will support and improve the plan over time. A numerical, hydrogeologic model would be a valuable tool to develop as part of the Iterative Phase of the Sustainable Groundwater Management Plan. A model would work in parallel with data collection and conceptual understanding of basin dynamics to refine thresholds and triggers. Model development would be completed collaboratively by the Technical Committee, with input from the USGS as objective technical experts.

3.4 Combined Water Right Administration (Order) and Sustainable Groundwater Management Plan

The purpose of this framework document is to establish a link between administration of water rights and a groundwater sustainability plan. The outline for the Sustainable Groundwater Management Plan Schedule in Section 3.3 includes a time-line for the technical development of a plan, but does not incorporate policy and administrative actions required for implementation and enforcement. The following section describes how groundwater sustainability can work concurrently with administration of water rights in the six-basin area.

Adopt a temporary order that:

1. Establishes a Sustainable Groundwater Management Group (SGMG) tasked with the purpose of concurrently managing the sustainable yield of the six-basin area and the administration of water rights.
2. Assigns the State Engineer as the leader of the SGMG and includes representatives from SNWA, MVWD, DOI (including FWS and USGS), MBOP, and CSI.
3. Recognizes the existing 2006 MOU as an initial set of Triggers, Thresholds, and Action Items used to protect existing water rights holders and the Moapa dace.
4. Allows for valid water right holders to exercise their rights given the understanding that those rights will be managed under the Plan.
5. Tasks the SGMG with developing a Sustainable Groundwater Management Plan that includes adaptive management techniques.
6. Tasks the SGMG with developing, as part of the Sustainable Groundwater Management Plan, appropriate reporting intervals, milestones, and activities that the group will undertake.

4.0 Conclusions and Recommendations

The LWRFS presents a unique opportunity to combine sustainable groundwater management with the administration of water rights in order to protect existing water rights and endangered species. The adaptive management process, as integrated into a Sustainable Groundwater Management Plan, provides a way to clarify, define, and evaluate important goals and objectives for the basin, all done collaboratively through stakeholder groups. Existing information on the basin's water and biological resources, including the 2006 MOU, may serve as a starting point to identifying the goals, metrics, thresholds and data that will best serve the basin moving forward. Development of a Sustainable Groundwater Management Plan would expand understanding of basin dynamics and allow basin goals to be met with best-available technical information.

The September 19, 2018 Draft Order fails to identify the process of how technical understanding will be incorporated in the administration of water rights. The process outlined in this concept paper provides a step-wise process for incorporating technical knowledge and adaptive techniques to maximize the State's resources. Instead of setting a maximum pumping limit based on an arbitrary time period[18], the process outlined above allows for technical experts to provide peer-reviewed analysis in a transparent process.

Development of technical knowledge through the formation of a Sustainable Groundwater Management Group, led by the State Engineer, will put the burden of managing the basin on the stakeholders. Different than other Monitoring, Management, and Mitigation (3M) plans implemented or proposed by SNWA in other parts of Nevada, the methodology proposed in this concept paper will be used to protect valid water rights holders by incorporating the administrative and technical steps. While the stakeholders would be responsible for developing technical knowledge, the State Engineer participation will incorporate administrative oversight to assure the State's resources are being managed according to state statutes.

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[18] Recent 3-year pumping limit specified in Draft Order.

COYOTE SPRINGS LAND

June 13, 2019

RECEIVED
2019 JUN 13 AM 9:25
STATE ENGINEERS OFFICE

Via Hand Delivery
Mr. Tim Wilson, PE
Acting State Engineer
Department of Conservation and Natural Resources
Division of Water Resources
901 South Stewart Street, Suite 2002
Carson City, Nevada 89701-5250

Re: Submittal pursuant to Nevada State Engineer Interim Order 1303

Dear Mr. Wilson:

Enclosed are two documents:

1. Technical Report 053119.0 dated May 31, 2019 issued by Stetson Engineers, Inc.

2. MYLAR set of the Large Lot Coyote Springs – Village A map

Pursuant to Section VI.5.b. of Nevada State Engineer Interim Order 1303, accompanying this letter is Coyote Springs Nevada LLC's ("CS Nevada") submission of a Technical Report dated May 31, 2019 by Stetson Engineers, Inc. that shows "an adequate and sustainable supply of water to meet the anticipated life of the subdivision" in support of the Large Lot Coyote Springs – Village A map submitted for your signature.

This submittal is also in furtherance of your office's conditional approval of the Large Lot Coyote Springs – Village A map pursuant to Mr. Mark Sivazlian's September 7, 2018 correspondence regarding "Tentative Subdivision Review No. 13216-T Permit None".

The attached Technical Report from Stetson Engineers, Inc. fully satisfies the condition set forth in Interim Order 1303. Interim Order 1303 requires that we first submit these items to you for review and signature.

Therefore, we request that your office sign the attached MYLAR MAP, verifying water quantity of 2000 afa (from permitted/certificated water rights held by Coyote Springs Investment LLC ("CSI") and/or the Clark County Coyote Springs Water Resources General Improvement District

("Coyote Water GID")) for Village A, and we will then submit it to the Coyote Water GID for their review and signature.

This request does not constitute a waiver of our rights to petition for administrative and judicial reviews of matters pertaining to our water rights.

The 2000 afa noted above is for the build-out of the eight large parcels (Lots 1-8) of Village A. Village A municipal water uses include single-family, multi-family, institutional, recreational, commercial, and resort. Each of the eight large parcels is subject to further subdivision using a portion of the 2000 afa to be committed under Village A.

The 2000 afa is well under what the Technical Report determined to be a sustainable supply of at least 4000 afa, and is well within the range of continuous pumping (post-1169 Pumping Test) by CSI and CS Nevada, which has had no demonstrated negative impact downstream. The State Engineer receives all relevant reports and is therefore aware that groundwater levels and spring flows remain flat in spite of CSI's and CS Nevada's continuous pumping.

In summary, at least 2000 afa within Coyote Spring Valley Basin can be committed now for subdivisions while studies, reports, and hearings are finalized and occur, as the case may be, to determine any additional water supply available to the Coyote Springs Master Planned Community above this initial 2000 afa.

Thank you.

Sincerely,

Emilia K. Cargill
Chief Operating Officer
Senior Vice President & General Counsel

cc, with full enclosures: Las Vegas office of State Engineer

vtn

LETTER OF TRANSMITTAL

TO: Division of Water Resources
400 Shadow Lane, Suite 201
Las Vegas, NV 89106

DATE: 6/13/2019

PROJECT: Coyote Springs Village A Final Map

ATTN:

W.O. NO.: 7720

BY MAIL: ☐ BY MESSENGER: ☐ PICK-UP: ☐ EXPRESS MAIL: ☐
FAX: ☐ FEDERAL EXPRESS: ☐

No. Copies:	Description
1	Technical Report 053119.0
1	Set of Coyote Springs Village A Final Map

COMMENTS:

DCNR/DWR/SNBO
RECEIVED
JUN 13 2019

MATERIAL SENT FOR THE FOLLOWING REASONS:

CHECKING: ☐ FILING: ☐ APPROVAL: ☒ YOUR FILES: ☐
OTHER: ☐ CC:

SENDER: Kayla Cassella

ABOVE MATERIAL RECEIVED BY:

2727 SOUTH RAINBOW BOULEVARD LAS VEGAS, NEVADA 89146-5148
TEL.: (702) 873-7550 FAX: 362-2597

TECHNICAL REPORT 053119.0

STETSON
ENGINEERS INC.
785 Grand Ave, Suite 202, Carlsbad, California 92008
TEL: (760) 730-0701 FAX: (415) 457-1638 e-mail: stever@stetsonengineers.com

TO: Coyote Springs Investment, LLC (CSI) DATE: May 31, 2019

FROM: Stetson Engineers Inc. JOB NO: 2674

RE: Adequate and Sustainable Groundwater in Coyote Spring Valley Available to Support Coyote Springs Nevada LLC's Subdivision Maps

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REGISTERED PROFESSIONAL ENGINEER
STEPHEN B. REICH
No. C58713
Exp. 12/20
CIVIL
STATE OF CALIFORNIA

PROFESSIONAL GEOLOGIST
STEPHEN B. REICH
No. 9712
EXP. 9/19
STATE OF CALIFORNIA

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FIGURES

APPENDICES

1.0 INTRODUCTION

The purpose of this Technical Report is to address water sufficiency for the build-out of Coyote Springs Nevada, LLC's (CS Nevada) Village A, including the Large Lot Final Map of Coyote Springs Village A (Tentative Map File Number TM 18-500081. 8 Lots) and Tentative Map - Coyote Springs Village A Parcels A-D (TM 18-500105. 575 Single-Family Residential Lots) maps (Hereinafter referred to as "initial subdivision maps"). The water required to support the build-out of Village A is approximately 2,000 acre-feet per year (AFY). The water required for the development identified within the initial subdivision maps is 425 AFY. Although final reports regarding water availability within the Joint Administrative Unit[1], as defined by the Nevada State Engineer's (NSE) Interim Order 1303, are not due until July 3, 2019, this Technical Report addresses the water sufficiency related to supporting the initial subdivision maps and the build-out of Village A. Based on technical hydrologic and hydrogeologic analyses that rely on both new and existing data, an "adequate and sustainable" supply of groundwater exists to support the build-out of Village A, which includes the initial subdivision maps.

Interim Order 1303 paragraph VI.5(b) placed a temporary moratorium on subdivision maps associated with development and construction as stated below:

> *"A temporary moratorium is issued regarding any final subdivision or other submission concerning development and construction submitted to the State Engineer for review, and such submissions shall be held in abeyance pending the conclusion of the public process to determine the total quantity of groundwater that may be developed within the Lower White River Flow System……."*

Paragraph VI.5(b), as well as the remainder of Interim Order 1303, limits development of existing water rights in the Joint Administrative Unit to beneficial uses other than development and construction. While holders of legal water rights with beneficial uses other[2] than municipal are allowed to exercise their rights for the duration of Interim Order 1303, the NSE places a specific requirement on legal water right holders that choose to exercise their rights for development and construction in the remainder of paragraph VI.5(b):

> *"…. The State Engineer may review and grant approval of a subdivision or other submission if a showing of an adequate and sustainable supply of water to meet the*

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[1] The NSE's Joint Administrative Unit includes: Coyote Spring Valley Hydrographic Basin (210), A Portion of Black Mountains Area (Basin 215), Garnet Valley (Basin 216), Hidden Valley (Basin 217), California Wash (Basin 218), and Muddy River Springs Area (A.K.A. Upper Moapa Valley) (Basin 219).

[2] Examples of other beneficial uses include: Irrigation, recreation, stockwatering, wildlife, mining, milling, power generation, domestic, and other.

anticipated life of the subdivision, other construction or development can be made to the State Engineer's satisfaction."

Existing and new data that show water sufficiency for the CS Nevada's subdivision maps are presented in this Technical Report for the NSE's review. Because the State Engineer will not determine the final amount of water available in the Joint Administrative Unit until sometime in late 2019 or early 2020, based on the completion of the July 3, 2019 reports, associated rebuttal reports, and administrative hearings, this Technical Report is intended to only address the water required to support the build-out of Village A .

The analyses included in this Technical Report build upon Stetson Engineers' December 13, 2018 Technical Memorandum 121318.0 to the Nevada State Engineer regarding Recent Hydrologic, Geologic, and Climatic Data to Consider to Support Administrative Management of the Lower White River Flow System (LWRFS) (Appendix A). Additionally, CS Nevada employed Zonge Engineering in April 2019 to perform an electrical geophysical survey of the middle portion of the Coyote Spring Valley. Results from this survey identify the locations of faults that act both as barriers and conduits to groundwater flow. Finally, the geologic maps and cross-sections of the area have been updated and presented in this Technical Report based on the completion of the 2017 Nevada Bureau of Mines and Geology Report 56 (NBMG Report 56), Geology and Geophysics of White Pine and Lincoln Counties, Nevada and Adjacent Parts of Nevada and Utah: The Geologic Framework of Regional Groundwater Flow Systems.

The April 2019 geophysical survey of Coyote Spring Valley, the NBMG Report 56, and additional previously existing data represent data that have not been considered by the State Engineer. Combined for your review, the new survey, report, and data show that "an adequate and sustainable supply of water" exists in the Coyote Spring Valley to support not only the initial subdivision maps that is the subject of your review, but all of Village A. Preferred groundwater flow paths, separated by fault-bounded carbonate rock, effectively isolate portions of groundwater within Coyote Spring Valley from the Muddy River Springs Area. As supported by the analyses and data contained in this Technical Report, CSI production wells 1, 3, and 4 are located within a preferred flow path on the west side of Coyote Spring Valley that is effectively isolated from the portion of regional groundwater flow that supports the Muddy River Springs Area. The total flow through Coyote Spring Valley, supported by local recharge and regional groundwater flow in excess of 54,000 AFY, provides an adequate and sustainable supply of water to meet the needs of Village A.

2.0 ORDER 1169 AQUIFER TEST AND SUBSEQUENT RULINGS

After reviewing aquifer test reports resulting from Order 1169 (March 8, 2002) and Order 1169A (December 21, 2012), the NSE issued Ruling #6255 on January 29, 2014. NSE's Order 1169 placed new applications for appropriation of water from Coyote Spring Valley, Black Mountains Area, Garnet Valley, Hidden Valley, Muddy River Springs Area, and Lower Moapa Valley (collectively termed Order 1169 Basins) in abeyance until the aquifer test was completed. NSE Order 1169A stated that the aquifer test was completed as of December 31, 2012 and the parties had until June 28, 2013 to file reports based on the test data[3]. Subsequently, aquifer test reports were submitted by Southern Nevada Water Authority (SNWA), CSI, U.S. Department of Interior (DOI), Moapa Band of Paiute Indians (MBOP), Moapa Valley Water District (MVWD), Great Basin Water Network (GBWN), and the Center for Biological Diversity (CBD).

After reviewing the pumping test reports, Ruling 6255 upheld the protests to applications for new appropriations in Order 1169 Basins, denying new applications based on the grounds that there is no unappropriated water, and that they would conflict with existing water rights. Ruling 6255 also addressed perennial yield and found that the scientific literature supported that the Coyote Spring Valley, Muddy River Springs Area, Hidden Valley, Garnet Valley and California Wash basins should be jointly managed[4]. Ruling 6255 did not determine the perennial yield of Coyote Spring Valley, but instead indicated that the total supply to the Order 1169 Basins is likely less than 50,000 AFY[5].

The information contained in the Order 1169 aquifer test reports by SNWA, CSI, DOI, MBOP, MVWD, GBWN, and CBD did not adequately present all the existing information to allow for the NSE to make an informed decision regarding the availability and sufficiency of water in what would become the Joint Administrative Unit. These reports were not unanimous in whether water was captured from storage or recharge, the effects of climate, or the impacts of geologic structure, among other differences.

The SNWA Study Report (SNWA, 2013) found that there is a lack of pumping responses north of the Kane Springs Fault, in an area north of the MX-5 pumping site. The MBOP Order 1169 Study (MBOP, 2013) observed that declines in groundwater levels during the test period were affected by local and regional climate, atmospheric pressure, tides, and crustal loading phenomena. Additionally, the MBOP Study concluded that the pumping response from groundwater pumped at MX-5 is dominated by boundary conditions, not groundwater storage[6].

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[3] Order 1169A also rescinded provision 8 of Order 1169 that required an update to Exhibit No. 54 from the July 2001 hearing.

[4] Ruling 6255, para V, page 26.

[5] Ibid.

[6] MBOP Order 1169 Study, page 32 (Mifflin and Associates, June 28, 2013).

The DOI Study (DOI, 2013) found that water captured during the test was likely from groundwater storage, and only a fraction was from natural discharge[7]; but their conclusion was based on an average 1.4-foot decline over the entire study area due to pumping without consideration of climate variability. The DOI report specifically stated: "Likewise, no corrections have been made for longer-term (regional) trends in groundwater levels given continued uncertainties concerning the availability of a 'reference' well that can be used to make such corrections." [8]

The GBWN Study (GBWN, 2013) found that "groundwater levels for all wells have been decreasing since the mid-1990s with some recovery due to wet conditions from 2004 to 2005. During the 2010 to 2012 pump test period the rate of decline in carbonate wells increased."[9] Data provided in their report indicates that groundwater levels in the carbonate aquifer[10] and spring discharge at Pederson[11] increased following the 2005 wet year event. While the GBWN Study discusses that "After 2005 the region primarily returned to drought conditions. The late 1990s were among the wettest years since 1980 (Mayer and Congdon 2008)"[12], it does not differentiate the impacts caused by Order 1169 pumping, other pumping in the five-basin area, and climatic conditions. Additional groundwater, spring, and climatic data would be required to assess how the carbonate aquifer and springs respond to prolonged wet and dry cycles.

Important factors that affect the availability of water in the Joint Administrative Unit area, which have become apparent since the submission of the Order 1169 Aquifer Test Reports in June of 2013, include: (1) the impact of long-term climatic cycles on regional groundwater levels; (2) regional geology and groundwater flow; (3) local structural and sedimentary geology; and (4) the effect of near-by pumping on springs in the Muddy River Springs Area (MRSA). These factors, as well as others, affect the determination of available water, as well as the availability of water to meet the demands of decreed Muddy River water rights and the Mopa dace.

Review of the climatic and hydrogeologic data collected after the submission of the Order 1169 reports (2013 through 2018), including results from analytical models, show that stresses other than Order 1169 pumping in Coyote Spring Valley influenced water availability and streamflow in the MRSA. This Technical Report presents the factors affecting the occurrence and movement of groundwater in the LWRFS for your consideration.

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[7] Ibid, page 31.
[8] Ibid, page 9.
[9] GBWN, 2013. Section: Muddy River Springs Area
[10] Ibid, Figure 13
[11] Ibid, Figure 17
[12] Ibid, Section: Discussion of Pumpage, Groundwater Levels and Spring Discharges.

3.0 GEOLOGIC HISTORY AND STRUCTURE

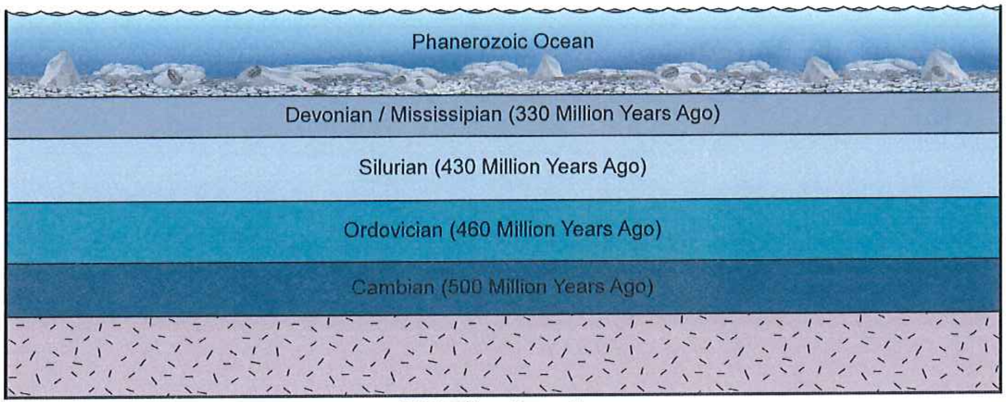
The purpose of this section is to describe the regional and local carbonate rock aquifer that contains developable water resources in eastern Nevada and western Utah. In general, groundwater moves parallel to faults, in a north-to-south direction, from the Upper White River Basin toward Lake Mead. Local recharge from rainfall and snowmelt supports water development in each basin and may contribute to regional groundwater flow. Discharge from the aquifer occurs as a result of groundwater production, discharge to streams and springs, interbasin groundwater flow, and loss to evapotranspiration (ET). The mechanisms that control groundwater flow throughout the entire carbonate rock province include structural geologic features, hydrogeologic properties, and natural and anthropogenic stresses.

3.1 Geologic History

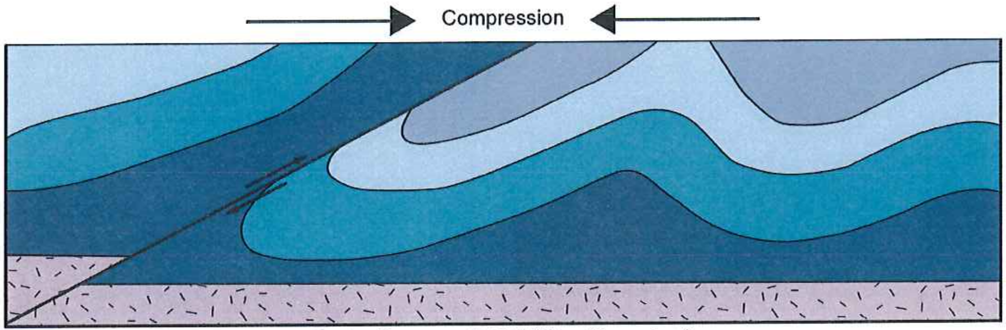
The geologic history of the eastern part of Nevada is characterized by rocks ranging from Precambrian sedimentary rocks to widespread Quaternary alluvial deposits (USGS, 2007). The geologic evolution of the study area since the end of Precambrian (650 million year ago (mya)) time may be subdivided into three general phases: (1) marine sediments deposited along a passive continental margin; (2) late Devonian to Eocene compressive deformation; and (3) middle to late Cenozoic extension, faulting, volcanism, and continental sedimentation (Levy and Christie-Blick, 1989). This sequence of sedimentation, compressive deformation, and extensional faulting establish the geologic framework that controls groundwater flow throughout eastern Nevada. Thus, any water-resource assessment of the area must consider the complex geologic history and consider the distribution of the diverse rock types and geologic environments.

Many studies have been performed by the USGS, DRI, SNWA, and others that describe the geologic history and framework in detail. The purpose of this section is to illustrate that the historical sequence of deposition and tectonic activity shows how geologic units and structure control the occurrence and movement of groundwater. The marine sediments that were deposited between 540 mya and 250 mya generally include carbonates, shales, and quartzites that form the aquifers which are the subject of this study. The formation of these sediments represents the transgression and regression of the sea over a broad continental shelf and is depicted in the upper cross-section of Figure 1.

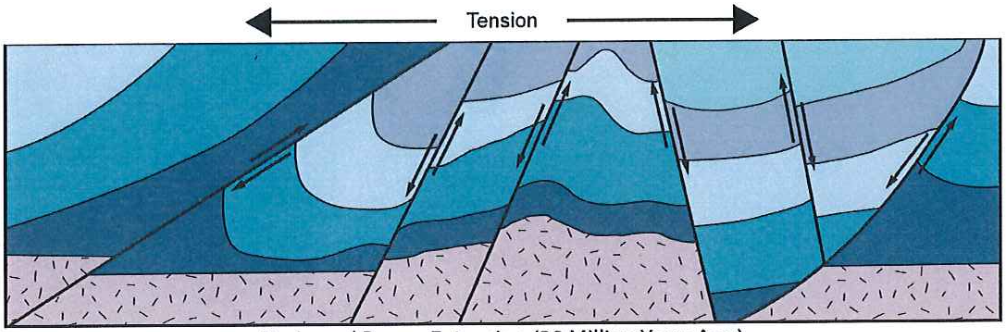
FIGURE 1



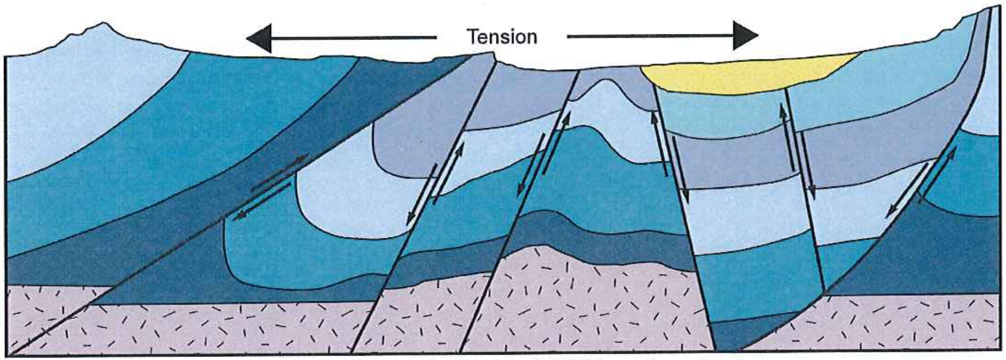
500 Million Years Ago



Sevier Orogeny (140 Million Years Ago)



Basin and Range Extension (20 Million Years Ago)



Basin and Range Extension (10 Million Years Ago)

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Conceptual Formation of Carbonate Aquifer in the Lower White River Flow System

Beginning at the end of the Devonian period (400 mya), compressional forces associated with the Antler Orogeny began to affect the northwest portion of eastern Nevada (Rowley et al., 2017). Later, around the Jurassic to early tertiary period (200 mya – 60 mya), structural compression associated with the Sevier Orogeny resulted in north- to north-northeast striking folds and thrust faults that are evident today throughout eastern and southeastern Nevada (Rowley et al., 2017). Finally, Basin and Range extension beginning about 20 mya formed the north striking basins and mountain ranges that characterize the Basin and Range province. The cross-sections shown in Figure 1 provide a generalized depiction of deposition, compressional folding, extensional faulting, and mountain building occurring from about 500 mya to the present.

The Sheep Range mountains, which are composed of carbonate rocks, form the western edge of Coyote Spring Valley. This range represents the leading edge of the Gass Peak thrust fault that was associated with the Sevier Orogeny (200 mya – 60 mya) (Rowley et al., 2017). The eastern boundary of Coyote Spring Valley is bounded by the Arrow Canyon Range to the south and the Meadow Valley Range to the north, both which were formed due to normal faulting associated with Basin and Range extension. Additional normal faults associated with Basin and Range extension are present between the two ranges (Rowley et al., 2017). A generalized geologic depiction of Coyote Spring Valley based on Rowley et al. (2017) is shown in Figure 2. The prominent geologic features of Coyote Spring Valley include the north- to north-northeast trending faults and the thick sequence of carbonate rocks.

3.2 Impact of Structural Features and Faults on Groundwater Flow

Based on the most recent study by Rowley et al., (2017), "Basin and Range extension controls groundwater flow", groundwater flow generally occurs along rock fractures associated with normal faults (extensional), while flow across faults is retarded. Rowley et al. (2017) further explain that extensional faulting is more important to groundwater flow, since these types of faults tend to stay open compared to compressional faults (i.e. Gass Peak Thrust) that do not result in open fractures for groundwater flow. Thus, identifying the locations of normal faults is a primary target for describing groundwater flow in the carbonate rock province.

There are numerous north- to north-northeast trending extensional normal faults within Coyote Spring Valley and the entire Joint Administrative Unit that act to control the occurrence and movement of groundwater. While some of these faults tend to convey groundwater parallel to the fault, they also act to impede water flow perpendicular to the strike of the fault. The impact of these faults is described in the various sections below, which detail the relative connection between pumping wells, observation wells, and springs throughout the study area.

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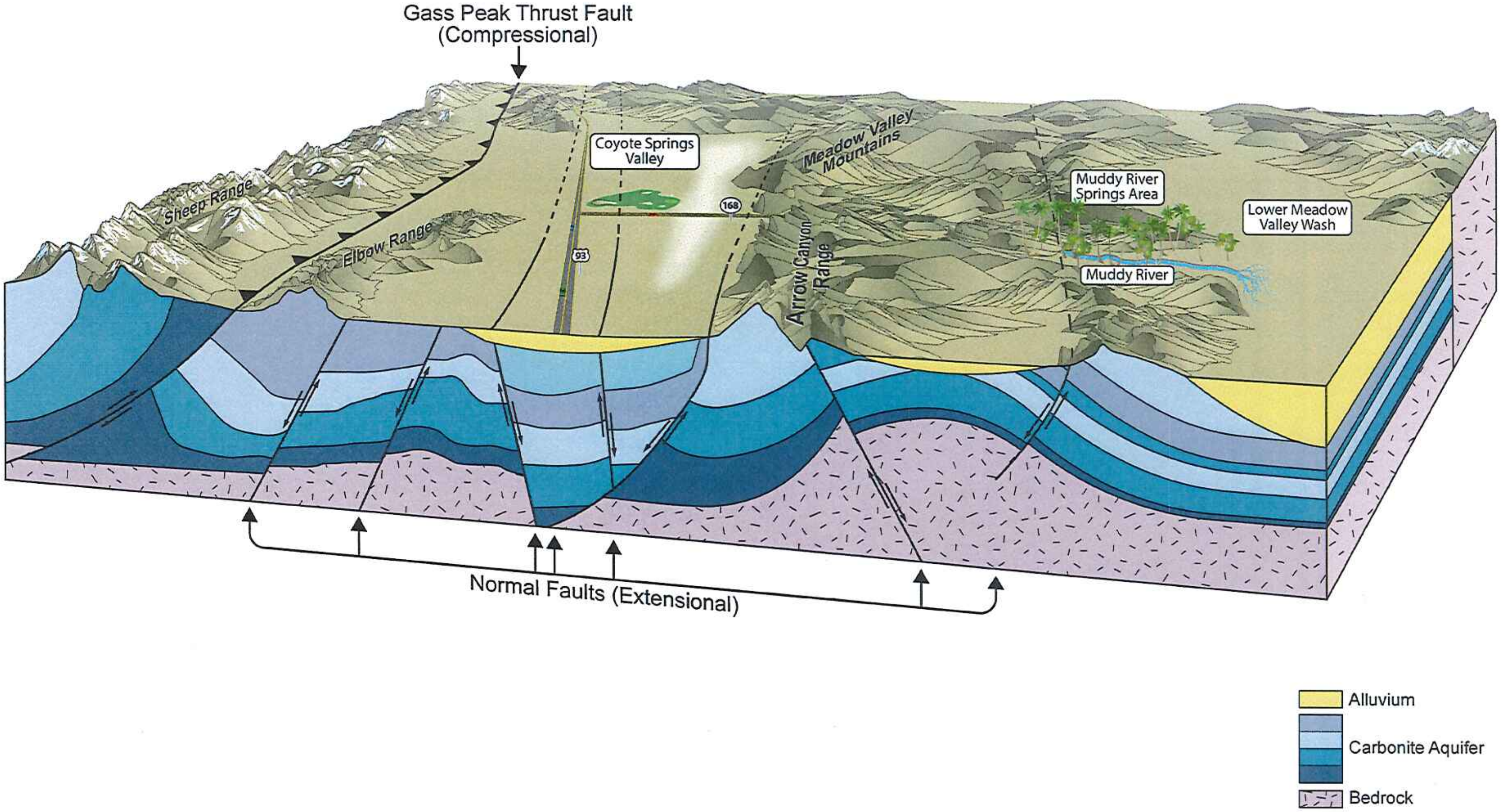

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Conceptual Geologic Cross-Section of Coyote Spring Valley and Muddy River Springs Area

FIGURE 2

3.3 Regional and Local Geologic Maps

The most recent geologic map of eastern Nevada developed by Rowley et. al (2017) is presented in Figure 3. The extent of the map reaches southern Elko, eastern Nye, White Pine, Lincoln, and Clark Counties. Generalized geologic maps of the Colorado River Flow system and the Lower White River Flow System are shown in Figures 4 and 5, respectively. The drainage basins included in the Colorado River Flow system have been adjusted from the NSE's inventory of basins for this area to account for interbasin groundwater flow from basins outside the NSE's surface boundary delineation (Figure 4). Additionally, individual geologic units have been generalized into basement, carbonate, volcanic, or basin fill units in order to better depict the aquifers that are the subject of this investigation (see Appendix B). The general geology in Coyote Spring Valley and surrounding basins is provided in Figure 5.

3.4 April 2019 Geophysical Investigation

Major faults within Coyote Spring Valley are based on Rowley et al. (2017) and a Controlled Source Audio-frequency Magnetotellurics (CSAMT) survey performed by CS Nevada in April 2019. A CSAMT survey transmits electrical signals into the ground through a 3,000- to 5,000-foot-long wire, grounded at each end, to control the electrical source. Electrical responses are then gathered at the receiver site located up to six miles away from the transmitter. These signals are then processed to determine the electrical resistivity of the geologic formations below the receiver site. By making measurements at numerous receiving stations along a line, a cross section of the earth's electrical resistivity properties can be produced, providing information about subsurface faults, fractures, geologic structures, mineralization, and groundwater. CS Nevada employed the CSAMT technique to assess the locations of normal (extensional) faults and structural blocks in Coyote Spring Valley to assess the preferred paths of groundwater flow.

The preliminary results of combining the generalized geologic map, known faults, and faults identified through the April 2019 CSAMT survey are shown in Figure 6. As previously discussed, groundwater generally moves parallel to normal (extensional) faults in the north-to-south direction. Groundwater flow in the west-to-east direction is impeded by the normal faults, except in areas where cross faults create a preferred pathway for groundwater flow. The Pahranagat wash area from Coyote Spring Valley to Muddy River Springs Area represents one of these areas where faulting between the two basins has resulted an area of high transmissivity for groundwater flow.

Review of the April 2019 CSAMT cross-sections in Appendix C shows a prominent carbonate block (blue color), bounded on either side by normal (extensional) faults. The carbonate block occurs between stations 8,900 and 11,500 on Line A and between stations 9,000 and 12,000 on Line B.

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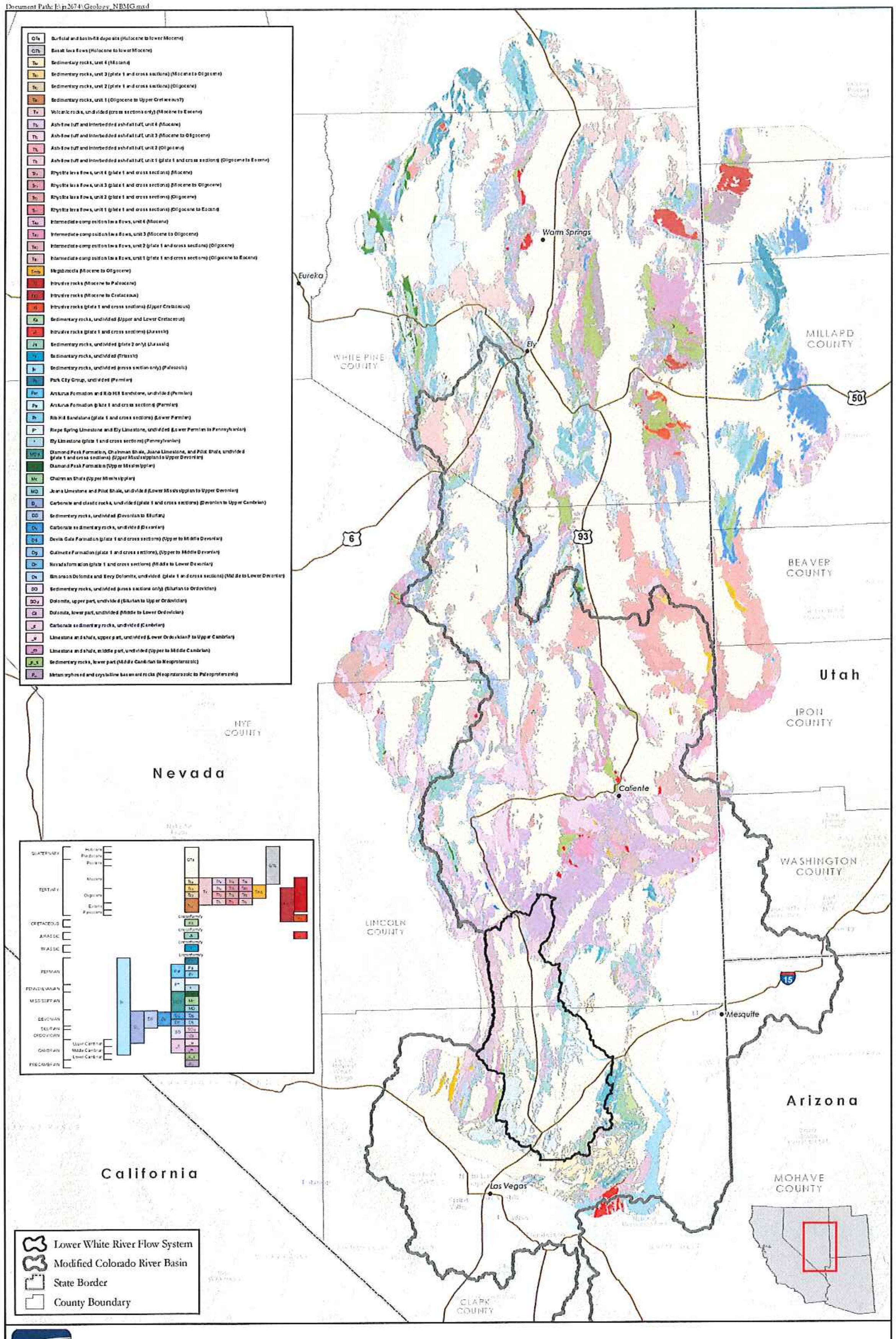

STETSON ENGINEERS INC.

REGIONAL GEOLOGIC MAP
COLORADO RIVER BASIN, NEVADA

Source: Modified from Rowley, et al; 2017

0 10 20 Miles

N

FIGURE 3

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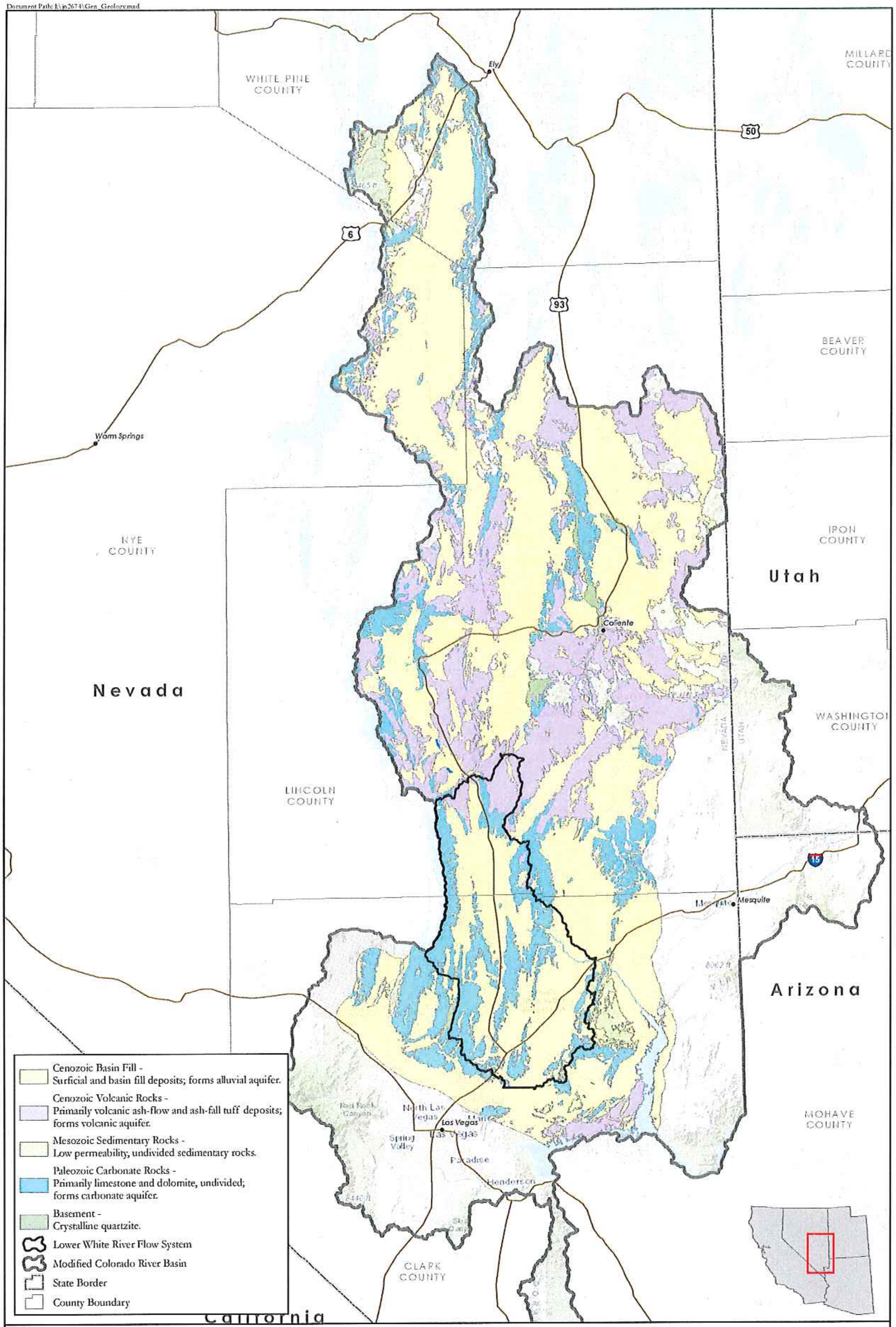


STETSON ENGINEERS INC.

GENERALIZED REGIONAL GEOLOGIC MAP
COLORADO RIVER BASIN, NEVADA

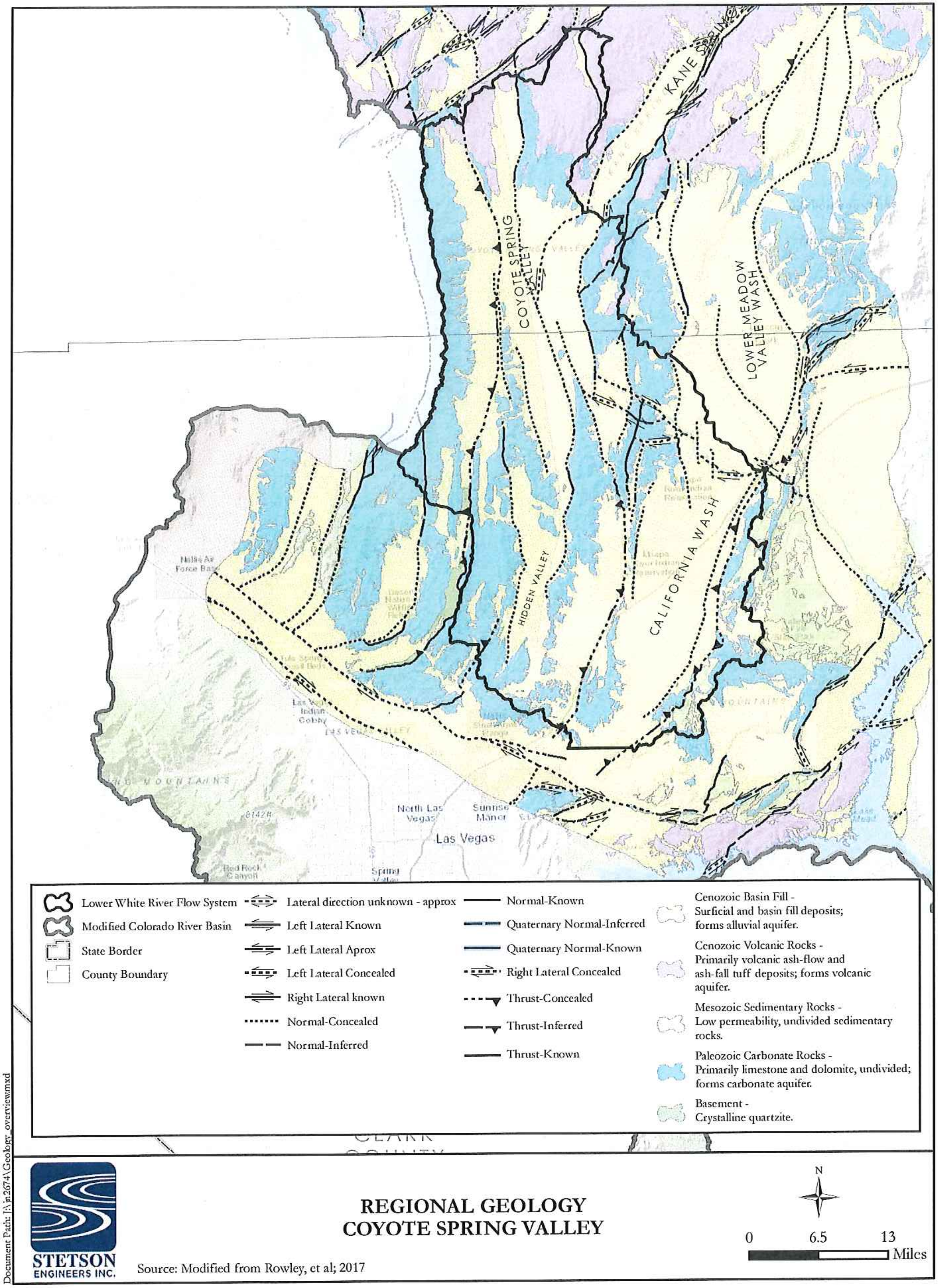
0 9.5 19 Miles

N

FIGURE 4

Source: Modified from Rowley, et al; 2017

FIGURE 5



REGIONAL GEOLOGY
COYOTE SPRING VALLEY

Source: Modified from Rowley, et al; 2017

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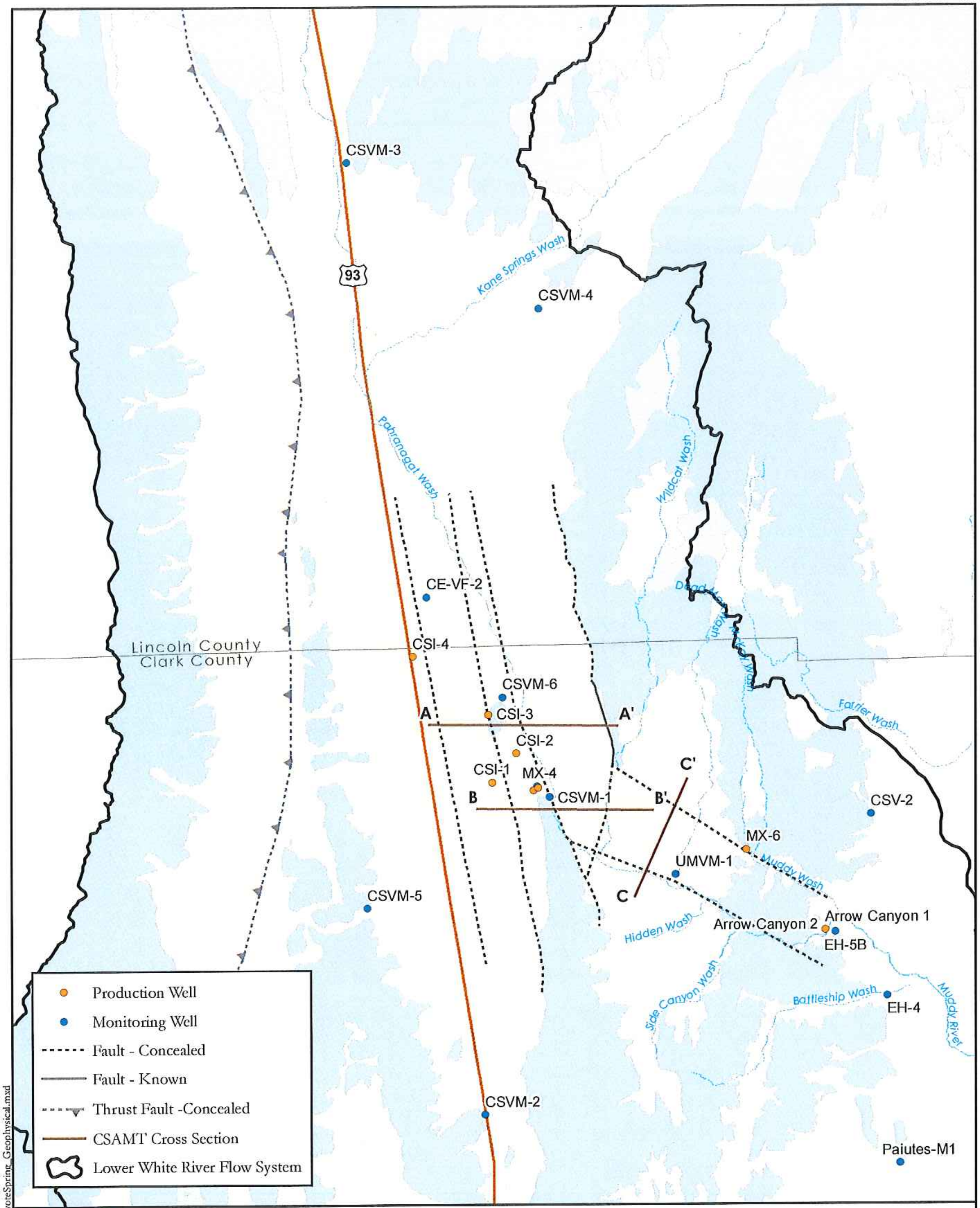
FIGURE 6



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FAULTS LOCATED BY APRIL 2019 CSAMT SURVEY
COYOTE SPRING VALLEY, NEVADA

Source: Modified from Rowley, et al; 2017
(See previous figure for geology legend)

N

0 2 4 Miles

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Production wells MX-5 and CSI-2 are located on the eastern side of the block, while production wells CSI-1, -3, and -4 are located on the western side of the block. The carbonate block effectively isolates the groundwater production wells on the east from those on the west. The block also results in a division of groundwater inflow to Coyote Spring Valley from Pahranagat, Delamar, and Kane Springs Valley. Interbasin groundwater outflow from Coyote Spring Valley is to both the Muddy River Springs Area and Hidden and Garnet Valleys. Furthermore, the carbonate block and normal faults isolate local recharge from the Sheep Range to the zone west of the carbonate block, such that it eliminates or limits contributions to interbasin groundwater flow to the Muddy River Springs Area.

4.0 REGIONAL AND LOCAL GROUNDWATER FLOW IN THE JOINT ADMINISTRATIVE UNIT

Groundwater flow through the carbonate aquifer in the Joint Administrative Unit originates from both regional and local sources. The regional source of groundwater flow is interbasin flow that originates approximately 200 miles to the north, at the head of the White River Flow System (Eakin, 1966). Additional precipitation and recharge falling in the Nevada's central eastern mountains recharges the regional carbonate aquifer that flows north-to-south, towards Las Vegas and Lake Mead. Local recharge occurs within many of the individual basins, along the bounding mountain ranges that define each basin's geographic boundary. Local recharge contributes to and supports groundwater production and evapotranspiration within that basin, as well as regional groundwater interbasin flow between adjacent basins.

Numerous studies have been performed to assess the quantity of local and regional groundwater flow in each of Nevada's basins. Reported estimates of local recharge to Coyote Spring Valley from the west bounding Sheep Range ranges from 2,500 AFY to 14,000 AFY[13]. Thomas et al. (2001) assessed local and regional flow in southeastern Nevada using a deuterium mass-balanced model and found regional inflow to Coyote Spring Valley was 50,000 AFY, of which Pahranagat Valley contributes 28,000 AFY, Delamar Valley contributes 16,000 AFY[14], and Kane Springs Valley contributes 6,000 AFY. Thomas et al. (2001) estimated local recharge to be 4,000 AFY. Published estimates of local recharge from the Arrow Canyon Range and Meadow Valley Mountains on the western side of Coyote Spring Valley were not available.

Pre-development outflow from Coyote Spring Valley was estimated based on reported and deuterium mass-balanced modeling (Thomas et al., 2001). Groundwater flow out of Coyote Spring Valley was split between flow to Muddy River Springs Area (37,000 AFY) and flow to Hidden and

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[13] Recent studies estimated to be 5,000 to 6,000 AFY by Kirk and Campana (1990) as cited in 2001 study; 4,000 AFY by Thomas et al. (2001); 14,000 AFY based on Thomas et al. (1996).

[14] Thomas and Mihevc, 2011, estimated outflow from Delamar Valley to be 24,900 AFY.

Garnet Valleys (16,000 AFY). Estimated ET in Coyote Spring Valley is 1,000 AFY. Groundwater flow to the Muddy River Springs Area was also supported by 32,000 AFY of flow from Lower Meadow Valley Wash to Lower Moapa. Groundwater flow out of Hidden and Garnet Valleys was toward the Black Mountains Area. The regional groundwater flow and local recharge in the vicinity of Coyote Spring Valley is shown graphically in Figure 7 and described in Table 1.

TABLE 1. PRE-DEVELOPMENT GROUNDWATER FLOW BUDGET FOR THE COYOTE SPRING VALLEY BASED ON DEUTERIUM MASS-BALANCED MODEL (THOMAS ET AL., 2001)

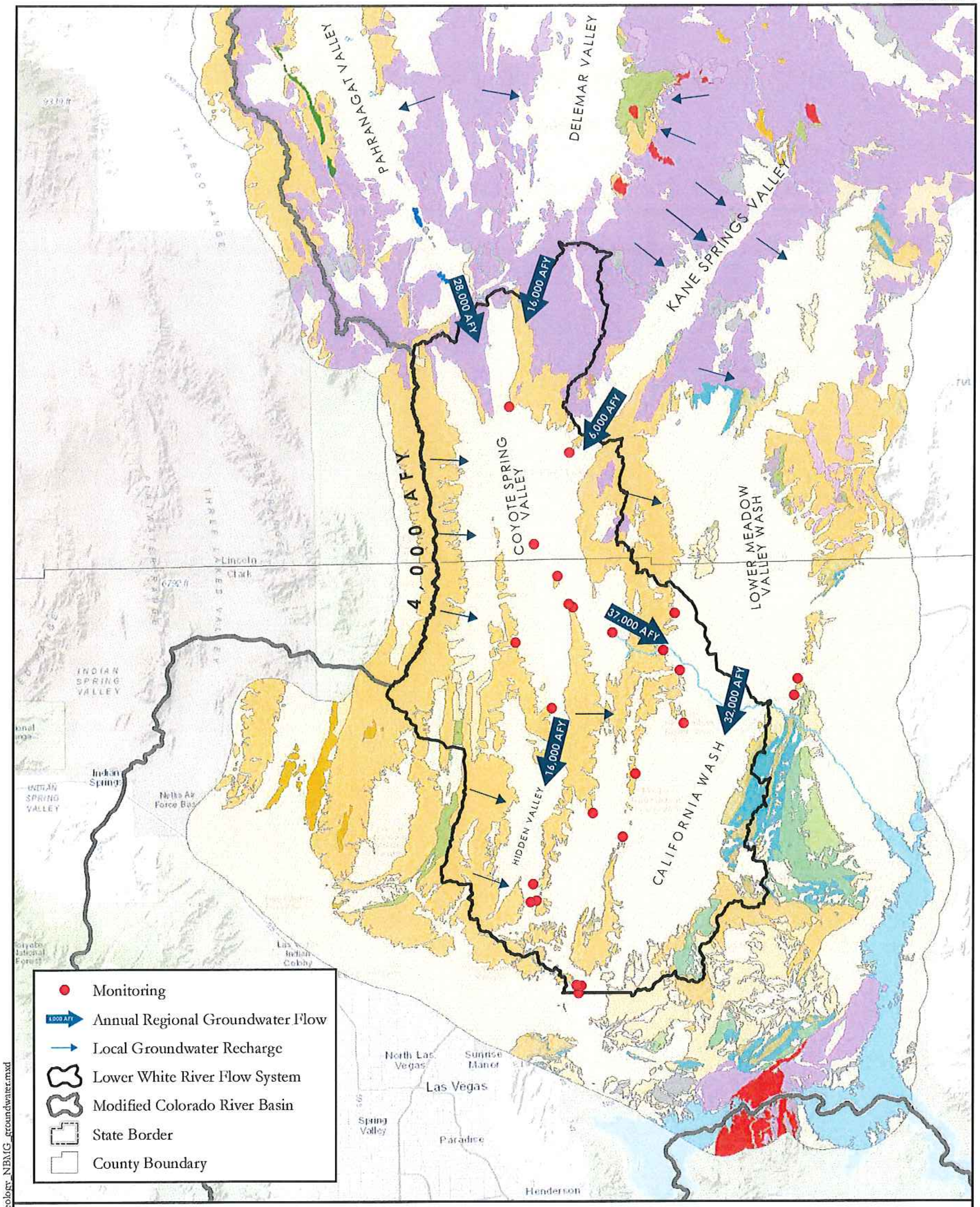
Flux Term	Annual Flux (AFY)
Inflow	
Pahranagat Valley	28,000
Delamar Valley	16,000
Kane Springs Valley	6,000
Local Recharge from Sheep Range	4,000
Local Recharge from east side of CSV[a]	Unknown
Total Inflow	54,000
Outflow	
Muddy River Springs Area	37,000
Hidden/Garnet Valley	16,000
Evapotranspiration	1,000
Total Outflow	54,000

Notes: Published estimates of local recharge to Coyote Spring Valley from Arrow Canyon Range and Meadow Valley Mountains were not available.

Groundwater outflow from Coyote Spring Valley towards Garnet and Hidden Valley eventually discharges toward Lake Mead and the Las Vegas Shear Zone, which is a prominent northwest-southeast trending feature that marks the end of the regional carbonate aquifer. In addition to local recharge and groundwater flow from California Wash, groundwater discharge may occur as evapotranspiration, spring discharge, or seepage along the northern boundary of Lake Mead and Las Vegas.

Local recharge to Coyote Spring Valley from the Sheep Range, which has been estimated to range from 2,500 AFY to 14,000 AFY, may be considered the perennial yield of Coyote Spring Valley. The perennial yield is more than an adequate and sustainable supply of water required to maintain steady-state groundwater conditions, avoid long-term depletion of the groundwater reservoir, and meet the 2,000 AFY water requirement for Village A.

FIGURE 7



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REGIONAL GROUNDWATER FLOW AND LOCAL RECHARGE IN THE COYOTE SPRING VALLEY

Source: Modified from Rowley, et al; 2017

N

0 6.5 13 Miles

5.0 GROUNDWATER-LEVEL RESPONSES

Groundwater-levels in the carbonate aquifer respond to changes in recharge and discharge fluxes that are due to long-term and short-term natural climatic variability and anthropogenic stresses. Long-term time periods characterized by wetter than normal climatic conditions will result in an increase in groundwater levels if discharge rates remain constant. When discharge rates from the aquifer vary and recharge remains constant, groundwater levels will increase when discharge is reduced and decrease when discharge increases. Short-term annual groundwater pumping is also reflected in the groundwater levels; as pumping rates increase during high summer demand, groundwater levels decrease. Review of groundwater level responses in monitoring wells located in both Muddy River Springs Area and the Coyote Spring Valley can be analyzed for impacts due to both long-term climatic variability and short-term changes in pumping rates.

Groundwater levels in the Muddy River Springs Area monitoring well EH-4 show a seasonal response to Muddy River Springs Area carbonate groundwater pumping; minimum groundwater levels occur in summer when pumping is at a maximum, while maximum levels occur in the winter when pumping is curtailed (bottom pane, Figure 8). When groundwater levels in EH-4 are compared to carbonate pumping in Coyote Spring Valley (top pane, Figure 8), there is no variation in the seasonal response pre-2005 and post-2005, when pumping in Coyote Spring Valley was initiated. What is most evident from the water level graph is the long-term climatic impact of drying from 1998 through 2004, wetting in 2004 and 2005, drying from 2006 through 2013, and stable water levels from 2013 through 2018.

Monitoring wells CSVM-1 (Figure 9), CSVM-6, and MX-4 (Appendix 4[15]) show a response during the Order 1169 aquifer test (upper pane, Figure 9), as well as a response to pumping in Muddy River Springs Area (lower pane, Figure 9). Similar to groundwater level responses in EH-4, a pumping signature from carbonate pumping in Muddy River Springs Area appears in CSVM-1, CSVM-6, and MX-4 prior to 2005 when groundwater pumping in Coyote Spring Valley began. The groundwater level data suggest hydraulic communication between Muddy River Springs Area and the eastern portion of Coyote Spring Valley. Also similar to EH-4, the long-term climatic variability from 1998 through 2018 results in increase and decreases in long-term trends of the groundwater level.

Coyote Spring Valley monitoring wells CSVM-2, -3, -4, -5 (Figure 10), and CE-VF-2 (Appendix 4) do not show a response to pumping that occurred in either Muddy River Springs Area or the eastern portion of Coyote Spring Valley. There was no response in these monitoring wells

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[15] See Appendix 4 supporting groundwater level graphs for: CE-VF-2, CSVM-1, CSVM-2, CSVM-3, CSVM-4, CSVM-5, CSVM-6, MX-4, EH-4, EH-5B, UMVM-1, and CSV-2.

from pumping at MX-5 during the Order 1169 aquifer test due to barriers to flow created by normal (extensional) faults that impede groundwater flow in the east-west direction, discussed in the above sections of this Technical Report. These monitoring wells are isolated from the eastern portion of Coyote Spring Valley by the normal faults and a structural carbonate block that act as barriers to flow, as evidenced by the lack of water level response.

Observations by SNWA in their June 2013 Order 1169 Test Report also noted the presence of flow barriers in the Coyote Spring Valley: "*Monitor wells CSVM-3 and CSVM-5 do not show any response due to pumping from the MX-5 and CSI 1-4 wells, strongly suggesting the presence of flow barriers between these wells and MX-5 rather than a delayed response...*".[16] The April 2019 CSAMT survey provides evidence to groundwater flow barriers and substantiates the observations made by SNWA in 2013. Normal faulting associated with the carbonate structural block act as a barrier to groundwater flow in the west to east direction.

Based on these observations, pumping in the western portion of Coyote Spring Valley would not impact groundwater levels on the eastern side of the valley[17]. Production wells CSI-1, -3, and -4, which are on the same side of the structural block as CSVM-2, -3, -4, -5, and CE-VF-2 monitoring wells, would be isolated from groundwater resources in the eastern portion of Coyote Spring Valley. Therefore, groundwater pumping in CSI-1, -3, and -4 will not cause impact to groundwater resources in the Muddy River Springs Area. Normal faults, as suggested by Rawley et al. (2017) and identified by the April 2019 CSAMT survey, act as barriers to groundwater flow in the west to east direction across the structural carbonate block bounded by the normal faults.

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[16] SNWA June 2013 Order 1169 Report, page 36.

[17] Information provided by MBOP at the April 22, 2019 pre-HRT meeting in Las Vegas discussed lack of water level response in CSI-3 during Order 1169 pumping.

Basin 219 - Muddy River Springs Area

EH-4

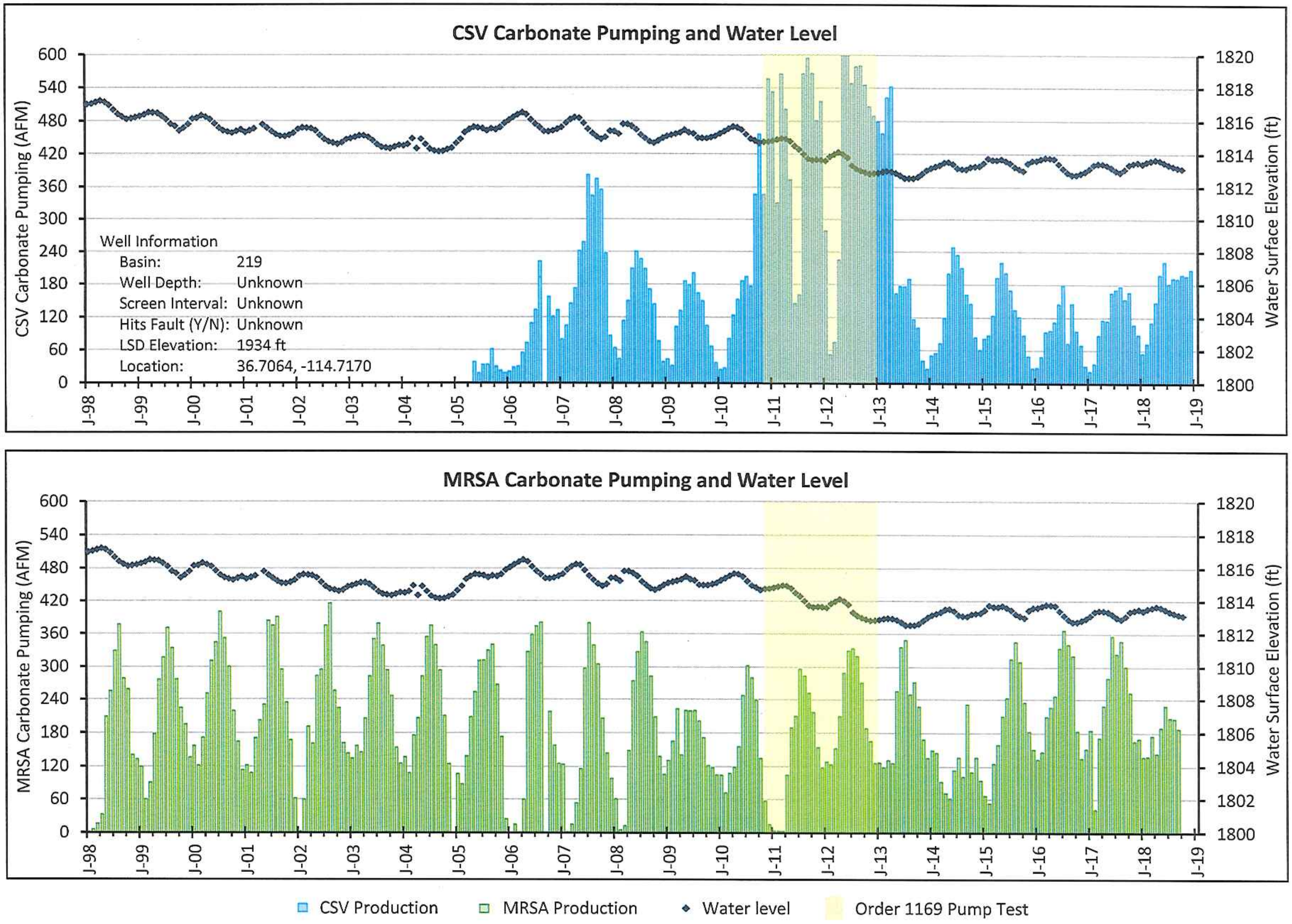

FIGURE 8

Basin 210 - Coyote Spring Valley

CSVM-1

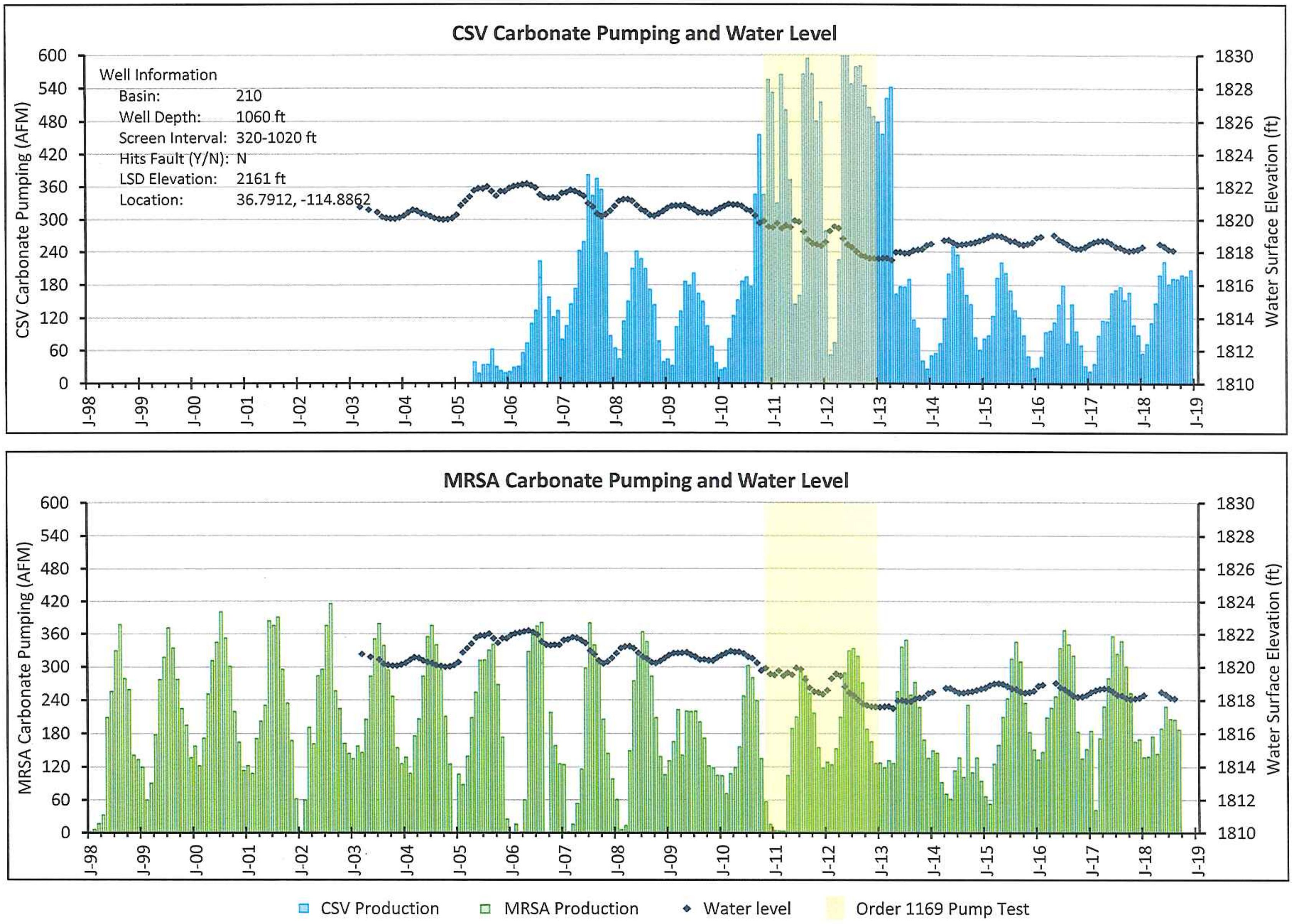

FIGURE 9

Basin 210 - Coyote Spring Valley

CSVM-5

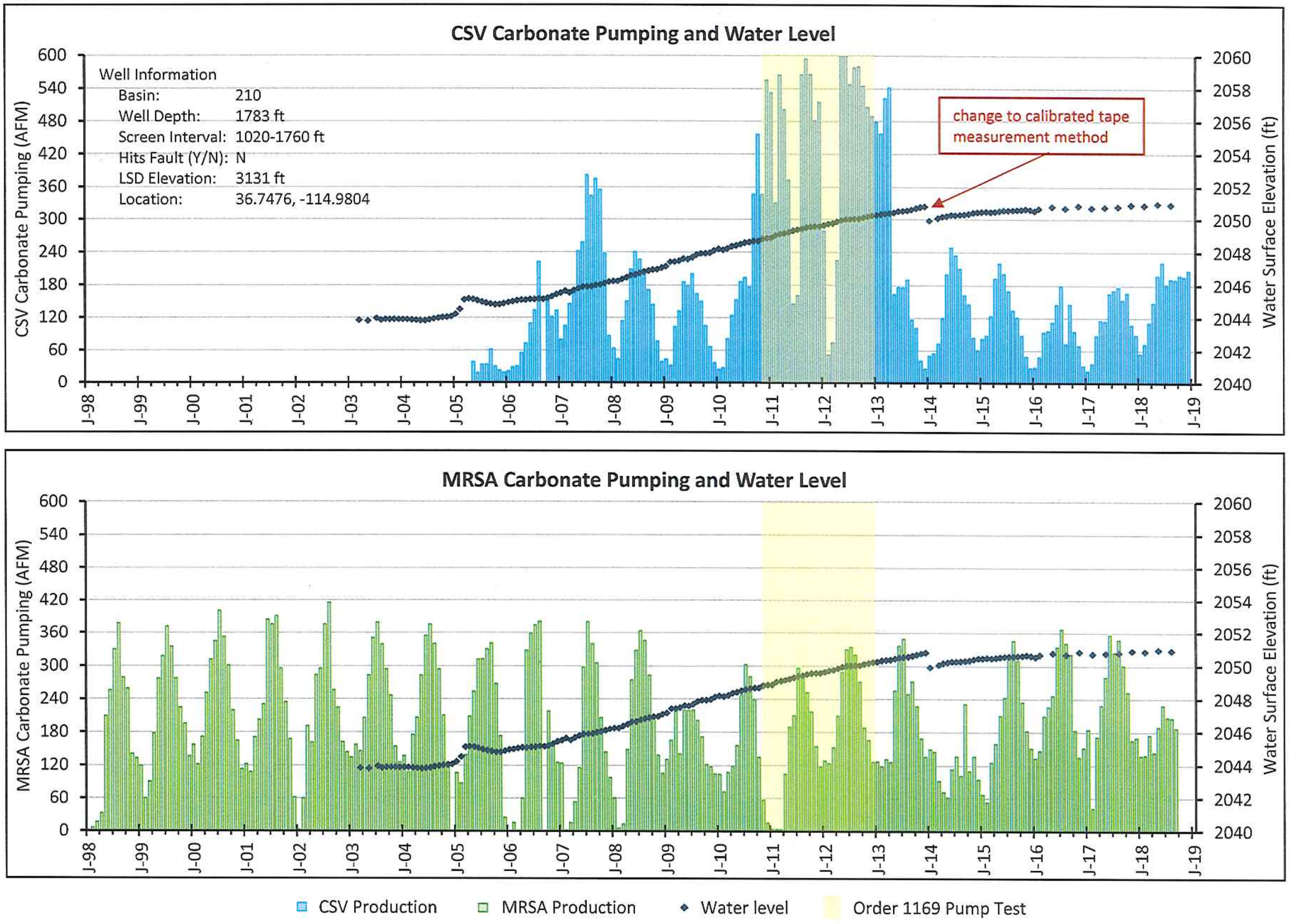

FIGURE 10

6.0 SUMMARY AND CONCLUSIONS

The carbonate aquifer of eastern Nevada supports regional groundwater flow over 200 miles, from the Upper White River Flow basin toward Lake Mead. The mechanisms that control groundwater flow throughout the entire carbonate rock province include structural geologic features, hydrogeologic properties, and natural and anthropogenic stresses. Groundwater flow through the Lower White River Flow System does not have a convenient and simple explanation, such as "flow into Coyote Spring Valley is equal to discharge in the Muddy River Springs Area." Rather, it must be explained using scientific principles that account for structural geology, geochemistry, geophysics, and mass balance equations that explain groundwater flow throughout the entire carbonate aquifer, independent of basins delineated by topographic boundaries.

The Lower White River Flow System cannot be explained by an arbitrary boundary based on surface drainage divides. Groundwater flow in the LWRFS occurs not only from Pahranagat, Delamar, and Kane Springs Valley, but also from substantial groundwater flow from Lower Meadow Valley Wash. Interbasin groundwater flow into Muddy River Springs Area occurs from both Coyote Spring Valley and Lower Meadow Valley Wash. Together, these sources of regional groundwater flow support streams and springs in Muddy River Springs Area, California Wash, and the Black Mountains Area basins. Assessment of impacts to decreed rights on the Muddy River, spring flow, and Moapa dace habitat must account for inflow from the entire carbonate rock aquifer and not just the portion within Coyote Spring Valley.

The April 2019 CSAMT geophysical survey identified normal (extensional) faults in Coyote Spring Valley which define preferred pathways for groundwater flow. Interbasin groundwater flow into Coyote Spring Valley is divided by geologic features that convey water to Muddy River Springs Area, as well as to Hidden and Garnett Valleys. Local recharge from the Sheep Range is contained on the west side of the geologic carbonate aquifer in a preferred flow path, effectively isolated from the groundwater flow path toward the Muddy River Springs Area.

Local recharge to Coyote Spring Valley from the Sheep Range, estimated to range from 2,500 AFY to 14,000 AFY, may be considered the perennial yield of Coyote Spring Valley. The perennial yield is more than an adequate and sustainable supply of water required to meet the 2,000 AFY requirement of Village A, including the 425 AFY water demand for the initial subdivision maps. Senior water right holders in Coyote Spring Valley are allowed to harvest the perennial yield under the historic practice of the NSE and supported by his duties to establish water available for appropriation[18]. Based on the information provided in this Technical Report, as well as the

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[18] See NRS 532.167(3).

December 13, 2018 Technical Memorandum, a long-term adequate and sustainable supply of up to 4,000 AFY[19] exists without causing long-term depletion of the groundwater reservoir. The source of recharge from the Sheep Range and the location of normal faults in Coyote Spring Valley effectively isolate any negative effects of groundwater production, occurring at CSI-1, -3, or -4, from impacting decreed water rights on the Muddy River, springs in the Muddy River Springs Area, and survival of the Moapa dace.

A summary of the analyses and information provided in this Technical Report and the December 13, 2018 Technical Memorandum are provided below.

- Groundwater flow in the carbonate rock aquifer cannot be defined by topographic boundaries that control the flow of surface water. The formation of Order 1303's Joint Administrative Unit does not account for all groundwater flows and should be adjusted or eliminated.

- The carbonate aquifer beneath the entire Colorado River Flow System boundary, not just that portion below Coyote Spring Valley, contributes to groundwater resources in Muddy River Springs Area, California Wash, and the Black Mountains Area. Contributions from Lower Meadow Valley Wash must be accounted for when assessing flow in the Lower White River Flow System.

- Normal (extensional) faults create preferred pathways for groundwater flow, in a direction parallel to the fault, throughout the regional carbonate aquifer. They also can act as a barrier to flow in the perpendicular direction to the strike of the fault.

- Identification of faults and structural features are the first step in assessing groundwater resources in the carbonate rock aquifer.

- The April 2019 CSAMT survey identified normal (extensional) faults in Coyote Spring Valley the control the movement of groundwater. Interbasin groundwater flow occurs to both Muddy River Springs Area and Hidden and Garnet Valleys.

- The normal (extensional) faults in the Coyote Spring Valley define a carbonate structural block that creates preferred flow paths that separate groundwater flow to Muddy River Springs Area from flow towards Hidden and Garnet Valleys.

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[19] Based on the Thomas et al. (2001) estimate.

- Regional groundwater inflow to Coyote Spring Valley is estimated to be 50,000 AFY. Total groundwater inflow, including local recharge, is approximately 54,000 AFY.

- Regional groundwater outflow to Muddy River Springs Area and Hidden and Garnet Valleys under pre-development conditions is estimated to be 54,000 AFY, including local recharge from the Sheep Range of 4,000 AFY.

- Local recharge in Coyote Spring Valley from the Sheep Range is contained west of a structural carbonate block that limits its contribution to the Muddy River Springs Area.

- Groundwater levels in monitoring wells located east of the structural block in Coyote Spring Valley are affected by groundwater pumping in Muddy River Springs Area, as well as pumping from MX-5 and CSI-2.

- Groundwater levels in monitoring wells located west of the structural block in Coyote Spring Valley are not affected by groundwater pumping in Muddy River Springs Area or pumping from MX-5 and CSI-2.

- The long-term *adequate and sustainable* supply of groundwater in the Coyote Spring Valley is equal to the perennial yield of locally derived water is estimated to be 4,000 AFY based on a deuterium mass-balanced model.

- Up to 4,000 AFY of local recharge may be pumped from the Coyote Spring Valley each year over the long-term without depleting the regional groundwater flow.

- Development of locally derived groundwater from wells on the west side of the structural block will not affect decreed water rights on the Muddy River, springs in the Muddy River Springs Area, or habitat that supports the Moapa dace.

Based on data and analyses presented in this Technical Report and the December 13, 2018 Technical Memoranda, the NSE should find that an adequate and sustainable supply of water exists to support the 2,000 AFY demand of Village A, including the 425 AFY water requirement of the initial subdivision maps. The final adequate and sustainable supply for Coyote Spring Valley, a quantity much greater than that required to support the initial subdivision maps, will be the subject of the July 3, 2019 reports prepared in response to Interim Order 1303.

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Appendix A

December 13, 2018 Technical Memorandum to Nevada State Engineer from Stetson Engineers

TECHNICAL MEMORANDUM 121318.0

STETSON
ENGINEERS INC.

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TEL: (760) 730-0701 FAX: (415) 457-1638 e-mail: stever@stetsonengineers.com

TO:	Nevada State Engineer	DATE:	December 13, 2018
FROM:	Stetson Engineers Inc.	JOB NO:	2674

RE: Recent Hydrologic, Geologic, and Climatic Data to Consider to Support Administrative Management of the Lower White River Flow System

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The purpose of this Technical Memorandum is to provide your office information that may not have been, or was not, considered in preparation of your proposed interim order "Designating the Administration of all Water Rights Within Coyote Spring Valley Hydrographic Basin (210), A Portion of Black Mountains Area (Basin 215), Garnet Valley (Basin 216), Hidden Valley (Basin 217), California Wash (Basin 218), and Muddy River Springs Area (A.K.A. Upper Moapa Valley) (Basin 219) As A Joint Administrative Unit, Holding in Abeyance Applications to Change Existing Groundwater Rights, and Establishing A Temporary Moratorium on the Review of Final Subdivision Maps" (Interim Order). In summary, the Interim Order fails to recognize recent hydrologic and climatic data that does not support managing the aforementioned basins as one Administrative Unit. Additionally, the data collected between January 2013 and 2018 shows that a long-term sustainable water supply for municipal use, consistent with NRS Chapter 534, exists within the Administrative Unit, and specifically within the Coyote Springs Valley (CSV).

Important factors that affect the availability of water in the 6-basin area, that have become apparent since the submission of the Order 1169 Aquifer Test Reports in June of 2013, include: (1) the impact of long-term climatic cycles on regional groundwater levels; (2) regional geology and groundwater flow; and (3) the effect of near-by pumping on springs in the Muddy River Springs Area (MRSA). These factors, as well as others, affect the determination of available water in the 6-basin area, as well as the availability of water to meet the demands of senior decreed water rights and the Moapa dace.

Review of the climatic and hydrogeologic data collected from 2013 through 2018, including results from analytical models, show that stresses other than just Order 1169 pumping in CSV affected water availability and streamflow in the MRSA. This Technical Memorandum presents the factors affecting the occurrence and movement of groundwater in the LWRFS for your consideration.

I. Sustainable Yield is based on Long-Term Wet and Dry cycles

The Sustainable Yield of a basin can be describes as "the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from the groundwater supply without causing an undesirable result."[1] The long-term conditions of the basin can be described by the regional climate that affects the recharge and groundwater conditions within that basin. The regional climate in the CSV is best described by the relatively long-term rainfall stations in southern Nevada.

Two precipitation records were reviewed to establish the long-term climatic conditions in the LWRFS. A longer 123-year record summarizing the *Extreme Southern* region of Nevada for the period 1895 to the 2017[2] was available from the Western Regional Climate Center (WRCC) (Figure 1, top graph). A shorter 52-year period precipitation record from 1966 to 2017 was also available for the Pahranagat Wildlife Refuge (National Weather Service cooperative station number 265880), located up-gradient from the LWRFS (Figure 1, bottom graph). Wet and dry cycles in the LWRFS may be identified from cumulative departure from mean (CDM) curves that show long-term precipitation trends referenced to average conditions.

The cumulative departure from mean curve for the *Extreme Southern* region of Nevada shows relative wet periods occurred from the early-1900s to the early-1920s, the mid-1930s to the early-1940s, and the mid- to late-1970s to the early-1980s. An extended dry period occurred from the mid-1940s to mid- to late-1970s and a shorter dry period from the mid-2000s to the present. The cumulative departure from mean curve for precipitation at the Pahranagat Wildlife Refuge also shows similar patterns of wet and dry cycles over the 1966 to 2017 period. A wet period occurred in early 1980s, 2004 to 2005, and again in the 2013 to 2017 period. Beginning in 2000, an extended dry period occurred through 2012, except for above average rainfall in 2004 and 2005. Coincidently, the end of the extended dry period in 2012 corresponds with the end of the Order 1169 aquifer test.

A cumulative departure from mean curve may also be used to describe a balanced hydrologic cycle, which occurs when the beginning and end of the cycle show a similar value for cumulative departure. For example, the 36-year period from 1982 through 2017, at both rainfall records, begins

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[1] California Code of Regulations §10721

[2] WRCC https://wrcc.dri.edu/cgi-bin/divplot2_form.pl?2604

and ends on the zero value for cumulative departure, indicating that this 36-year period has the same conditions, on average, as the longer-term periods on each graph. 1982 through 2017 reflects a balanced hydrologic cycle, containing wet periods in the early 1980s and mid 2000s, an average period from 1992 through 2000, and a dry period from 2006 through 2012. For short-term planning, a 14-year balanced hydrologic period may be identified from 2003 through 2016. The data for the *Extreme Southern* region of Nevada shows a wetting cycle in 2004-2005 and an extended dry period from 2006 through 2017. The Pahranagat precipitation record for 14-year period is characterized by the 2004-2005 wet cycle and a dry cycle from 2006 through 2012.

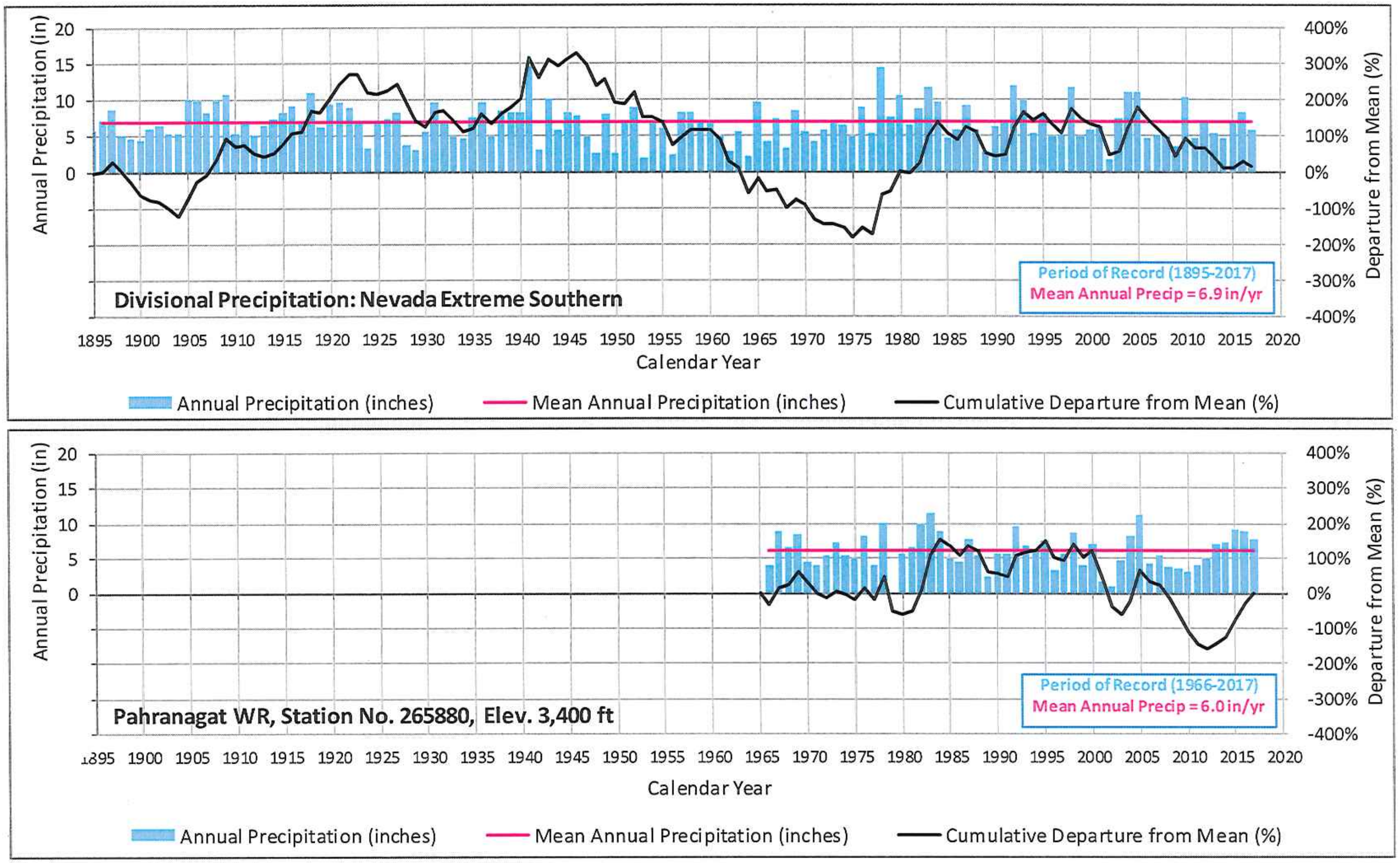

FIGURE 1 – PRECIPITATION CUMULATIVE DEPARTURE FROM MEAN FOR SOUTHERN NEVADA AND PAHRANAGAT WR

The groundwater levels in monitoring wells also show similar trends in wetting and drying cycles even when pumping and geologic structure is not taken into account. Groundwater level elevation at MX-5 and cumulative departure from mean may be plotted on the same graph as shown in Figure 2. Review of combining these datasets show that groundwater levels respond to climatic variability. The groundwater level (light blue line) in MX-5 shows a decline from 1998 to 2004 and from 2006 through 2012; coincident with a decline in the cumulative departure from mean values (dark blue line) during the same periods. The response to 2004-2005 rainfall is shown in both the groundwater levels and cumulative departure from mean curves.

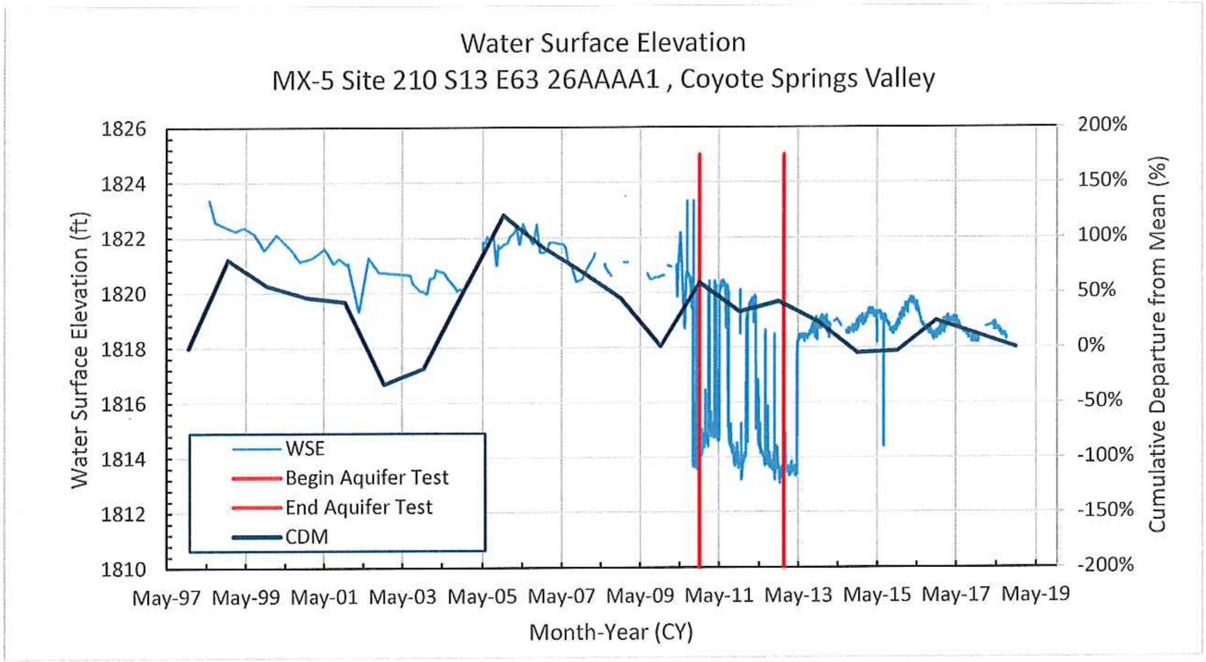

FIGURE 2 – GROUNDWATER LEVEL AT MX-5 AND PRECIPITATION CUMULATIVE DEPARTURE FROM MEAN (CDM)

The precipitation data for the *Extreme Southern* region of Nevada also indicates that the longest extended dry period occurred from 1946 through 1975. As evident by the relationship between groundwater level and precipitation cumulative departure from mean, local recharge affects the availability of water. Assessment of minimum streamflow, spring flow, and groundwater levels in the LWRFS should be based on review of records from this time period. Conclusions regarding water availability based on records from recent years may not correctly characterize the range of flows that exists due to climate variability.

II. Local Recharge to the Coyote Springs Valley

Groundwater level data in CSV indicates that groundwater pumping in the basin has not resulted in negative impacts to groundwater in storage. Monitoring wells CSVM-3, CSVM-6, and CSVM-2 show groundwater levels from north to south in CSV (Figure 3). Review of the groundwater levels indicate: 1) hydrogeology in the north is different than in the central and southern portions of CSV; and 2) wetting and drying climatic cycles are reflected in CSVM-6 and CSVM-2 in the central and southern portions of CSV, respectively.

Groundwater levels in the most northern monitoring well (CSVM-3) show a distinctly different water-level signature than that in the central and southern CSV monitoring wells. It is likely that geologic units and structural factors in the northern portion of CSV control and influence the occurrence and movement of groundwater differently than that in the central and southern portion of CSV. Inclusion of the northern portion of CSV in the proposed Administrative Unit should be reviewed based on observed groundwater level response in CSVM-3. We recommend that the northern portion of CSV should not be managed the same as wells in the other portions of CSV.

The long-term climatic signature of precipitation in the *Extreme Southern* region of Nevada record is evident in the CSVM-6 and CSVM-2 groundwater levels. Groundwater levels increase in 2004/2005 consistent with above average rainfall, then decrease steadily until the end of 2012, mimicking the extended dry period reflected in the rainfall gage. Following the end of the dry period in 2012, groundwater levels remain constant through 2018, fluctuating consistently with seasonal variations. Conclusions that may be drawn from review of groundwater level data in CSV, include: (1) the effect of Order 1169 pumping on groundwater availability is masked by natural climatic variability; (2) the basin may be in equilibrium based on a long-term balanced hydrologic period (i.e. no groundwater mining); and, (3) recharge from local precipitation events affects groundwater levels.

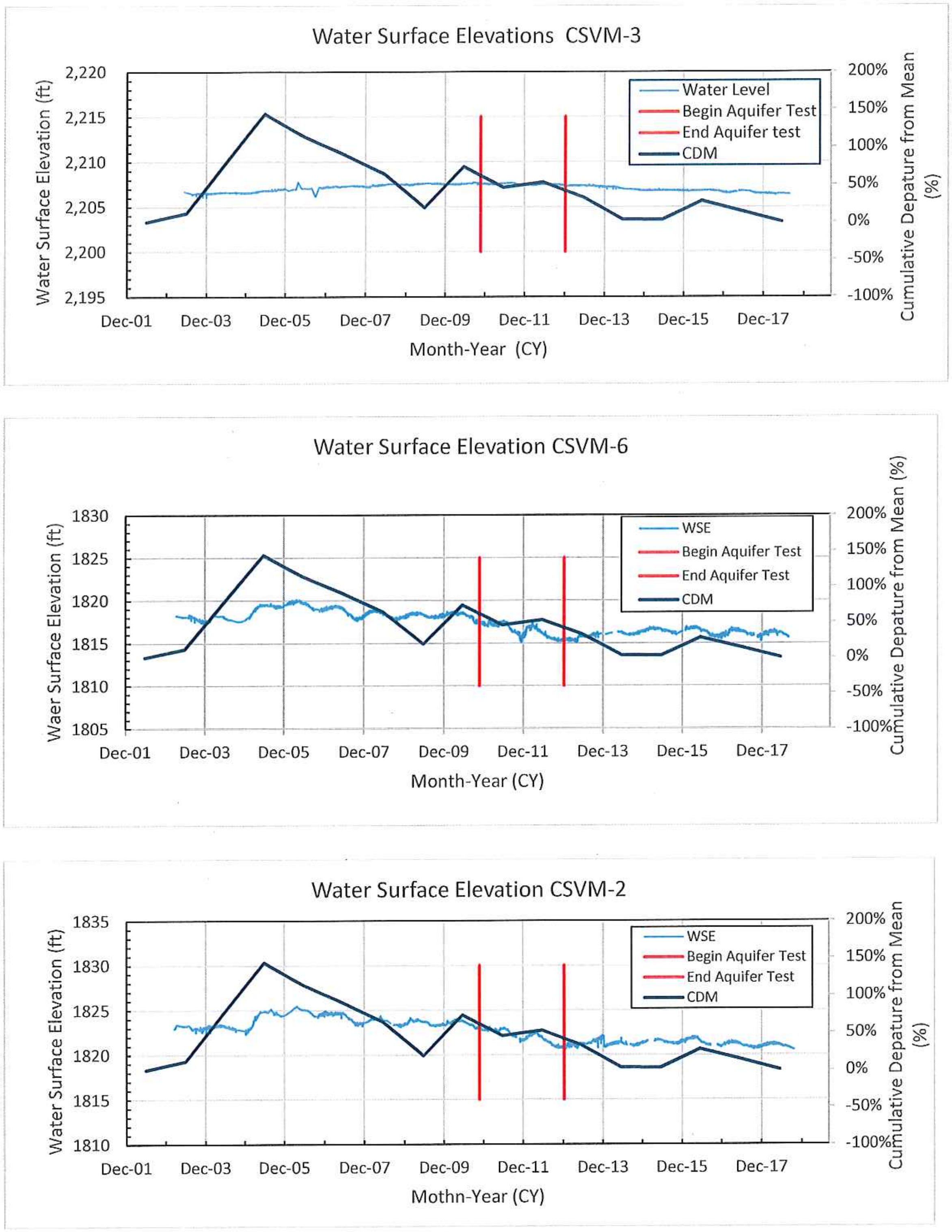

FIGURE 3 – NORTHERN (CSVM-3), CENTRAL (CSVM-6), AND SOUTHERN (CSVM-2) GROUNDWATER LEVELS IN CSV. RED BARS INDICATE PERIOD OF ORDER 1169 AQUIFER TEST.

Groundwater pumping in CSV averaged 2,605 acre-feet per year (AFY) between 2005 and the present; and 2,068 AFY excluding 2011 and 2012[3]. Groundwater pumping in the MRSA in 2016 and 2017 ranged from 3,553 AF to 4,048 AF[4]. Throughout the LWRFS, groundwater pumping ranged from 9,090 AFY to 13,254 AFY[5] in years 2013 through 2017, averaging 10,677 AFY[6].

Long-term carbonate aquifer groundwater levels in the MRSA have been recorded at Well EH-4 since January 1987 (Figure 4). When these water levels are compared to the cumulative departure from mean for precipitation, a relationship can be developed between water availability and recharge. Similar to groundwater levels in CSV that respond to local recharge events, groundwater levels in the MRSA respond to wet cycles (2004-2005) and long-term drying cycles (1998 – 2003 and 2007 through 2012).

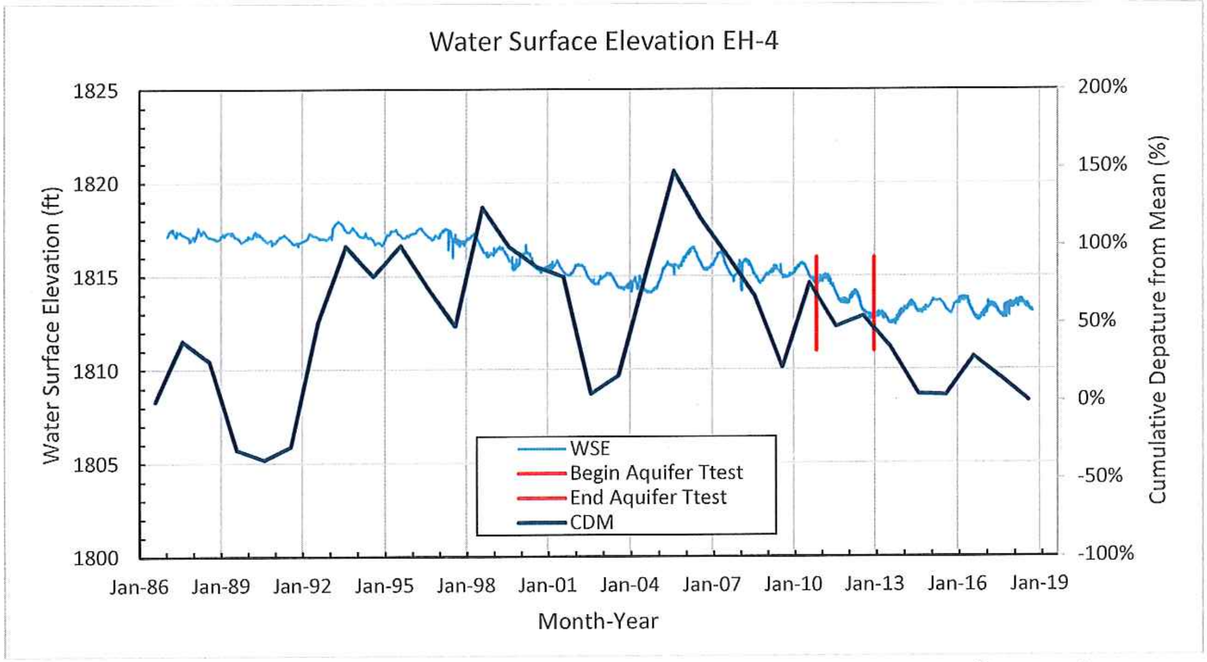

FIGURE 4 – GROUNDWATER LEVELS IN CARBONATE AQUIFER NEAR PEDERSON SPRING COMPLEX

The climatic and hydrologic data indicates that even during the relative normal or below normal (declining CDM) climatic condition from 2013 through 2017, groundwater levels remained constant in the MRSA. During this recent 5-year period, groundwater pumping from the alluvial and carbonate aquifers throughout the entire LWRFS averaged 10,677 AFY. The constant water levels in EH-4 suggest that groundwater storage is in equilibrium and has neither been depleted nor

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[3] Interim Order, page 8
[4] Interim Order, page 9
[5] Interim Order, page 9
[6] Interim Order, Appendix B

increased during the recent 5-year period. Based on the available climatic and hydrologic datasets, groundwater levels would be expected to increase during wet or very wet hydrologic conditions that occur for at least two or more years.

A direct impact from carbonate pumping in the MRSA on EH-4 groundwater levels is not definitive when climatic conditions are considered (Figure 5). Although groundwater levels fell from 1997 to 2003 after carbonate pumping increased in the mid-1990s, groundwater levels remained constant from 2013 to 2017, at similar pumping levels to those that occurred in the early 2000s. As previously discussed, the long-term drying cycle from 1998 to 2003 and 2007 to 2012, as well as the 2004 to 2005 wet period can also be observed in the groundwater levels.

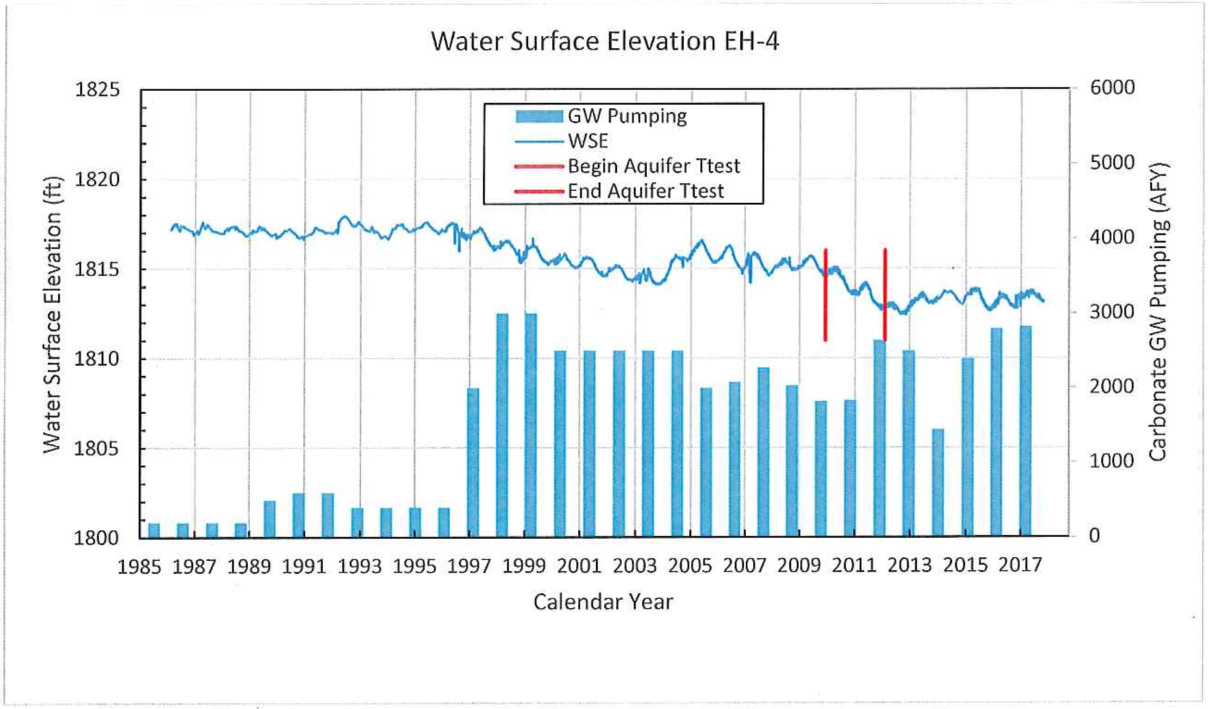

FIGURE 5 – GROUNDWATER PUMPING AND GROUNDWATER LEVELS IN THE CARBONATE AQUIFER IN THE MRSA

Local recharge from the Sheep Range to groundwater resources beneath CSV have been estimated to range between 12,000 AFY to 14,000 AFY based on geochemical and isotopic studies (USGS, WRI 95-4168). Throughflow from Meadow Valley Wash toward MRSA and California Wash has been estimated to contribute 8,000 AFY (SNWA[7]). Throughflow from the White River flow system may only account for approximately one-half of the water in the groundwater flow system south of CSV toward MRSA and California Wash. The availability of local recharge sources

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[7] Identified by SNWA through the Cave, Dry Lake, and Delamar Valleys hearing.

to CSV, as well as separate recharge sources to the MRSA, support the relationship between climatic conditions and groundwater levels observed in both CSV and the MRSA. These recharge sources have been previously ignored when assessing the availability of water and will be described in Section IV for assessing impacts from pumping in CSV and MSRA on groundwater levels in the vicinity of the Pederson Spring Complex.

Additional geologic data that affects the groundwater flow between the CSV and the remainder of the LWRFS includes faulting, folding, and other structural elements. The Arrow Canyon Range fault zone is located on the east side of CSV and consists of block faulting (westside down) high angle normal faults that offset the carbonate aquifer against alluvial deposits to the west, and Cambrian (dolomite) and Pre-Cambrian formations to the east (Figure 6). Faulting across an aquifer may act as a barrier or conduit to groundwater flow. Investigation of the high angle faults in the Arrow Canyon Range fault zone is required to determine their effect on groundwater flow from CSV to the MRSA. Faulting, folding, and other structural elements that impact the pumping response from CSV pumping in the MRSA were not accounted for in previous investigations.

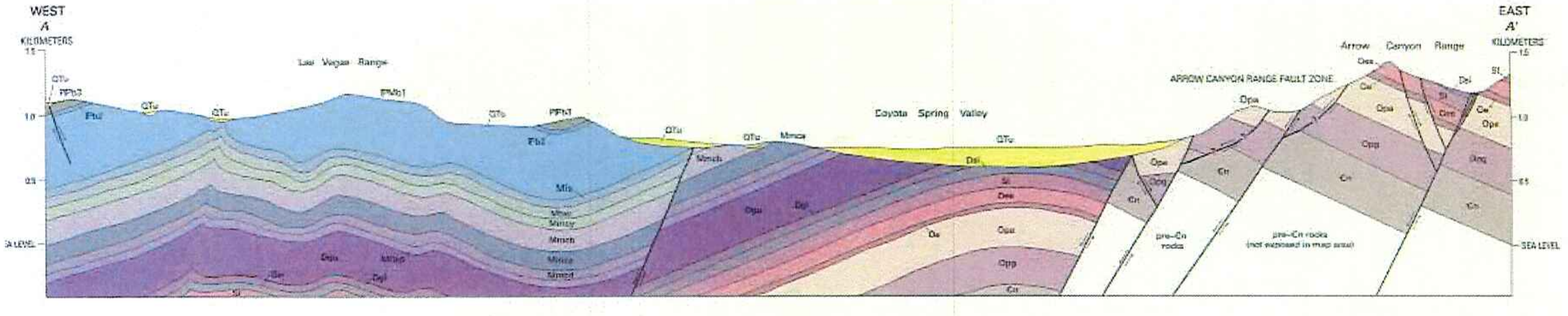

FIGURE 6 – GEOLOGIC-CROSS SECTION FROM THE SHEEP RANGE (WEST – A) TO WESTERN PORTION OF MUDDY RIVER SPRINGS AREA

Source: Geologic Map of the Arrow Canyon NW Quadrangle, Clark county Nevada. 1998, USGS GQ-1776, William R Page.

The Interim Order effectively prevents valid water rights holders in CSV from exercising their right to beneficially use local recharge generated within the basin. The climatic and hydrogeologic data indicate groundwater levels are linked to climatic variability. Because a balanced hydrologic cycle or period has not been established for the LWRFS, it cannot be determined that changes in groundwater levels, and related spring flow, is outside the normal variability of the system. Groundwater in storage in CSV and the MRSA is in equilibrium with pumping since 2003, and is likely within equilibrium over a long-term balanced hydrologic period when extended drought and very wet conditions are accounted for in the calculation. The recent 5-year pumping rate in the LWRFS of 10,677 AFY should be considered as a minimum "*adequate supply of water in perpetuity*"[8] based on the recent 5-year hydrologic condition. Because the recent 5-year hydrologic period may be considered to be "below normal" and does not contain extended wet or dry periods, the final value of long-term water supply will likely be greater. By placing a temporary moratorium on the review of final subdivision (or other submissions concerning development and construction) maps and ignoring available water supplies, the Interim Order is issuing de facto seniority to other water rights holders that propose beneficial use of water other than development.

III. Moapa Dace

The Moapa dace was federally-listed as endangered under the Endangered Species Preservation Act (ESA or Act) of 1966 on March 11, 1967 (32 FR 4001), and has been protected under the Act since its inception in 1973. The Moapa dace are found in the Warm Springs Area which consists of about 20 springs linked to the White River Groundwater Flow system[9].

A Memorandum of Agreement (MOA) was reached between SNWA, the United States Fish and Wildlife Service (FWS), CSI, and MBOP on April 20, 2006 to support conservation measures to protect the Moapa dace (*Moapa coriacea*). The MOA outlines a series of conservation measures consistent with the 2006 Biological Opinion (BO), that includes: 1) Establishment of Recovery Implementation Program; 2) Dedication of Water Rights; 3) Habitat Restoration and Recovery Measures; 4) Protection of Instream Flows; 5) and formation of a Hydrologic Review Team. The MOA identifies the need for operational coordination among FWS, SNWA, CSI, and MWD and directs SNWA and CSI to coordinate in locating and drilling production wells.

CSI dedicated 460 AFY of its water rights to the survival and recovery of the Moapa dace and its habitat. CSI has already relinquished these rights to Permit 70430 under order 70430R01.

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[8] Interim Order, para 4.b, page 13.

[9] January 11, 2006 FWS Biological Opinion.

SNWA and MVWD also worked together to dedicate the one cubic foot per second (cfs) Jones Right to support Apcar Spring. The Jones Right and CSI's dedication of a portion of Permit 70430 will be managed by the FWS to support the Moapa dace.

The 2006 MOA specifically identifies the need for the parties to follow adaptive management methods to protect and recover Moapa dace following initiation of the Recovery Implementation Program. Specifically, the parties agree to cooperate in continuing to re-evaluate necessary measures to protect and recover the Moapa dace. These measures include funding studies, establishing a science-based monitoring and management plan, and assessing feasibility of augmenting and/or restoring in-stream flows. The adaptive management techniques would be applied to all aspects of the conservation measures included in the 2006 MOA.

There are limited metrics to objectively describe minimum or optimal habitat requirements for the Moapa dace. Hydraulic studies have looked at the impact of increased or decreased flows. Recent snorkel counts were provided at the 2018 Biological Working Group meeting to document existing population (Attachment A). The first graph shows the counts on all reaches, and the 2nd and 3rd break the counts into the Apcar/Pederson area and Muddy River Main Stem, respectively. The trends differ: in the Apcar/Pederson springs areas, the populations seem to have grown; but on the Muddy River Main Stem, populations have declined.

The Interim Order suggests that it is necessary to maintain the status quo of the water development within the LWRFS so as to provide time to engage in a process to evaluate the amount of groundwater that may be developed without adversely affecting the public interest in maintaining the habitat of the Moapa dace[10]. Existing conservation measures implemented under the 2006 MOA currently provide adaptive management techniques consistent with the 2006 BO. Based on existing agreements and past and current scientific studies, the public's interest in the protection of the Moapa dace is accounted for without the need for additional protection as suggested in the Interim Order.

IV. Qualitative Analysis of Pumping

The Interim Order states "that it is necessary to maintain the status quo of water development within the LWRFS while engaging in a process to evaluate the amount of groundwater that may be developed within the LWRFS without conflicting with senior decreed rights on the Muddy River or adversely affecting the habitat of the endangered Moapa dace." The State Engineer's office should provide data that indicates a conflict exists with either senior decreed rights or habitat that support

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[10] Interim Order, page 11.

the Moapa dace. The Order 1169 Aquifer Test reports and existing adaptative management plans for the Moapa dace do not show a shortfall in meeting decreed rights or a declining Moapa dace population on the Pederson spring tributaries.

Review of the Muddy River decree indicates there are 13 rights with a combined duty of approximately 24,000 AF to surface flow of the Muddy River. A map showing the place of use of decreed rights, depicted by green squares, is shown in Figure 7. Streamflow at the Muddy River near Moapa gage has shown a steady increase from 2003 to the present as shown in Figure 8. Streamflow data provided by the USGS indicate that median daily flow has increased from 33 cfs in the early 2000s to 41.5 cfs for the most recent 5-year period January 2013 through October 2018. While the flow at the Muddy River near Moapa does not account for contributions from the downstream California Wash, Meadow Valley Wash, and Anderson Wash, available streamflow in the Muddy River is at its highest level since 2003.

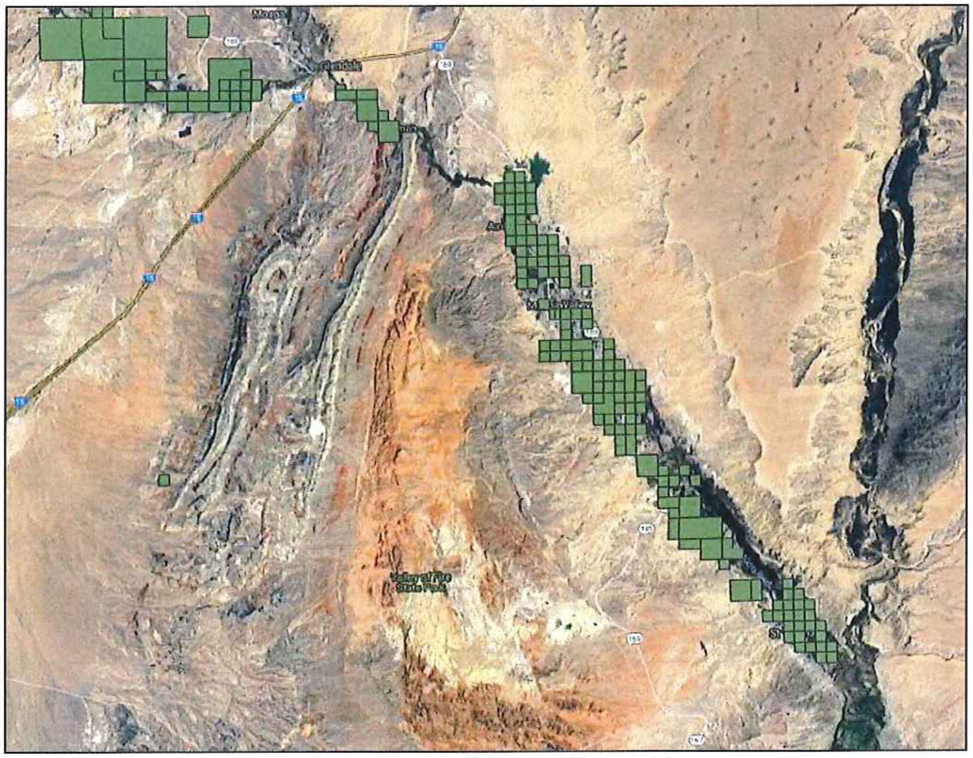

FIGURE 7 – PLACE OF USE OF MUDDY RIVER DECREED LANDS

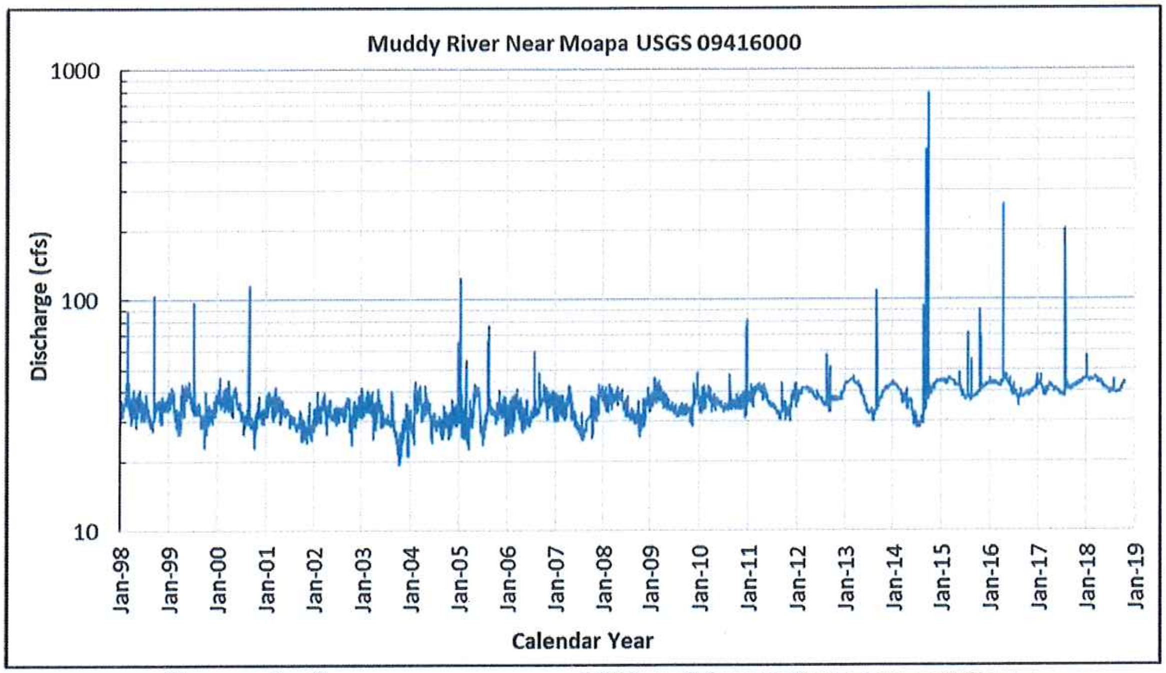

FIGURE 8 – SURFACE FLOW SINCE 1998 AT MUDDY RIVER NEAR MOAPA

The Interim Order states that spring flow decreased from 0.22 cfs to 0.08 cfs and from 0.12 cfs to 0.08 cfs at the Pederson Spring East gage at the end of the 2-year pump test. Although the Order 1169 Aquifer test reports did not isolate the impact from groundwater pumping in the MRSA compared to that in CSV, the total decrease in spring flow from these two springs is estimated to be 0.18 cfs or the equivalent of 129 AFY. Although the Interim Order "aims to protect existing senior rights and the public interest in an endangered species"[11], objective data linking the survival of the Moapa dace to flow in Pederson Springs has not been provided. Presently, the data indicate that pumping approximately 14,000 AFY, in the LWRFS, for two years at the end of the 2006 to 2012 dry period results in an impact to the Pederson Spring complex of approximately 129 AFY. As described in the following section, the greatest impact to the springs and resources in the MRSA is from pumping and diversions within the same basin.

V. Estimated Impact to the Pederson Spring Complex from Groundwater Pumping

The Interim Order relies on Ruling 2654 that cited modeling analysis by the Department of Interior (DOI) to identify a regional-wide carbonate aquifer water-level decline estimated to be 1 to

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[11] Interim Order, Page 1

1.6 feet in 1,100 square miles of the LWRFS[12] during the Order 1169 aquifer test. Ruling 2654 cited the DOI's Order 1169 Aquifer Test report (DOI, 2013) that used SeriesSee modeling to discern and partition the effects of pumping at MX-5 on other locations. Review of the DOI Order 1169 Report and attached appendices show that it does not represent an adequate basis for establishing one "Administrative Unit" for the entire LWRFS. The documented SeriesSEE modeling does not include local and regional recharge, changes in the alluvial aquifer, climatic variability, or boundary effects that could affect the model's conclusions when the full dynamics are accounted for in the LWRFS.

The DOI report relied upon by the State Engineer in the Interim Order is based on modeling results that support a region-wide drawdown based on a simple Theis solution. The calibration process, hydrogeologic parameters used for modeling, and supporting pump test data are not documented and does not allow for third-party verification. Both regional and local recharge that affects the availability of water is not accounted for in DOI's evaluation. Furthermore, available data from 2013 through 2017 have not been used to verify the results of the 2013 model. Based on the lack of documentation and inability for third-party repeatability, the DOI report should not be the primary document relied upon to support region-wide water level drawdown and the need for an Interim Order.

In order to evaluate the results from the 2013 DOI model, a Theis solution was utilized to assess relative impacts to the Pedersen Spring Complex from pumping in both the CSV and MRSA. An aquifer test report from CSI-2 well development report (2005) was relied upon to analytically model groundwater level drawdown in the MRSA from two pumping centers located at MX-5 and Arrow Canyon wells. The analytical model AquiferWin32© was used to simulate drawdown caused by pumping at the two locations. All pumping in the CSV was simulated as occurring at the "MX-5" well location. Since MX-5 is the closest to the Pederson Spring area (compared to other production wells in CSV), this provides a more conservative assumption for this analysis. A single pumping rate of 5,216.5 AFY or 3,231.8 gallons per minute (gpm) was selected to represent pumping at this location. This is the average of the CY 2011 (5,331 AFY) and CY 2013 (5,102 AFY), as reported in SNWA (2013). The MX-5 location is approximately 11.5 miles from the Pederson Spring location at a heading of 300°.

A midpoint location between the two Arrow Canyon wells was used to simplify carbonate pumping in the MRSA. The volume of pumping was estimated to be 3,000 AFY (1,859 gpm). This is similar to an estimate of historical pumping shown in some of the figures in SNWA (2013) for MRSA. This location is 2.5 miles from the Pederson Spring location, at a heading of approximately

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[12] Ibid, Page 4

320°. Simulated drawdown due to (1) pumping in CSV, (2) pumping in Arrow Canyon, and (3) pumping from both well locations are shown in Figure 9.

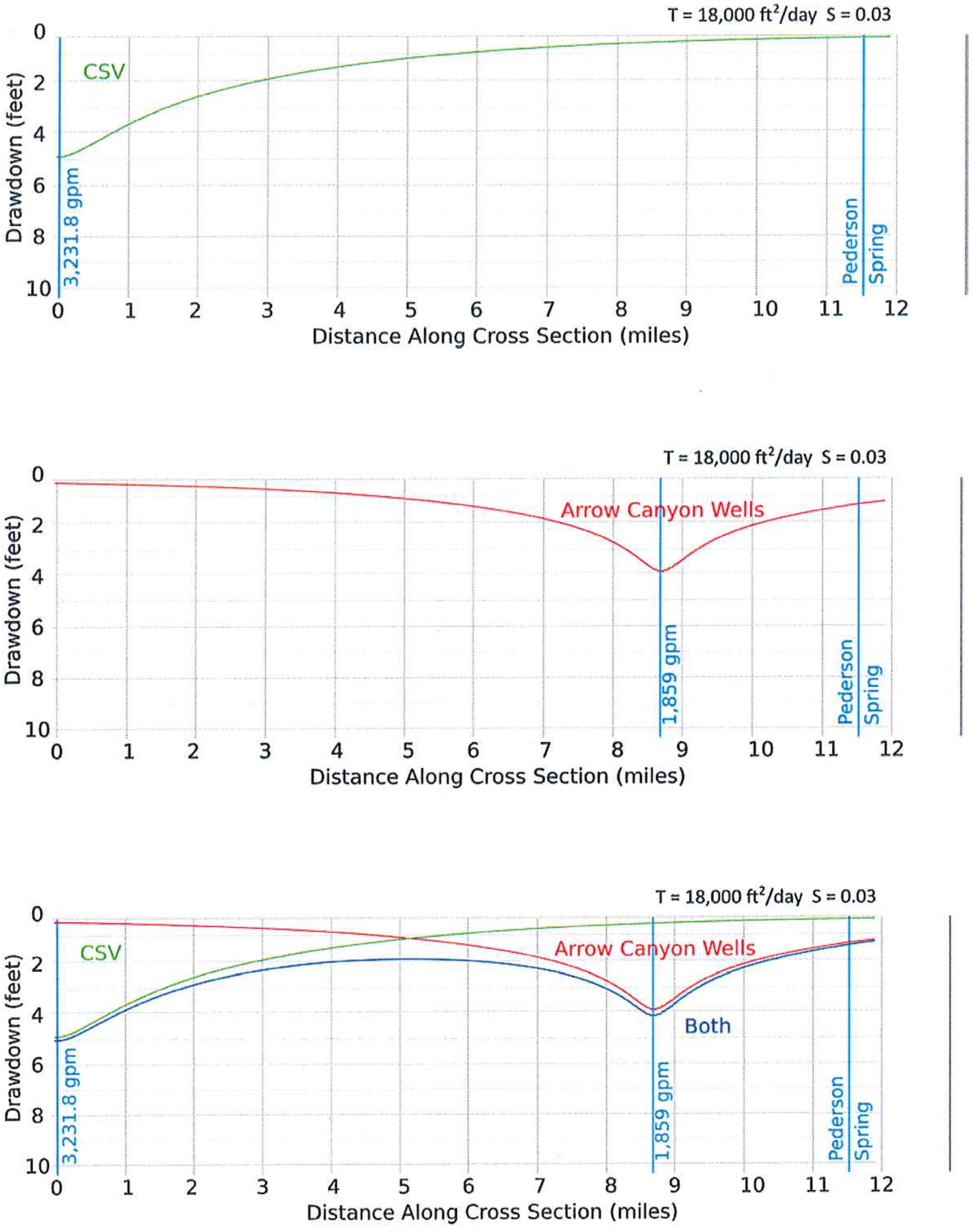


FIGURE 9 – SIMULATED DRAWDOWN AT PEDERSON SPRING COMPLEX DUE TO PUMPING IN CSV, ARROW CANYON, AND BOTH LOCATIONS.

Simulated groundwater level drawdown at the Pederson Spring Complex due to pumping 5,217 AFY in CSV is estimated to be less than 0.09 feet (see green line in upper graph of Figure 9) after 1 year. Simulated groundwater level drawdown at the Pederson Spring Complex due to pumping 3,000 AFY at the Arrow Canyon Wells is estimated to be 1.24 feet (see red line in middle graph of Figure 9) after 1 year. Finally, simulated groundwater level drawdown at the Pederson Spring Complex due to pumping a combined 8,217 AFY at the CSV and Arrow Canyon Wells is estimated to be 1.33 feet (see blue line in lower graph of Figure 9) after 1 year. Results of this analysis indicate that pumping in CSV during the Order 1169 Aquifer Test has less than a 7% impact on groundwater level decline at the Pederson Spring Complex after 1 year.

The results of this analysis provide an example of the difference in impacts to groundwater levels at the Pederson Spring Complex due to pumping in CSV versus Arrow Canyon. The analysis was based on Theis equation analytical model that assumed:

1. Groundwater pumping is at a constant average rate through the year based upon historical groundwater production.
2. Groundwater pumping is generalized to occur at two locations.
3. An existing general flow gradient of a 1 foot drop every 2 miles.
4. A homogeneous aquifer.
5. The aquifer was assumed to be of infinite extent, and no additional influences to the resulting cone of depression was considered beyond the specified gradient. These include no recharge or surface inflows from precipitation, agriculture return flows, streamflow, or other sources.
6. No boundary effects.

This evaluation was performed to develop a relative impact analysis of pumping in CSV and MRSA to groundwater levels at the Pederson Spring Complex. These results are different than those presented in the 2013 DOI report. Our results show a greater influence to EH-4 water levels from pumping at Arrow Canyon wells that are closer to the spring complex, then from pumping at MX-5 in CSV, which is farther from the springs. The DOI SeriesSEE model simulates the greatest impact at EH-4 from pumping in CSV.

Summary

The data and analyses presented in this Technical Memorandum are intended to provide the State Engineer with a summary of information that has been collected since the Order 1169 Aquifer Test reports were prepared in June 2013. Continued monitoring of groundwater levels, spring flow, and pumping, combined with new and existing climatic data, provide additional information that should be considered prior to issuing the Interim Order. The direct relationship between local recharge and water availability clearly shows that the pumping is only one element to consider when assessing whether the 6-basin area should be managed as one "Administrative Unit". Other factors that have been presented, which include geologic processes, Moapa River streamflow, and a Theis analysis, also indicate that managing the 6 basins as one area over simplifies a complex hydrogeologic system.

The Order 1169 Aquifer Test reports described hydrogeologic processes based on a small snapshot of time in the LWRFS. The data discussed in this Technical Memorandum, and previously presented at public meetings during 2018, show that there is not a 1 to 1 relationship between pumping in CSV and water resources in the MRSA. Investigation of long-term hydrologic cycles that include extended wet and dry periods are required to opine above the occurrence, movement, and availability of groundwater in each of the six basins in the LWRFS. The data presented in this report show that water levels rise in response to above normal rainfall that occur for two or more consecutive years. These wet hydrologic conditions "reset" the balance of available groundwater and allow managers to meet targets based on varying demands over the multiple year periods based on a balanced hydrologic period. The Order 1169 aquifer test that was conducted in 2011 and 2012 occurred at the end of an extended dry period when all water resources throughout the LWRFS were being negatively affected. Due to the paucity of available long-term groundwater level and spring flow data, the Order 1169 Aquifer Test reports were not able to assess all the mechanisms that affect the availability and connection of water between each of the six basins in question.

The Interim Order's suggestion that "The State Engineer may review and grant approval of a subdivision or other submission if a showing of an adequate supply of water in ***perpetuity*** [emphasis added] can be made to the State Engineer's satisfaction" is vague and subjective. We believe the data provided in this Technical Memorandum clearly meets the standard of a long-term water supply in CSV. The CSV groundwater basin has been shown to be in equilibrium, local recharge from the Sheep Range is estimated to be between 12,000 AFY and 14,000 AFY, adequate streamflow is available to meet senior decreed rights, and the survival of the Moapa dace is not threatened. A summary of the findings presented in this Technical Memorandum are presented below for your consideration

- Climatic variability and identification of a balanced hydrologic cycle is used for assessing groundwater sustainability. The Interim Order should consider these tools that when assessing long-term sustainable conditions in the LWRFS and the need for one "Administrative Unit".

- Groundwater level data in CSV and MRSA indicate a strong correlation with climatic variability. The Order 1169 Aquifer test occurred over the last two years of an extended 7-year drought (2006-2012). The Interim Order should consider climate to account for varying hydrologic conditions in the LWRFS that affect water availability.

- Surface water flows that support senior decreed water rights on the Muddy River have steadily increased from 33 cfs in the early 2000s to 41.5 cfs in 2018. Data have not been presented to indicate that water availability to senior decreed water rights will be threatened in the future.

- Muddy River decreed rights total approximately 24,000 AFY. Recent flow of the Muddy River has been more than 41.5 cfs (30,000 AFY), not including downstream contributions. The Interim Order fails to provide evidence that senior decreed right holders are injured.

- Groundwater in the northern portion of CSV is controlled by different geologic units and structures than groundwater in the central and southern portions of the basin. It is recommended that the Interim Order exclude the northern portion of the CSV from the "Administrative Unit" because of the different hydrogeology that controls the occurrence and movement of groundwater in this area.

- Recharge to CSV is estimated to range between 12,000 AFY and 14,000 AFY based on geochemical and isotopic studies. The Interim Order prevents existing water right holders from exercising their right to the beneficial use of local recharge.

- Geologic and hydrogeologic factors affecting the boundary of the "Administrative Unit" should be clearly stated in the Interim Order so the boundary is defined and may be repeated in the future. The location of faults, folds, and other structural elements that affect the flow of groundwater should be addressed if one "Administrative Unit" is to be considered; or possibly used for developing sub-management areas.

- Groundwater level modeling data provided by the DOI Order 1169 Aquifer Test Report (2013) and relied upon by the State Engineer in Ruling 2654 should be reevaluated using recent data if it is to be relied upon in the Interim Order. The SeriesSEE model assumptions ignore local recharge, climatic conditions, structural barriers, and other aspects that affect the occurrence and movement of groundwater throughout the LWRFS.

- A Theis solution shows that pumping in CSV has less than a 7% impact on groundwater levels at the Pederson Spring Complex after 1 year of pumping 5,217 AFY in CSV and 3,000 AFY in MRSA. The impact to groundwater levels and spring flow in the MRSA is greatly affected by pumping in the MRSA and less by distant wells.

- Water Quality and isotopic data required to address flow between groundwater basins, local recharge, and regional flow and support the formation of one "Administrative Unit" have not been presented in the Interim Order.

- Groundwater pumping in the LWRFS during the 2-year Order 1169 Aquifer test was approximately 14,000 AFY and resulted in a cumulative 0.22 cfs (129 AF) drop in flow at the Pederson Spring Complex. Objective criteria should be developed in the Interim Order if these springs are to be relied upon to determine whether impacts are occurring to Moapa dace habitat or senior decreed water rights.

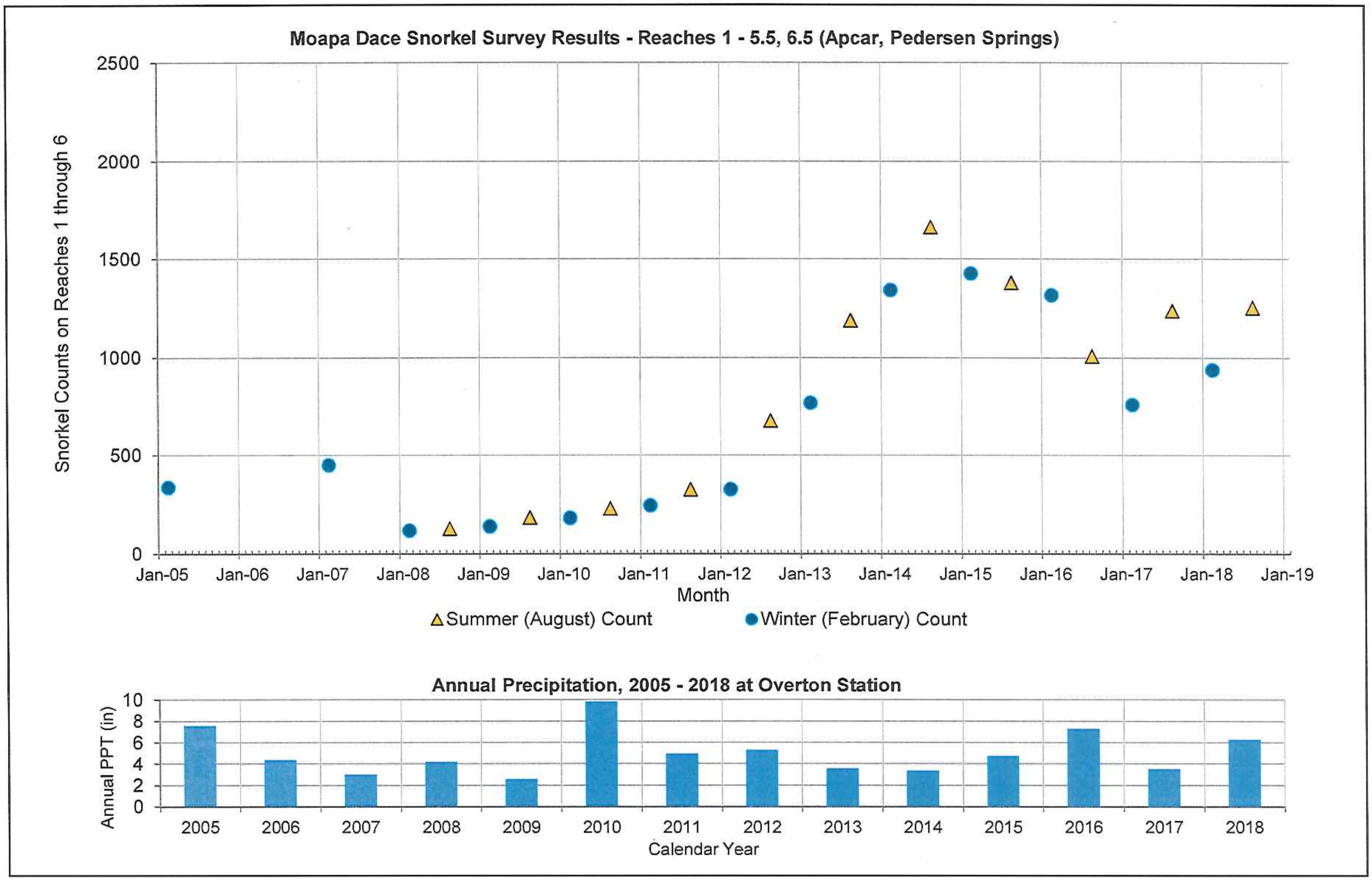
Conclusions that may be drawn from review of groundwater level data in CSV, including: (1) the effect of Order 1169 pumping on groundwater availability is masked by natural climatic variability; (2) the basin may be in equilibrium based on a long-term balanced hydrologic period (i.e. no groundwater mining); (3) recharge from local precipitation events affect groundwater levels; and (4) boundary effects from structural faulting and folding affect groundwater flow. The Interim Order fails to recognize recent hydrologic and climatic data that does not support managing the LWRFS as one Administrative Unit. Additionally, the data collected between January 2013 and 2018 show that a long-term sustainable water supply for municipal use, consistent with NRS Chapter 534, exists within the Administrative Unit, and specifically within the Coyote Springs Valley (CSV).

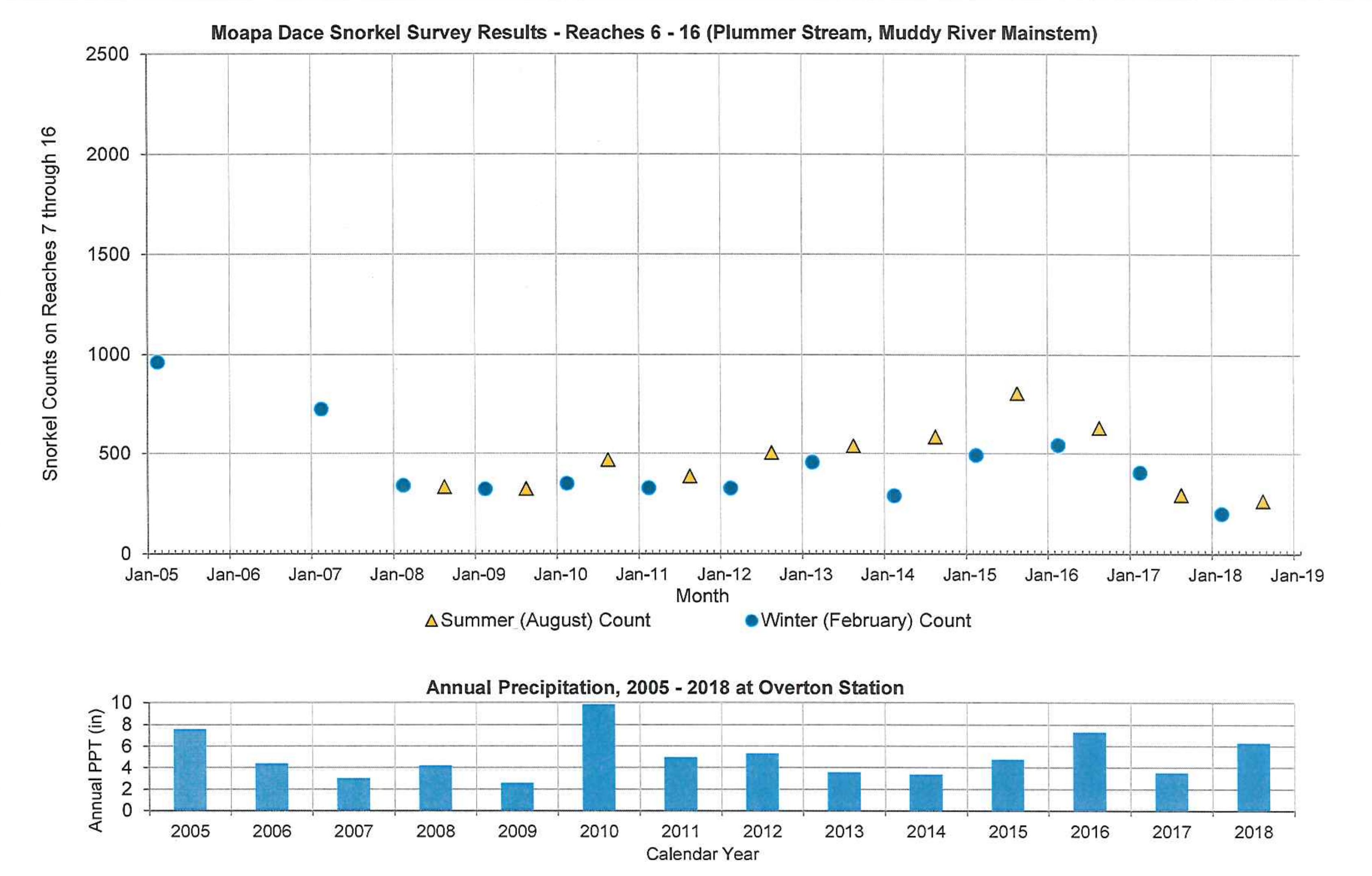
ATTACHMENT A

MOAPA DACE RECENT SNORKEL COUNTS

2018 Biological Working Group


Moapa Dace Snorkel Survey Results - All Reaches
Snorkel Counts on Reaches 1 through 16
2500
2000
1500
1000
500
0
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Month
Summer (August) Count
Winter (February) Count
Annual Precipitation, 2005 - 2018 at Overton Station
Annual PPT (in)
10
8
6
4
2
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Calendar Year


Moapa Dace Snorkel Survey Results - Reaches 1 - 5.5, 6.5 (Apcar, Pedersen Springs)
Snorkel Counts on Reaches 1 through 6
2500
2000
1500
1000
500
0
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Month
△ Summer (August) Count
● Winter (February) Count
Annual Precipitation, 2005 - 2018 at Overton Station
Annual PPT (in)
10
8
6
4
2
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Calendar Year



Moapa Dace Snorkel Survey Results - Reaches 6 - 16 (Plummer Stream, Muddy River Mainstem)

Annual Precipitation, 2005 - 2018 at Overton Station

Appendix B

General Grouping of Geologic Layers

STETSON
ENGINEERS INC.

DRAFT NOTE TO FILE

785 Grand Avenue, Suite 202 • Carlsbad, California • 92008
Phone: (760) 730-0701 FAX: (415) 457-1638 Web site: www.stetsonengineers.com

TO: File
DATE: April 26, 2019
FROM: Nichole Weedman
JOB NO: 2674-002
RE: Grouping of Geologic Units in the Lower White River Flow System, Nevada.

1.0. GEOLOGIC UNITS

Rawley et al. (2017) mapped twenty-two geologic units within the Lower White River Flow System (LWRFS). These units range in age from Cambrian to Quaternary, and compose the three aquifers observed in the Lower White River Flow System: the carbonate aquifer (oldest), the volcanic aquifer and the alluvial aquifer (youngest). Due to density of individual geologic units, units were grouped based on water-bearing properties, rock type, and age. Description of units grouped can be found in Table 1.

2.0. PALEOZOIC BASEMENT AND CARBONATE ROCKS

Paleozoic rock units found in the LWRFS were grouped as 1) Basement or 2) Paleozoic Carbonate Rocks based largely on rock type and presence within the carbonate rock aquifer.

Middle Cambrian to late Proterozoic (CpCs)

- This rock unit was grouped as Paleozoic Basement Rock. CpCs is composed largely of metamorphic quartzite with minor limestone and shale. Based upon rock type and Rowley, et al.'s (2017) definition of the lower aquifer, it can be inferred that this geologic unit is not part of the carbonate rock aquifer. CpCs was classified as Paleozoic Basement.

Upper to Middle Cambrian (Cm)

- Cm was grouped with the Paleozoic Carbonate Rock unit. Rowley, et al. (2017) defined this unit as "a thick limestone sequence that marks the base of the lower carbonate rock aquifer." Inclusion within the carbonate rock aquifer was the reason this unit was grouped as Paleozoic Carbonate Rock.

TABLE 1. LOWER WHITE RIVER FLOW SYSTEM

Era	NV Bureau of Mines Units (Rowley, et al., 2017)	Grouped Units[1]
Cenozoic	QTa	Basin Fill
	QTB	Volcanic
	Ts4	Basin Fill
	Tt4	Volcanic
	Tt3	Volcanic
	Tt2	Volcanic
	Ta5	Volcanic
	Ti	Volcanic
Mesozoic	Ks	Sedimentary
	Js	Sedimentary
	^s	Sedimentary
Paleozoic	Pp	Carbonate
	Par	Carbonate
	P*	Carbonate
	MD	Carbonate
	Du	Carbonate
	Ds	Carbonate
	Ol	Carbonate
	Cc	Carbonate
	Cu	Carbonate
	Cm	Carbonate
	CpCs	Basement

---

[1] Units were grouped as of Paleozoic Basement, Paleozoic Carbonate Rocks, Mesozoic Sedimentary Rocks, Cenozoic Volcanic Rocks, or Cenozoic Basin Fill

Lower Ordovician? to Upper Cambrian (Cu)

- This unit was grouped as Paleozoic Carbonate Rock based on rock type (undivided limestone and shale) and map contacts. Cu was in contact with numerous other rock units grouped as Paleozoic Carbonate Rocks, and was observed in the surrounding ranges.

Cambrian (Cc)

- Cc was grouped as Paleozoic Carbonate Rock based on the rock type (undivided carbonate sedimentary rock).

Middle to Lower Ordovician (Ol)

- Ol was grouped as Paleozoic Carbonate Rock. Although this unit is composed largely of quartzite, two dolomite formations (Laketown and Ely Springs) are present in the LWRFS allowing this unit to be grouped with the Paleozoic Carbonate Rock unit.

Middle to Lower Devonian (Ds)

- Ds was grouped as Paleozoic Carbonate Rock due to rock type (undivided dolomite).

Devonian (Du)

- Like Ds, this geologic unit was grouped as Paleozoic Carbonate Rock based on its rock type (undivided carbonate sedimentary rocks).

Lower Mississippian to Upper Devonian (MD)

- This unit was grouped as Paleozoic Carbonate Rock based on rock type. In the LWRFS MD is composed primarily of limestone.

Lower Permian to Pennsylvanian (P*)

- P* was grouped with Paleozoic Carbonate Rock based on rock type (limestone).

Lower Permian (Par)

- Par was included with Paleozoic Carbonate Rock although it is not carbonate. Par is an undivided sandstone unit within the carbonate rock aquifer (Rowley, et al., 2017). Due to its inclusion within the carbonate aquifer, Par was grouped with carbonate rocks.

Upper and Lower Permian (Pp)

- This unit was included with Paleozoic Carbonate Rock based on rock type as well as the unit's water-bearing properties. This unit is composed of limestone and marks the top of the carbonate aquifer (Rowley et al., 2017).

3.0. MESOZOIC SEDIMENTARY ROCKS

Mesozoic sedimentary rocks found in the LWRFS were grouped as a separate unit. This decision was made based on the unit's age and low-permeability. Mesozoic Sedimentary Rocks found in the LWRFS include Triassic (TRs), Jurassic (Ji), and Upper and Lower Cretaceous (Ks). These units are composed of clastic, fluvial deposits.

4.0. CENOZOIC VOLCANIC AND BASIN FILL ROCK UNITS

Cenozoic rock units observed in the LWRFS were grouped as Cenozoic Volcanic Rocks or Cenozoic Basin Fill. The grouping of units was based on rock type as well as water-bearing properties. Volcanic Rocks observed in the LWRFS are the result of surrounding caldera complexes and compose the volcanic rock aquifer. The remaining basin fill observed in the LWRFS formed as a result of fluvial deposits, and compose the alluvial aquifer.

Miocene to Paleocene (Ti)

- Ti was grouped as Cenozoic Volcanic Rock based on rock type and map contacts. Ti is an intrusive pluton formed from the intrusion of magma into another rock body. This rock unit was grouped with Cenozoic Volcanic Rocks because plutonic and volcanic rocks form through similar processes, however plutonic rocks cool underground whereas volcanic rocks cool above ground.

Miocene (Ta4)

- Ta4 was grouped as Cenozoic Volcanic Rock based on rock type. This unit is composed of lava flows.

Oligocene (Tt2), Miocene to Oligocene (Tt3), and Miocene (Tt4)

- Tt2, Tt3, and Tt4 were grouped as Cenozoic Volcanic Rock based on rock type. All three units are poorly to densely welded ash-flow tuffs with interbedded ash-fall tuffs.

Miocene (Ts4)

- Ts4 was grouped a Cenozoic Basin Fill based on Rowley, et al.'s (2017) definition of Ts4 as "a basal basin-fill sedimentary unit."

Holocene to lower Miocene (QTb)

- QTb is the final unit observed in the LWRFS grouped as Cenozoic Volcanic Rock. Rowley, et al. (2017) stated QTb is "The mafic end of the bimodal volcanic sequence."

Holocene to lower Miocene (QTa)

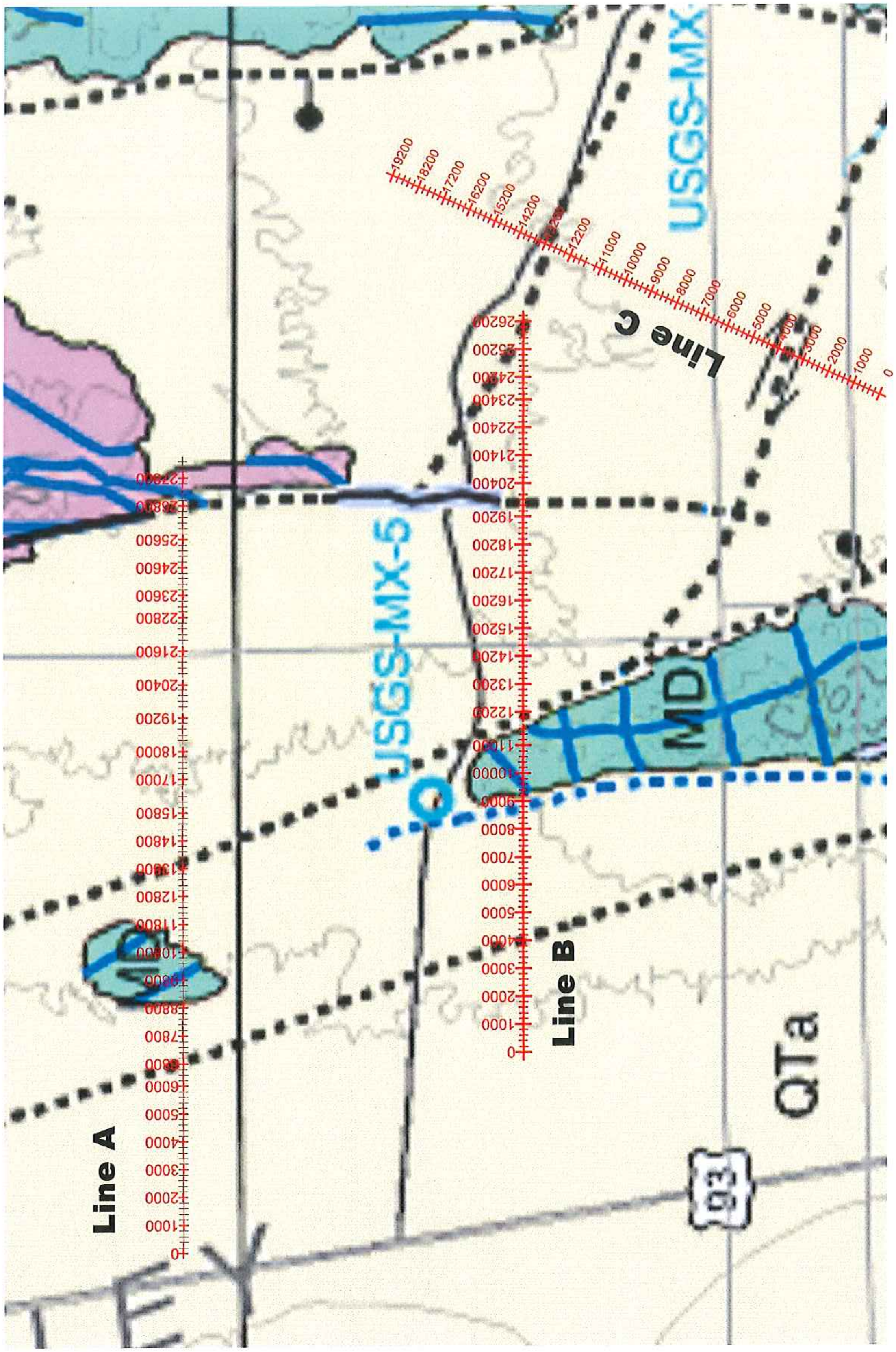
- QTa was grouped as the final Cenozoic Basin Fill unit observed in the LWRFS. This unit was formed through fluvial processes and forms the alluvial aquifer.

5.0. REFERENCES

Rowley, P.D., Dixon, G.L., Mankinen, E.A., Pari, K.T., McPhee, D.K., McKee, E.H., Burns, A.G., Watrus, J.M., Ekren, E.B., Patrick, W.G., and Brandt, J.M., 2017, Geology and geophysics of White Pine and Lincoln Counties, Nevada, and adjacent parts of Nevada and Utah: The geologic framework of regional groundwater flow systems: Nevada Bureau of Mines and Geology Report 56.

Appendix C

April 2019 CSAMT Preliminary Results


Line A
Line B
Line C
USGS-MX-5
USGS-MX
MD
MD
QTa
93
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12200
13200
14200
15200
16200
17200
18200
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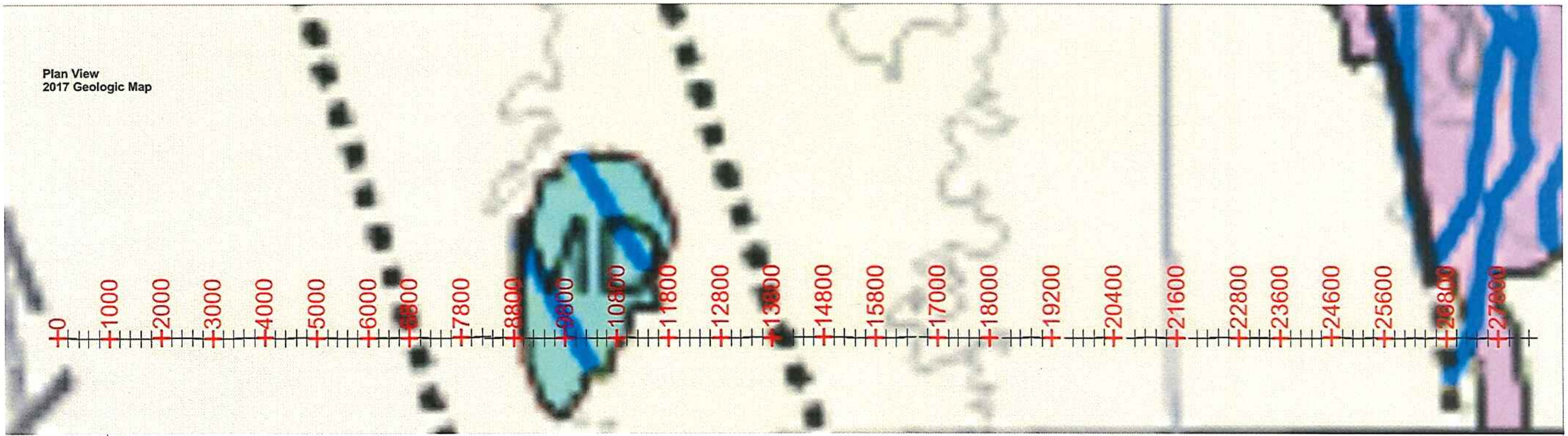
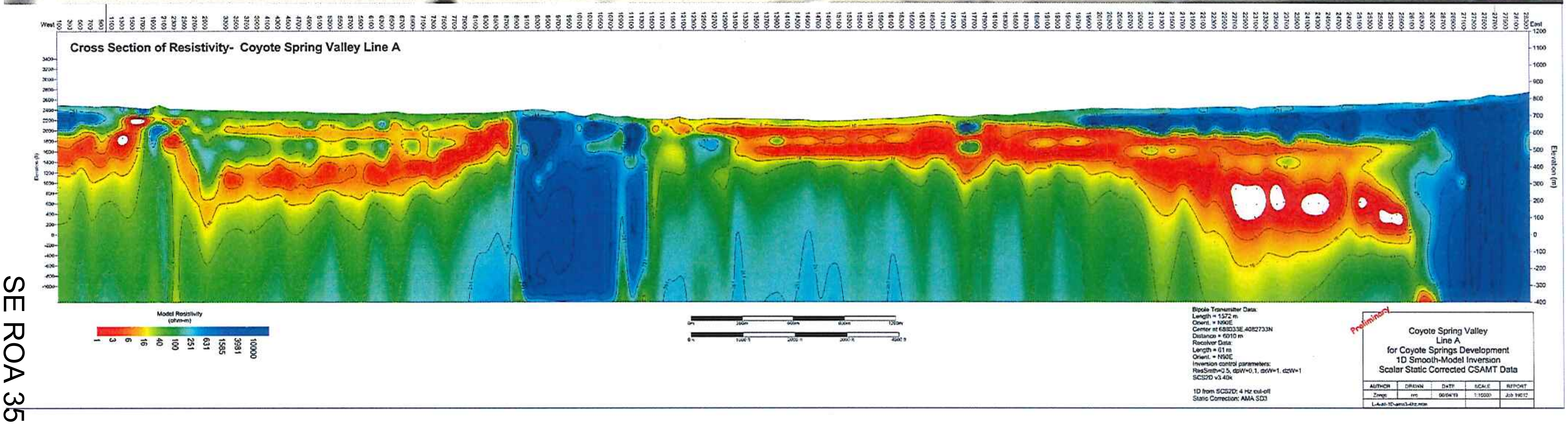
5000

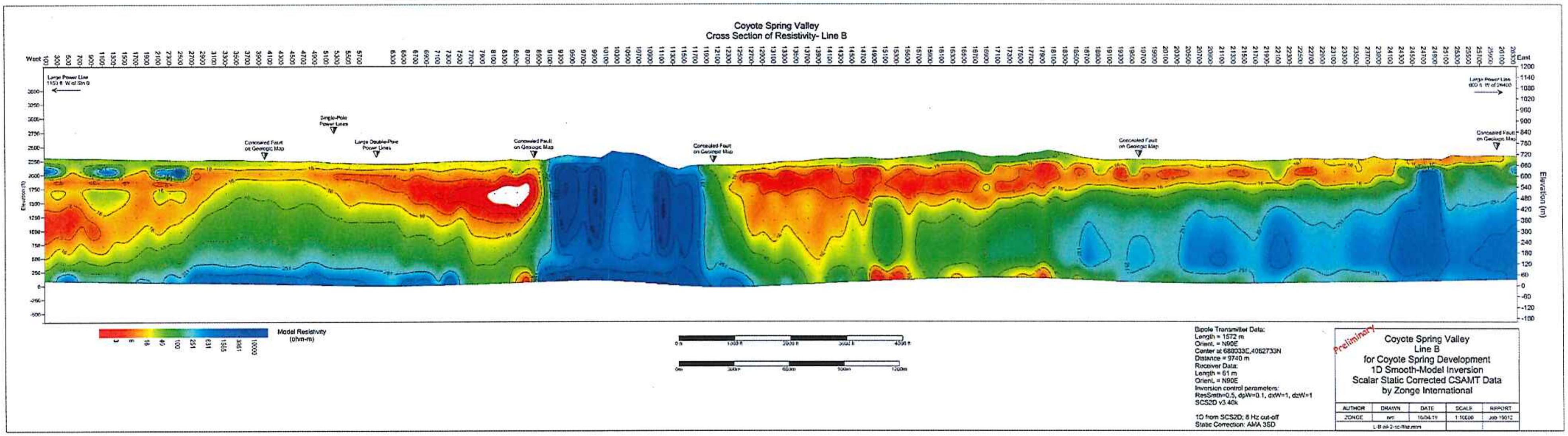


Plan View
2017 Geologic Map



Cross Section of Resistivity- Coyote Spring Valley Line A

Coyote Spring Valley
Cross Section of Resistivity- Line B



Bipole Transmitter Data:
Length = 1572 m
Orient. = N90E
Center at 668033E,4062733N
Distance = 9740 m
Receiver Data:
Length = 61 m
Orient. = N90E
Inversion control parameters:
ResSmth=0.5, dpW=0.1, dxW=1, dzW=1
SCS2D v3.40k

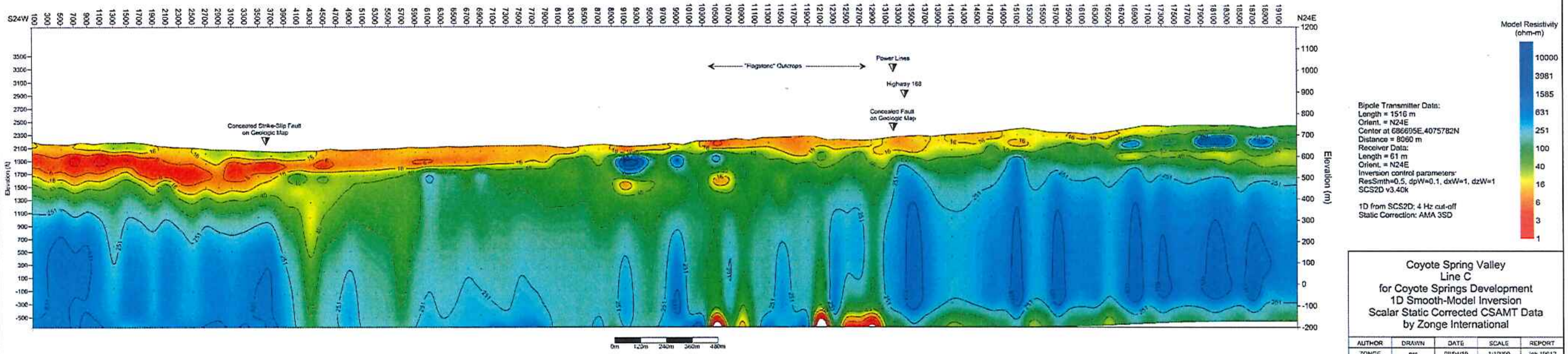
1D from SCS2D; 8 Hz cut-off
Static Correction: AMA 3SD

Preliminary

Coyote Spring Valley
Line B
for Coyote Spring Development
1D Smooth-Model Inversion
Scalar Static Corrected CSAMT Data
by Zonge International

AUTHOR	DRAWN	DATE	SCALE	REPORT
ZONGE	wrc	15/04/11	1:10000	Job 10012
L-B-al-2-sc-fltz.mtm				

Coyote Spring Valley
Cross Section of Resistivity- Line C



Bipole Transmitter Data:
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Orient. = N24E
Center at 686695E,4075782N
Distance = 8060 m
Receiver Data:
Length = 61 m
Orient. = N24E
Inversion control parameters:
ResSmth=0.5, dpW=0.1, dxW=1, dzW=1
SCS2D v3.40k

1D from SCS2D; 4 Hz cut-off
Static Correction: AMA 3SD

Coyote Spring Valley
Line C
for Coyote Springs Development
1D Smooth-Model Inversion
Scalar Static Corrected CSAMT Data
by Zonge International

AUTHOR	DRAWN	DATE	SCALE	REPORT
ZONGE	nrc	08/04/19	1:10000	Job 10612

L-C-AllSC3-1D-4Hz.mtm

Appendix D

SUPPORTING GROUNDWATER LEVEL AND PUMPING GRAPHS

Appendix D

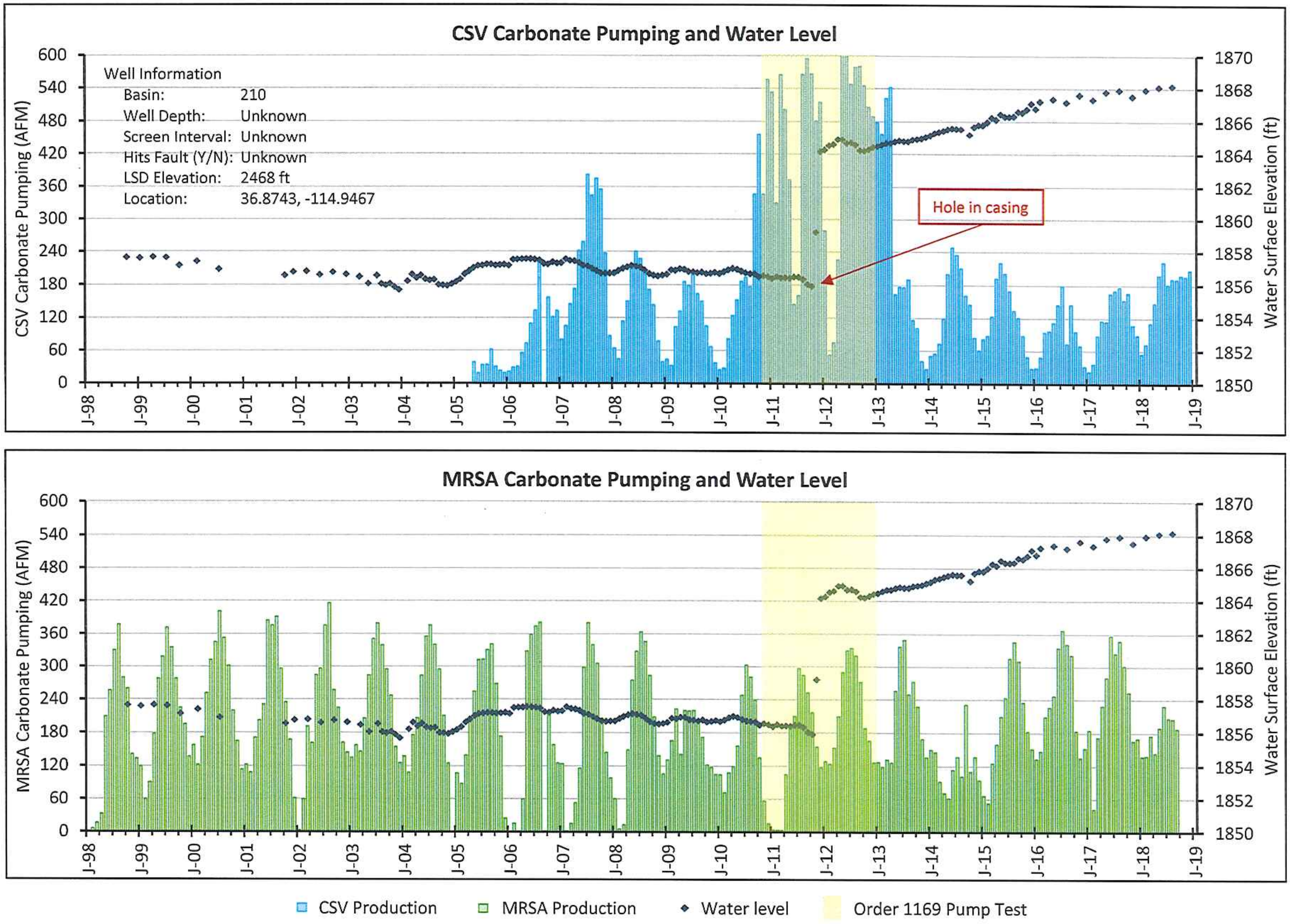
Carbonate Aquifer Monitoring Wells

Coyote Spring Valley and Muddy River Springs Area

				Screened Interval		Hits Fault		Location	
No.	**Well Name**	**Basin**	**Well Depth**	**Start Depth**	**End Depth**	**(Y/N)**	**LSD Elevation**	**Lat**	**Long**
1	CE-VF-2	210					2468 ft	36.8743	-114.9467
2	CSVM-1	210	1060 ft	320 ft	1020 ft	N	2161 ft	36.7912	-114.8862
3A 3B	CSVM-2	210	1425 ft	720 ft	1380 ft	N	2573 ft	36.6618	-114.9231
4	CSVM-3	210	1230 ft	380 ft	1180 ft	N	2651 ft	37.0525	-114.9834
5	CSVM-4	210	1605 ft	800 ft	1580 ft	N	2842 ft	36.9911	-114.8865
6	CSVM-5	210	1783 ft	1020 ft	1760 ft	N	3131 ft	36.7476	-114.9804
7A 7B	CSVM-6	210	1200 ft	420 ft	1160 ft	N	2252 ft	36.8325	-114.9092
8	MX-4	210	669 ft			N	2177 ft	36.7957	-114.8928
9	EH-4	219					1934 ft	36.7064	-114.7170
10	EH-5B	219					1845 ft	36.7329	-114.7426
11	UMVM-1	219	1785 ft	960 ft	1760 ft	N	1785 ft	36.7581	-114.8232
12	CSV-2	219	478 ft				2186 ft	36.7807	-114.7227

Basin 210 - Coyote Spring Valley

CE-VF-2



CSV Carbonate Pumping and Water Level

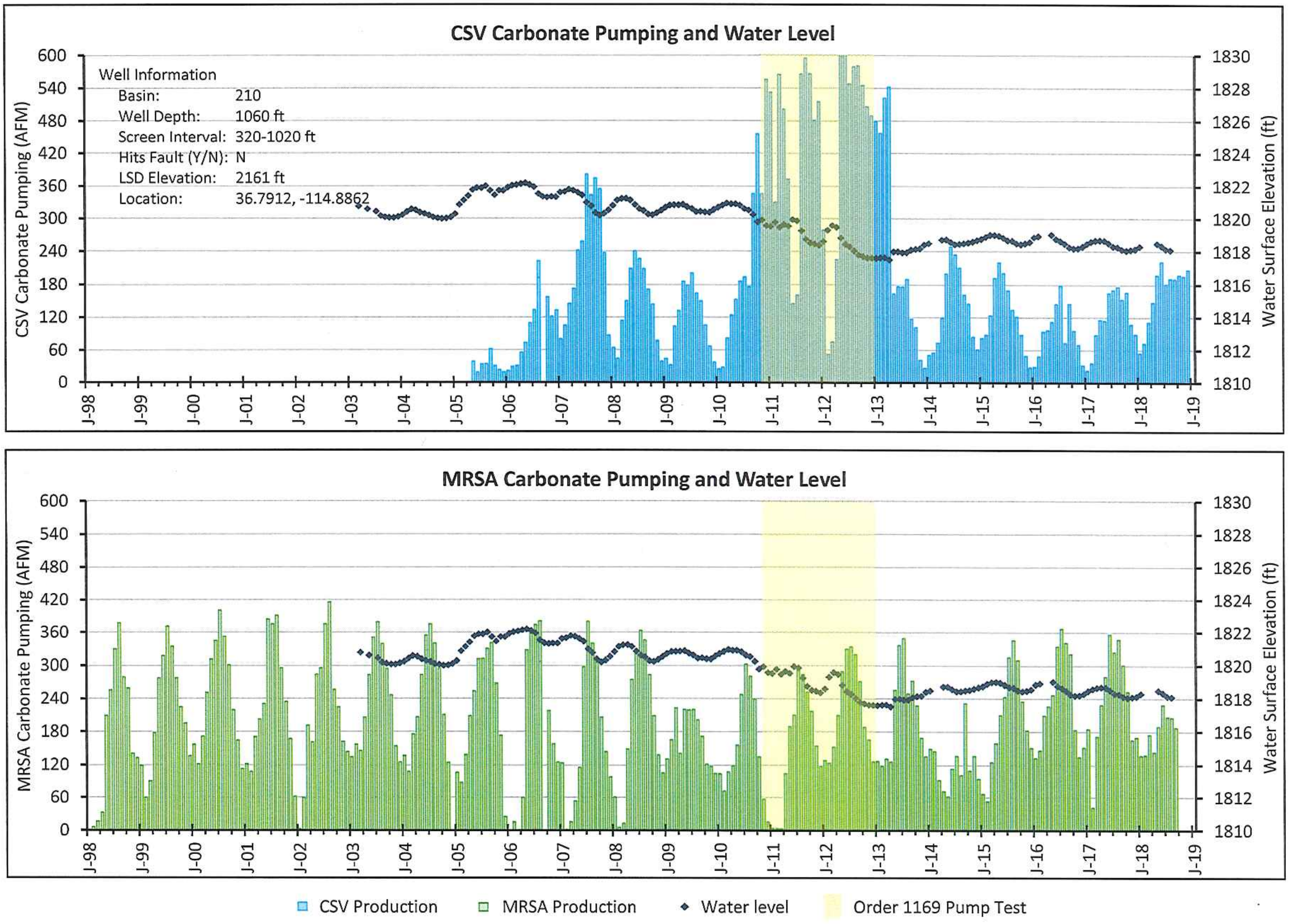
Well Information
Basin: 210
Well Depth: Unknown
Screen Interval: Unknown
Hits Fault (Y/N): Unknown
LSD Elevation: 2468 ft
Location: 36.8743, -114.9467

Hole in casing

MRSA Carbonate Pumping and Water Level

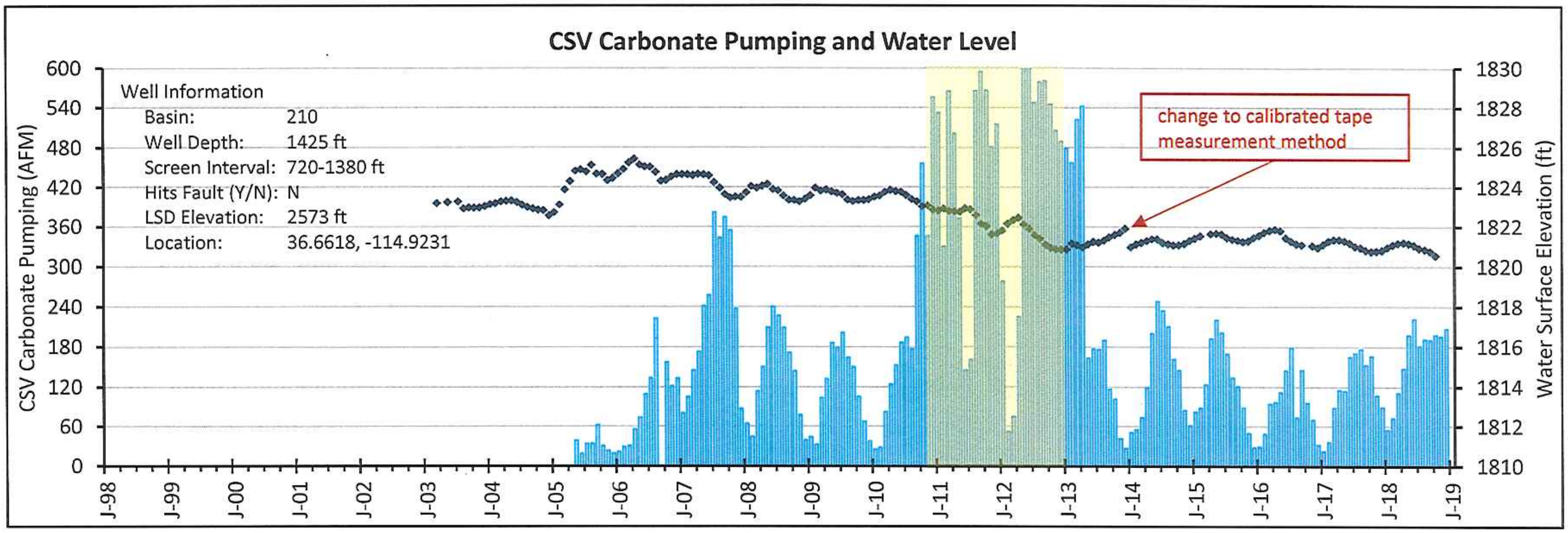
Basin 210 - Coyote Spring Valley

CSVM-1

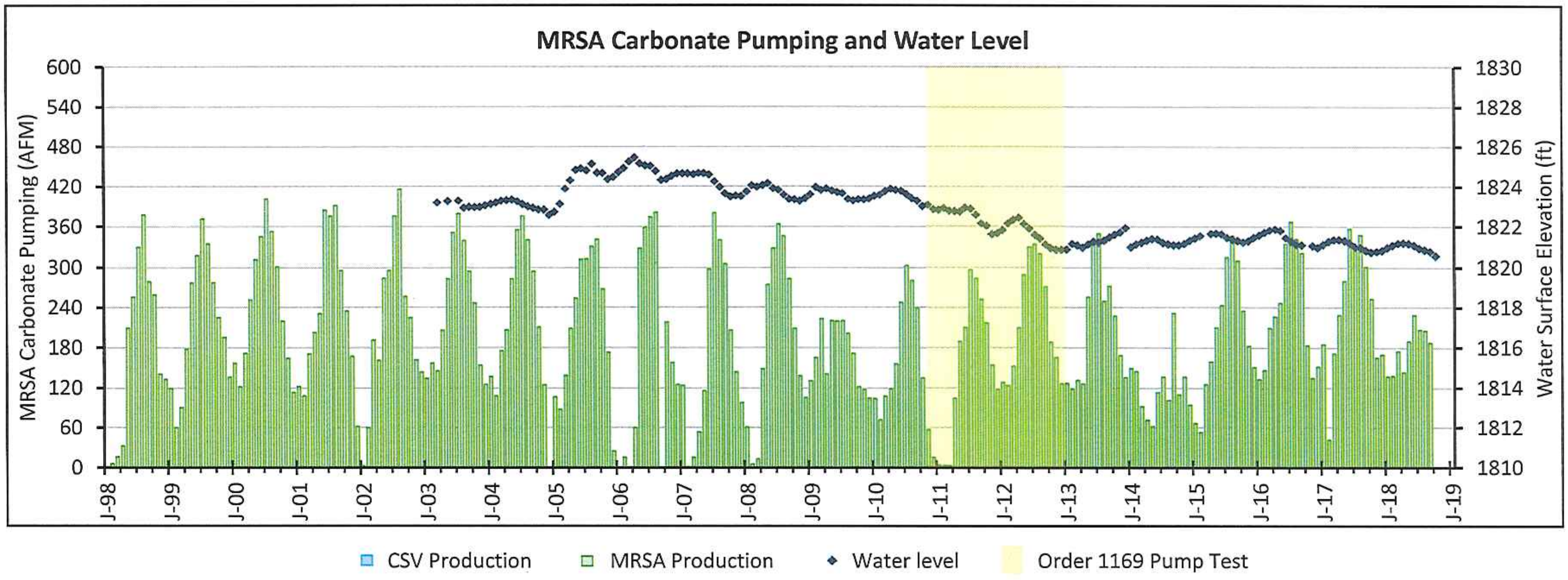


Basin 210 - Coyote Spring Valley

CSVM-2



CSV Carbonate Pumping and Water Level

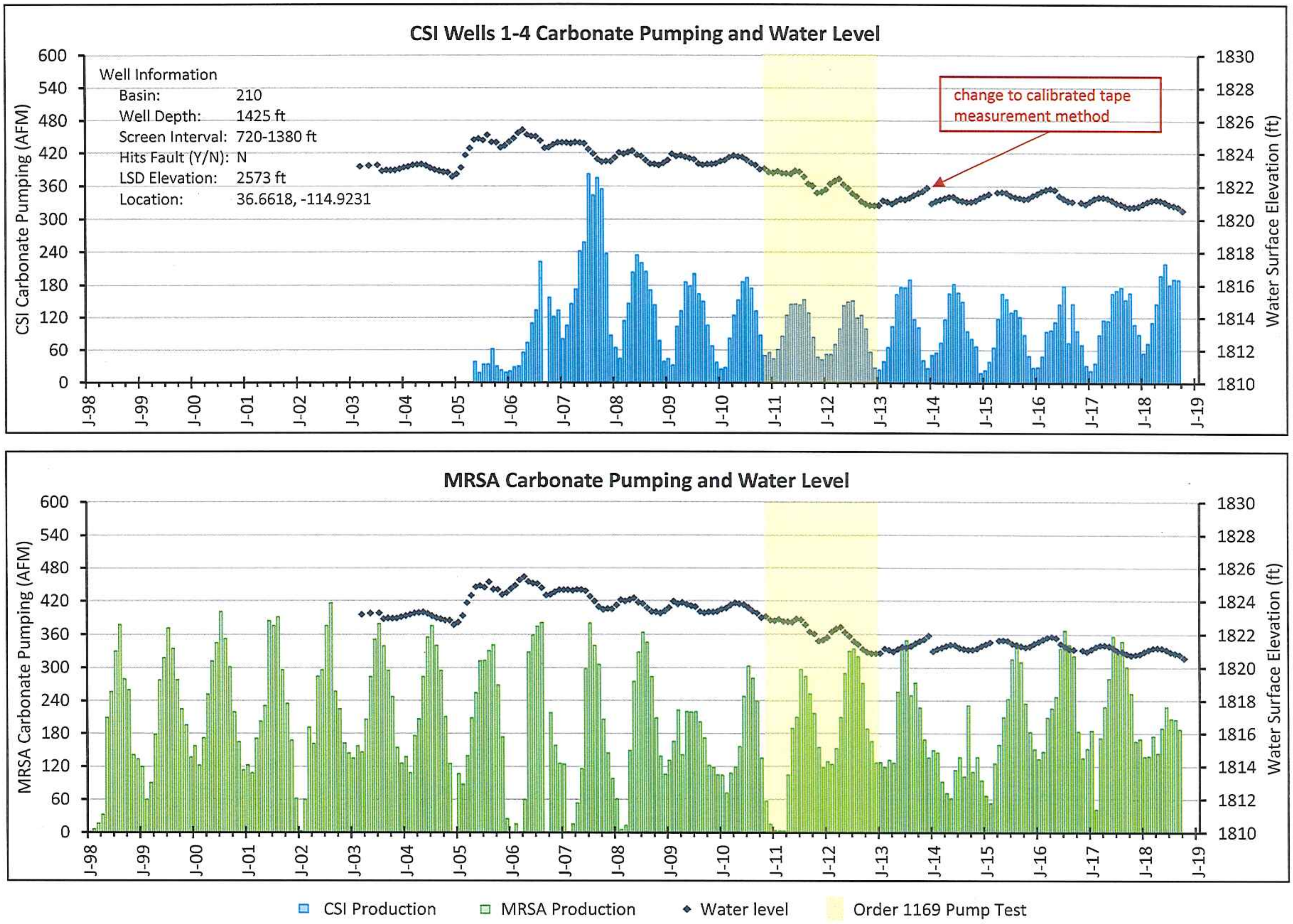


MRSA Carbonate Pumping and Water Level

3A

Basin 210 - Coyote Spring Valley

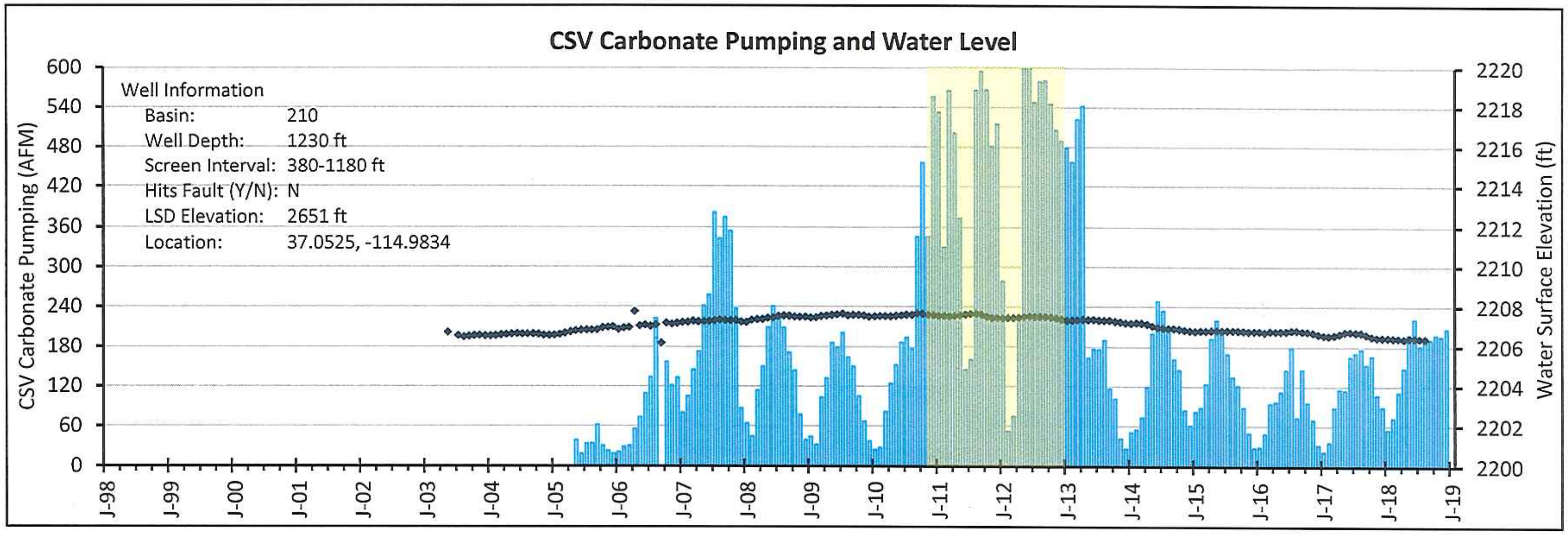
CSVM-2

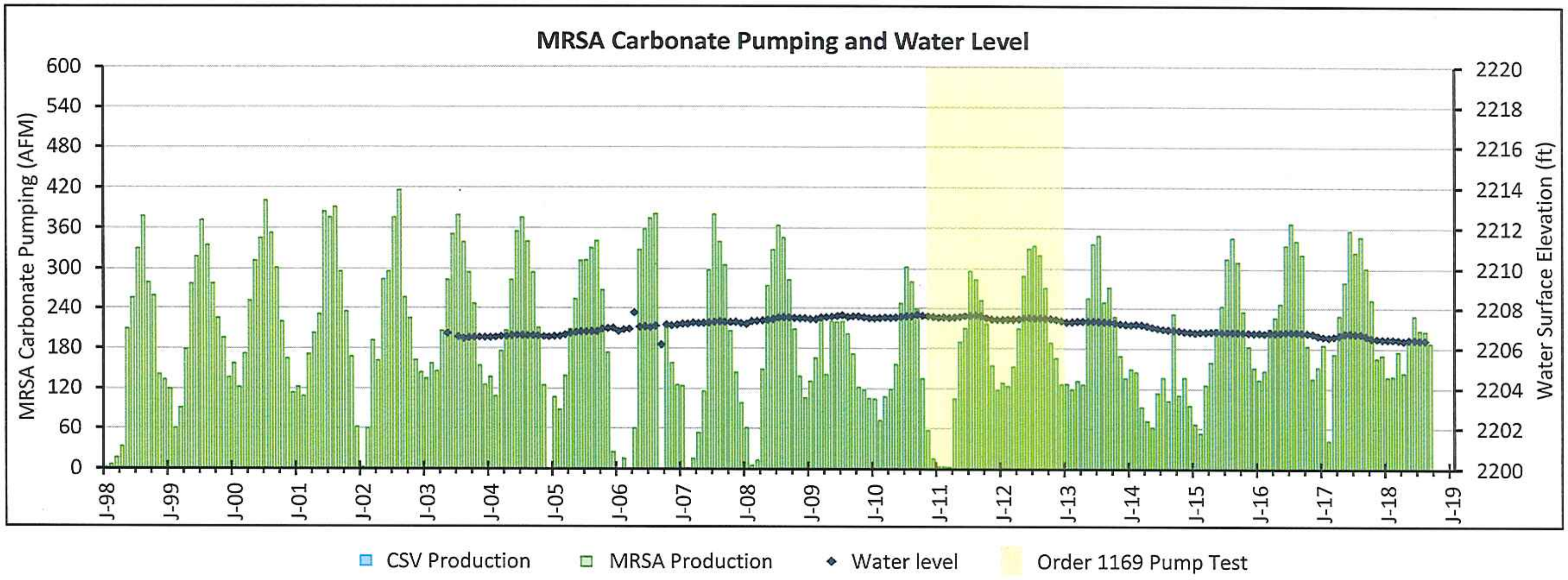


Well Information
Basin: 210
Well Depth: 1425 ft
Screen Interval: 720-1380 ft
Hits Fault (Y/N): N
LSD Elevation: 2573 ft
Location: 36.6618, -114.9231

Basin 210 - Coyote Spring Valley

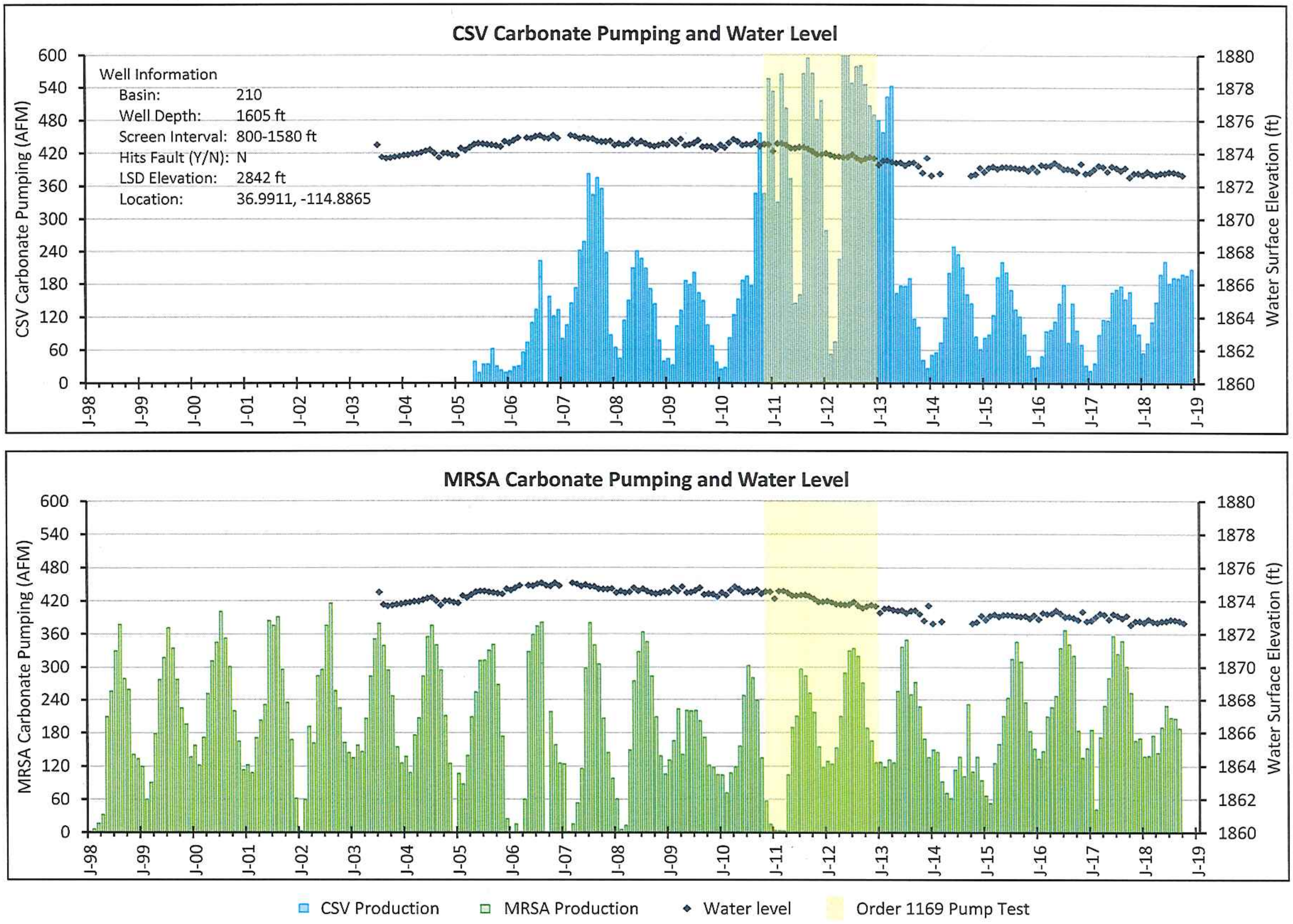
CSVM-3





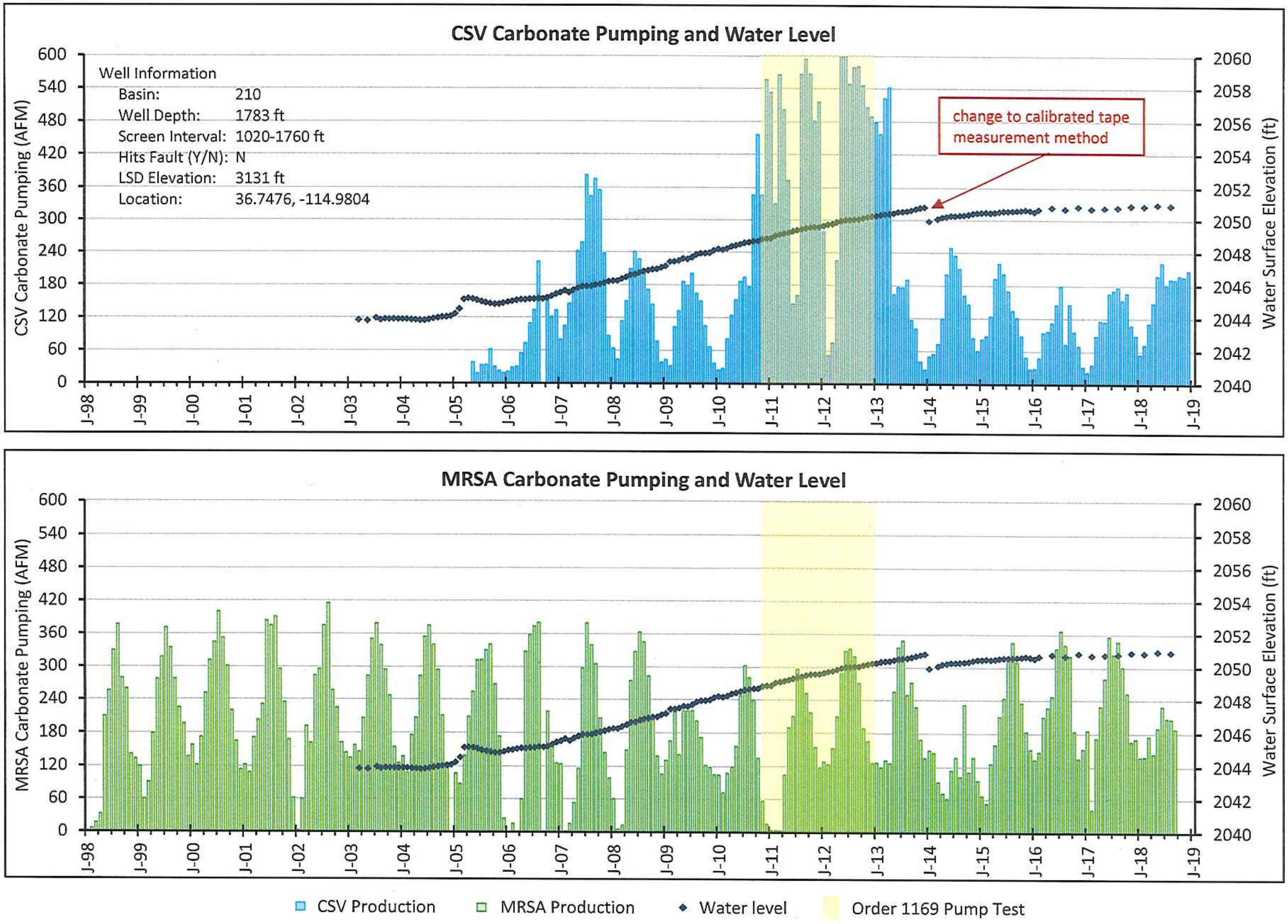
Basin 210 - Coyote Spring Valley

CSVM-4



Basin 210 - Coyote Spring Valley

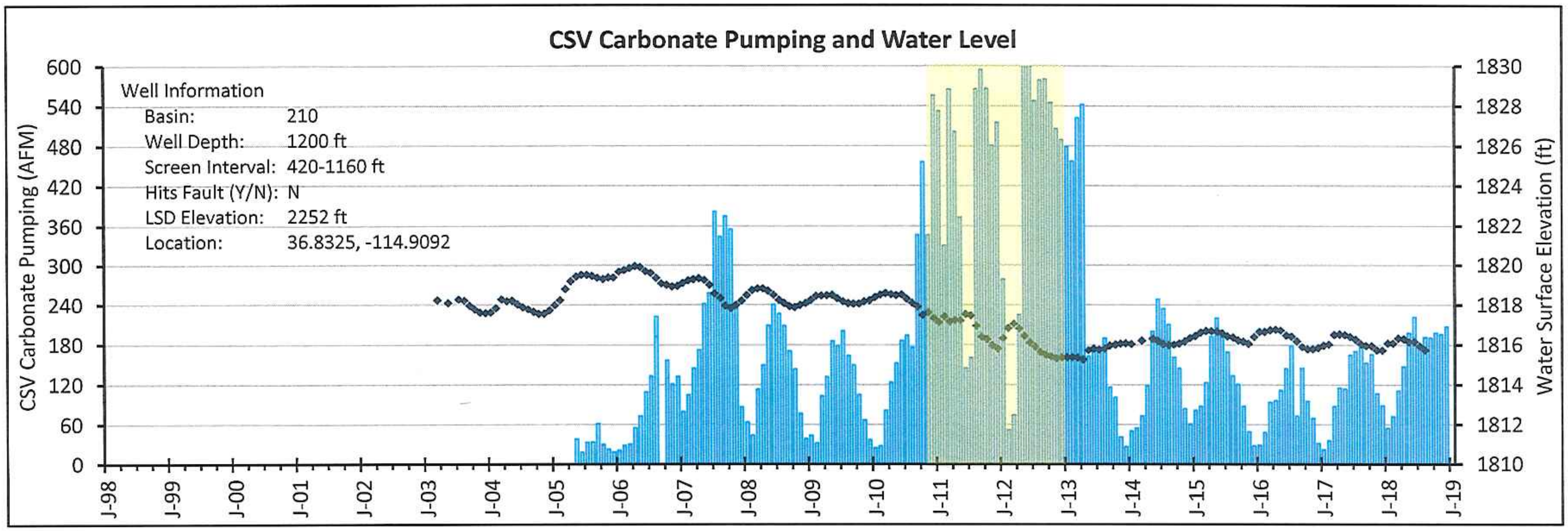
CSVM-5

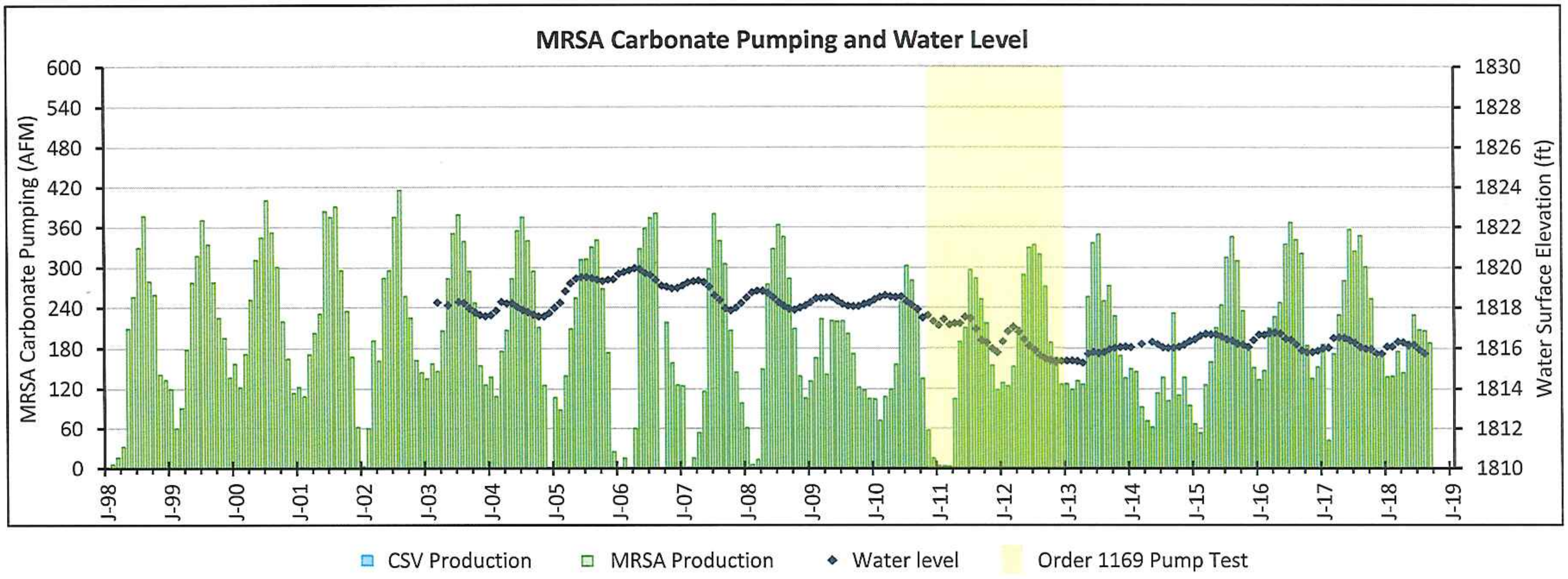

CSV Carbonate Pumping and Water Level

MRSA Carbonate Pumping and Water Level

Basin 210 - Coyote Spring Valley

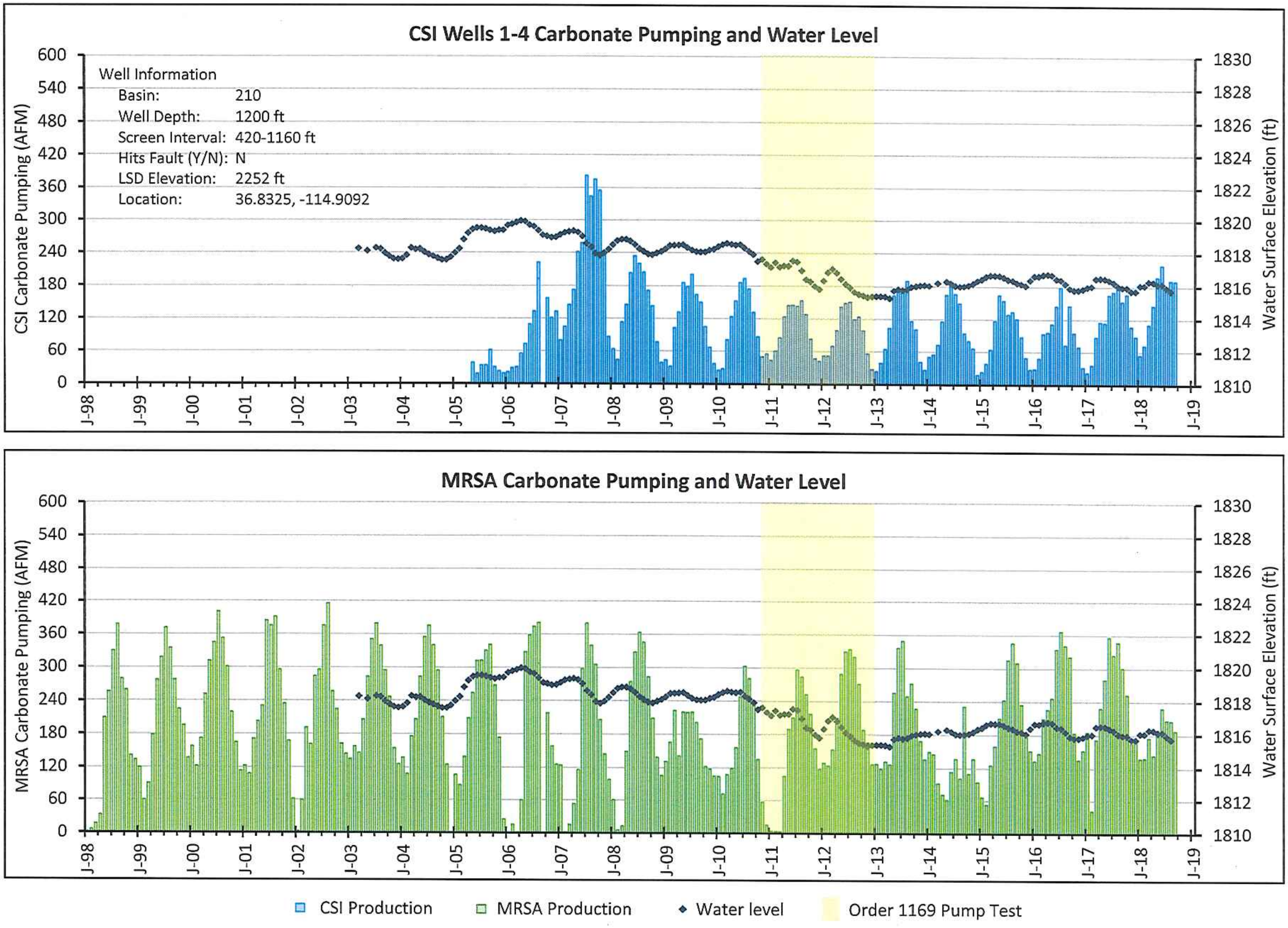
CSVM-6


CSV Carbonate Pumping and Water Level


MRSA Carbonate Pumping and Water Level

Basin 210 - Coyote Spring Valley

CSVM-6



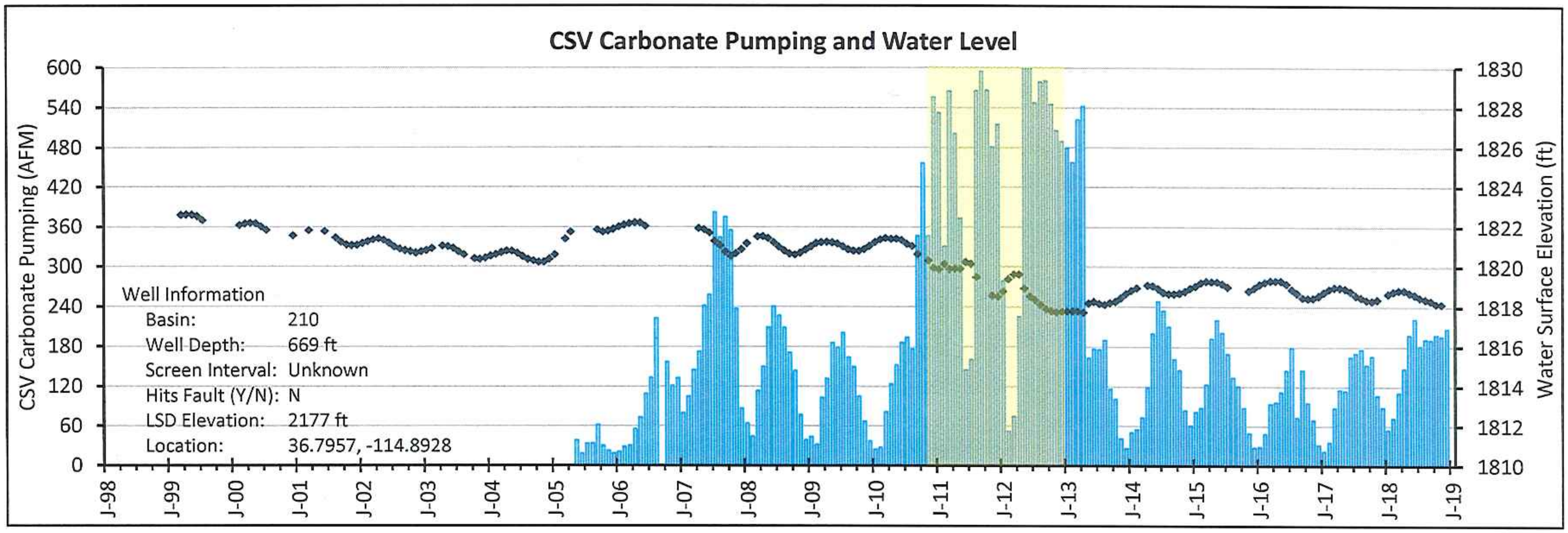
CSI Wells 1-4 Carbonate Pumping and Water Level

MRSA Carbonate Pumping and Water Level

7B

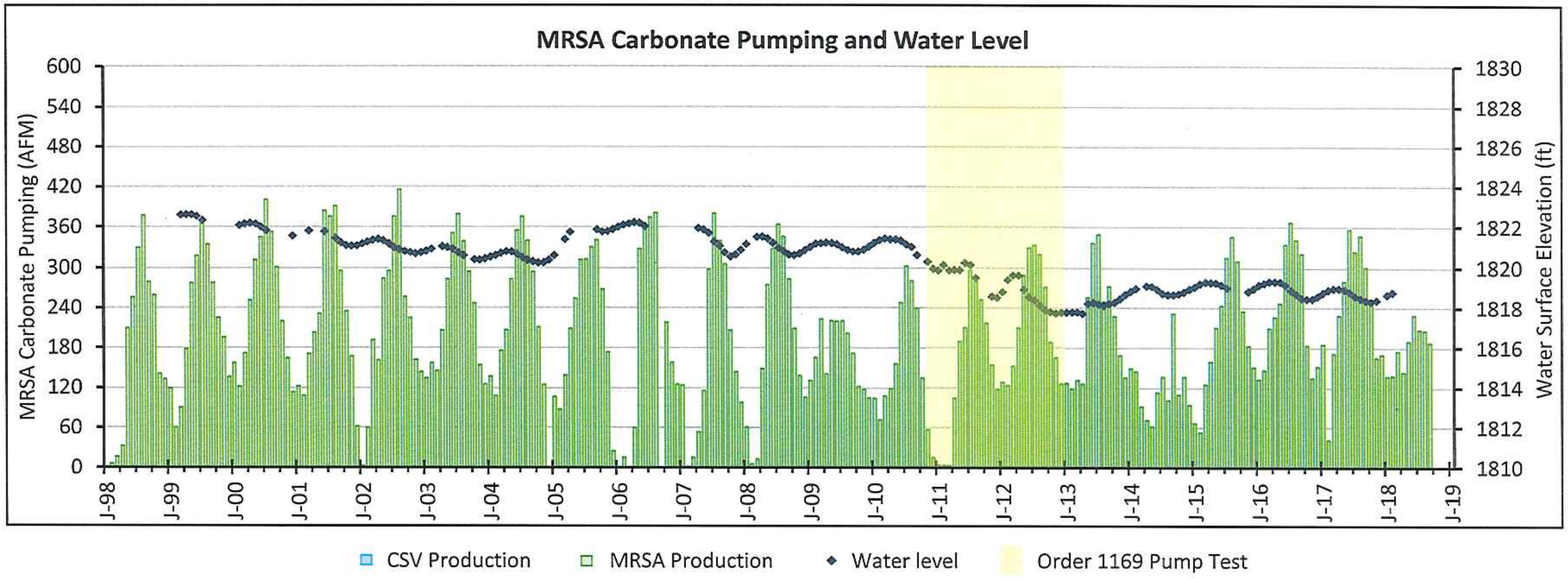
Basin 210 - Coyote Spring Valley

MX-4

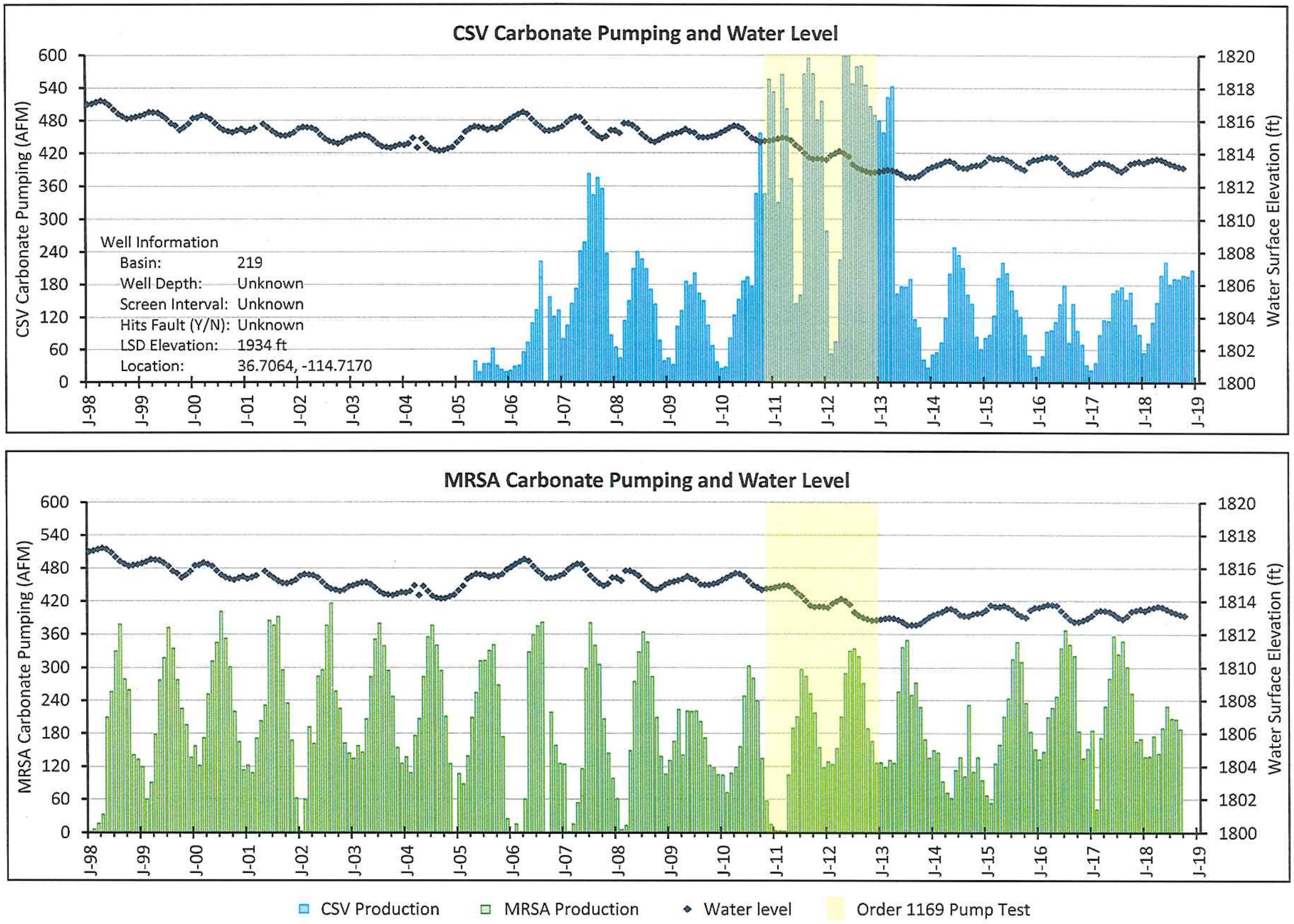


Well Information

Basin:	210
Well Depth:	669 ft
Screen Interval:	Unknown
Hits Fault (Y/N):	N
LSD Elevation:	2177 ft
Location:	36.7957, -114.8928

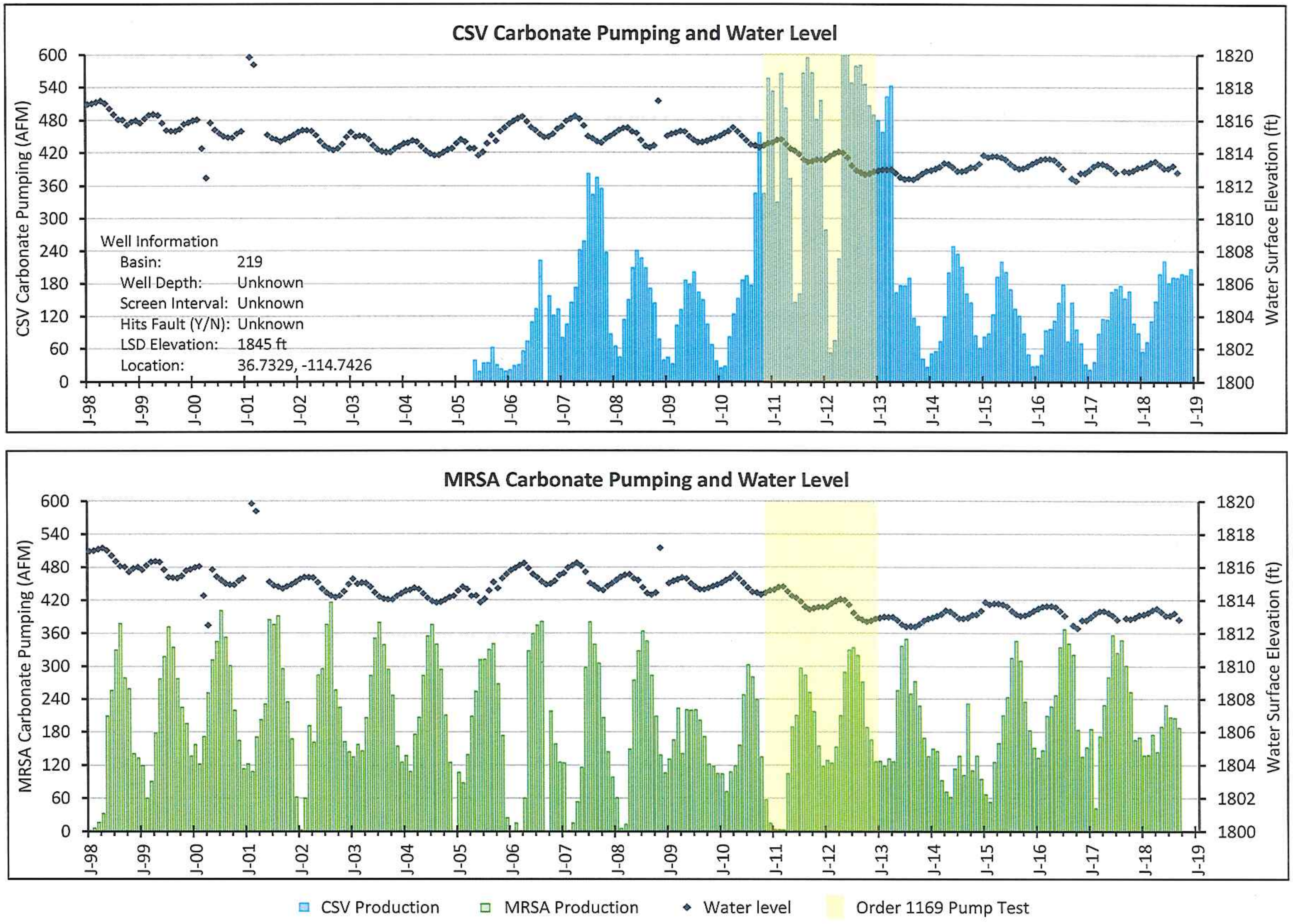


Basin 219 - Muddy River Springs Area



Basin 219 - Muddy River Springs Area

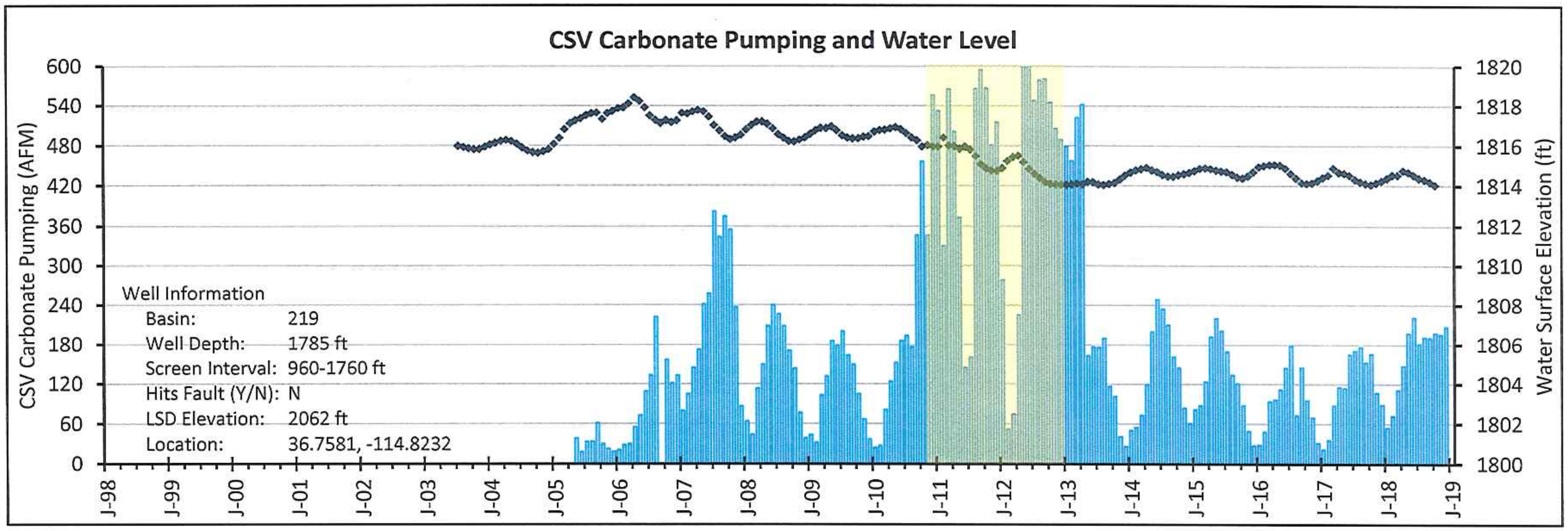
EH-5B



Well Information
Basin: 219
Well Depth: Unknown
Screen Interval: Unknown
Hits Fault (Y/N): Unknown
LSD Elevation: 1845 ft
Location: 36.7329, -114.7426

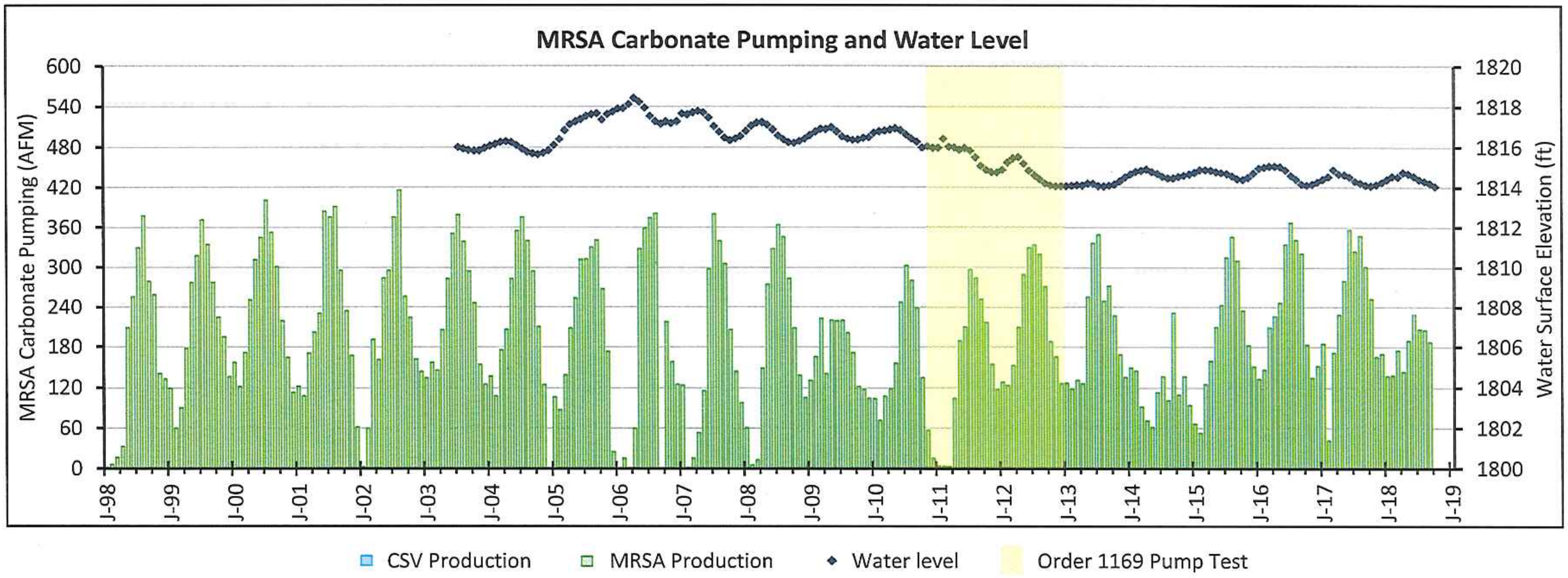
Basin 219 - Muddy River Springs Area

UMVM-1



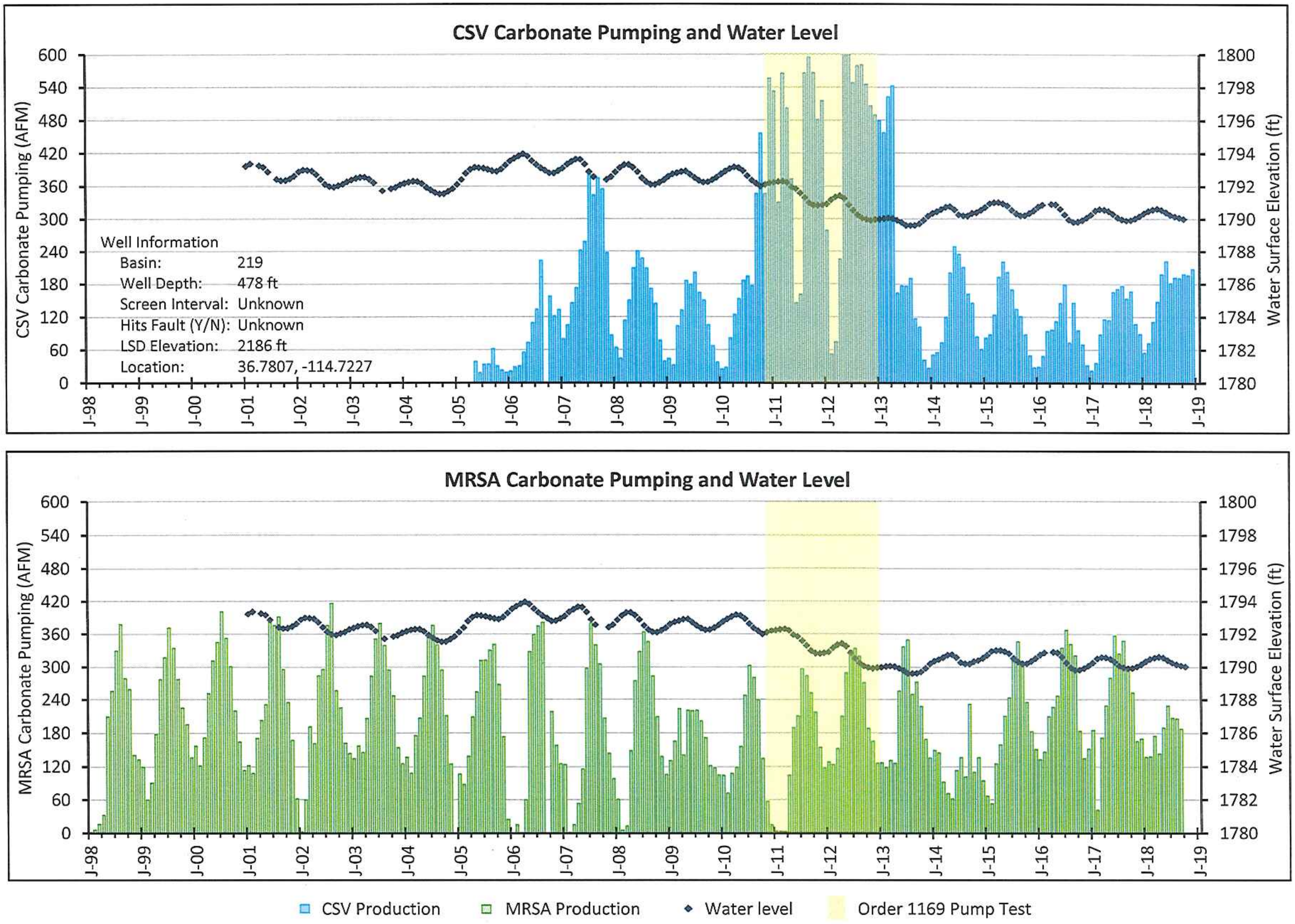
Well Information

Basin: 219
Well Depth: 1785 ft
Screen Interval: 960-1760 ft
Hits Fault (Y/N): N
LSD Elevation: 2062 ft
Location: 36.7581, -114.8232



Basin 219 - Muddy River Springs Area

CSV-2



LARGE LOT FINAL MAP OF

COYOTE SPRINGS VILLAGE A

(COMMON INTEREST COMMUNITY)

BEING A MERGER AND RE-SUBDIVISION OF COMMON LOT C-A , LOTS 1, 2 AND 11 OF PLAT BOOK 141, PAGE 14, PARCEL 3 OF PARCEL MAP FILE 113, PAGE 99, PARCELS 1 AND 4 OF PARCEL MAP FILE 117, PAGE 8, PARCELS 3 AND 4 OF PARCEL MAP FILE 117, PAGE 9, PARCELS 2, 3 AND 4 OF PARCEL MAP FILE 117, PAGE 10, PARCELS 1, 2 AND 3 OF PARCEL MAP FILE 117, PAGE 18 LOCATED WITHIN SECTIONS 15, 16, 21, 22 AND 23, TOWNSHIP 13 SOUTH, RANGE 63 EAST, M.D.M., CLARK COUNTY, NEVADA

OWNER'S CERTIFICATE

COYOTE SPRINGS NEVADA,
DOES HEREBY CERTIFY THAT THEY ARE THE OWNER OF THE PARCEL OF LAND WHICH IS SHOWN UPON THIS MAP OF:

"COYOTE SPRINGS VILLAGE A"

WE HEREBY CONSENT TO THE PREPARATION AND RECORDATION OF THIS PLAT AND DO HEREBY OFFER AND DEDICATE ALL OF THE PUBLIC RIGHTS-OF-WAY, STREETS (EXCEPT PRIVATE STREETS) AND GRANT THE PUBLIC EASEMENTS AS SPECIFICALLY INDICATED AND OUTLINED HEREON TO CLARK COUNTY, NEVADA, ITS SUCCESSORS AND ASSIGNS FOR THE USE OF THE PUBLIC.

FURTHERMORE, THE ABOVE NAMED OWNER OF THE WITHIN PLATTED LANDS DOES HEREBY GRANT AND CONVEY TO COYOTE SPRINGS WATER RESOURCES GENERAL IMPROVEMENT DISTRICT, LINCOLN COUNTY POWER DISTRICT AND LINCOLN COUNTY TELEPHONE, LAS VEGAS VALLEY WATER DISTRICT, COX COMMUNICATIONS LAS VEGAS, INC. AND CLARK COUNTY WATER RECLAMATION DISTRICT, JOINTLY AND SEVERALLY, AND TO THEIR SUCCESSORS AND ASSIGNS, AN EASEMENT OVER ALL AREAS AS SHOWN HEREON AS COMMON LOTS, PRIVATE STREETS AND UTILITY EASEMENTS; AN EASEMENT ON ALL PROPERTY LINES ABUTTING PRIVATE STREETS FOR ABOVE GROUND TRANSFORMER PADS AND TELEPHONE EQUIPMENT PADS. WHERE NO SIDEWALKS EXIST, THE WIDTH OF SAID EASEMENT SHALL BE DEFINED BY A LINE RUNNING PARALLEL TO AND TEN FEET DISTANT, MEASURED AT RIGHT ANGLES FROM THE BACK OF CURB WITHIN SAID PUBLIC AND WITHIN SAID PRIVATE STREET. WHERE SIDEWALK EXISTS, THE WIDTH OF SAID EASEMENT SHALL BE DEFINED BY A LINE RUNNING FIVE FEET DISTANT, MEASURED AT RIGHT ANGLES, FROM THE BACK OF ANY STREET FRONTAGE SIDEWALK, EXCEPTING ANY PORTION THEREOF LYING WITHIN STRUCTURES. ALSO AN ADDITIONAL TWO FEET AROUND ABOVE GROUND TRANSFORMER PADS AND ABOVE GROUND TELEPHONE EQUIPMENT PADS WITHIN THE PLATTED LANDS FOR THE CONSTRUCTION, MAINTENANCE, OPERATION, FINAL REMOVAL AND/OR ABANDONMENT OF STREET LIGHTS, FIRE HYDRANTS, AND UNDERGROUND POWER, TELEPHONE, WATER, CABLE T.V. LINES AND APPURTENANCES, TOGETHER WITH THE RIGHT OF INGRESS AND EGRESS THERETO.

FURTHERMORE, THE ABOVE NAMED OWNER OF THE WITHIN PLATTED LANDS, HEREBY GRANTS AND CONVEYS TO COYOTE SPRINGS WATER RESOURCES GENERAL IMPROVEMENT DISTRICT AND TO THEIR SUCCESSORS AND ASSIGNS, AN EASEMENT FOR SEWER AND WATER PURPOSES ON ALL LANDS AS INDICATED AS PRIVATE STREETS, UTILITY EASEMENTS (UE) AND SEWER EASEMENTS. AS SPECIFICALLY INDICATED AND OUTLINED HEREON TOGETHER WITH THE RIGHT OF INGRESS AND EGRESS THERETO.

FURTHERMORE, THE ABOVE NAMED OWNER DOES HEREBY GRANT TO THE COYOTE SPRINGS CHARTER ASSOCIATION, INC. ALL COMMON LOTS, PRIVATE STREETS, PRIVATE ACCESS EASEMENTS, PEDESTRIAN ACCESS, LANDSCAPE EASEMENTS AND PRIVATE DRAINAGE AREAS TOGETHER WITH THE MAINTENANCE OBLIGATIONS THERETO.

____
COYOTE SPRINGS NEVADA DATE

BY:

ACKNOWLEDGEMENT

STATE OF NEVADA)
SS
COUNTY OF CLARK)

THIS INSTRUMENT WAS ACKNOWLEDGED BEFORE ME ON __________________,

BY ______________________________, AS ______________________________ OF

COYOTE SPRINGS NEVADA.

____
NOTARY PUBLIC IN AND FOR SAID COUNTY AND STATE
MY COMMISSION EXPIRE:

COYOTE SPRINGS CHARTER ASSOCIATION ACCEPTANCE STATEMENT

THE COYOTE SPRINGS CHARTER ASSOCIATION, INC. DOES HEREBY ACCEPT ALL OF THE COMMON LOTS, PRIVATE STREETS, PRIVATE ACCESS EASEMENTS, PEDESTRIAN ACCESS, LANDSCAPE EASEMENTS AND PRIVATE DRAINAGE AREAS AS SHOWN HEREON, TOGETHER WITH THE MAINTENANCE OBLIGATIONS THERETO.

____
BY:

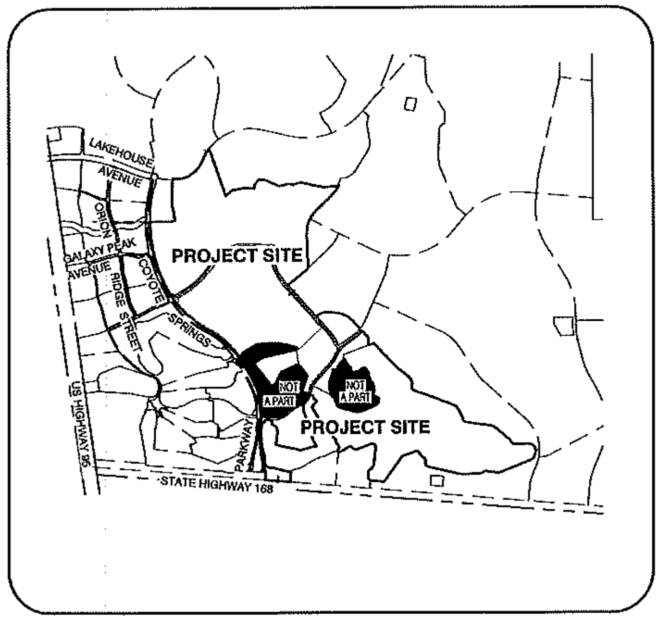
COYOTE SPRINGS CHARTER ASSOCIATION, INC.

UTILITY EASEMENT NOTE

DATE

MAINTENANCE WORK ON FACILITIES LOCATED WITHIN UTILITY EASEMENTS GRANTED BY THIS MAP AND OWNED AND/OR OPERATED BY THE UTILITIES (BOTH FRANCHISE AND MUNICIPAL) MAY INCLUDE THE PLACEMENT OF AN ASPHALT OR CONCRETE PATCH AS APPLICABLE. NO EFFORT WILL BE MADE TO REPLACE OR MATCH ANY DECORATIVE SURFACE, LANDSCAPE FEATURE, OR ANY OTHER IMPROVEMENTS DISTURBED AS A RESULT OF THE MAINTENANCE ACTIVITIES OF THE UTILITIES OR THEIR AUTHORIZED REPRESENTATIVES.

ALL COMMON AREAS AND UTILITY EASEMENTS INDICATED HEREON AS "COMMON AREAS" OR "UTILITY EASEMENTS" ARE TO BE PRIVATELY MAINTAINED BY THE OWNER'S ASSOCIATION (OR PROPERTY OWNER IF NO OWNER ASSOCIATION IS TO BE FORMED).



VICINITY MAP
NOT TO SCALE

COUNTY SURVEYOR'S CERTIFICATE

I, DUSTIN L. CROWTHER, COUNTY SURVEYOR FOR CLARK COUNTY, NEVADA, DO HEREBY CERTIFY THAT ON THIS____ DAY OF ____________, 201__, I DID EXAMINE THE FINAL MAP OF

"COYOTE SPRINGS VILLAGE A"

THAT THE MAP, AS SHOWN HEREON, IS TECHNICALLY CORRECT AND IF THE MONUMENTS HAVE NOT BEEN SET, A PROPER PERFORMANCE BOND OR OTHER FINANCIAL ASSURANCE HAS BEEN DEPOSITED GUARANTEEING THEIR SETTING ON OR BEFORE THE _____ DAY OF __________, 20____.

DUSTIN L. CROWTHER, P.L.S.
CLARK COUNTY SURVEYOR
NEVADA CERTIFICATE NO. 19869

UTILITY AGENCIES AND APPROVALS

WE, THE HEREIN NAMED UTILITY COMPANIES AND AGENCIES, APPROVE THE GRANT OF THE DESIGNATED EASEMENTS.

6/10/2019
LINCOLN COUNTY POWER DISTRICT - DATE

6/10/2019
LINCOLN COUNTY TELEPHONE - DATE

____
LAS VEGAS VALLEY WATER DISTRICT - DATE

____
COX COMMUNICATIONS LAS VEGAS, INC. - DATE

____
CLARK COUNTY WATER RECLAMATION DISTRICT - DATE

____
COYOTE SPRINGS WATER RESOURCES GENERAL IMPROVEMENT DISTRICT DATE

LEGAL DESCRIPTION

SEE SHEET 2

NOTE

FOR SURVEY ANALYSIS SEE SHEET 2

SURVEYOR'S CERTIFICATE

I, RAYMOND A. JOHNSON, A PROFESSIONAL LAND SURVEYOR LICENSED IN THE STATE OF NEVADA, AS AN AGENT FOR VTN NEVADA, CERTIFY THAT:

1. THIS PLAT REPRESENTS THE RESULTS OF A SURVEY CONDUCTED UNDER MY DIRECT SUPERVISION AT THE INSTANCE OF COYOTE SPRINGS NEVADA.
2. THE LANDS SURVEYED LIE WITHIN THE SECTIONS 15, 16, 21, 22 AND 23, TOWNSHIP 13 SOUTH, RANGE 63 EAST, M.D.M., CLARK COUNTY, NEVADA AND THE SURVEY WAS COMPLETED ON SEPTEMBER 28, 2017.
3. THIS PLAT COMPLIES WITH THE APPLICABLE STATE STATUTES AND ANY LOCAL ORDINANCES IN EFFECT ON THE DATE THAT THE GOVERNING BODY GAVE ITS FINAL APPROVAL.
4. THE MONUMENTS DEPICTED ON THE PLAT WILL BE OF THE CHARACTER SHOWN, AND OCCUPY THE POSITIONS INDICATED BY ________________________ AND AN APPROPRIATE FINANCIAL GUARANTEE WILL BE POSTED WITH THE GOVERNING BODY BEFORE RECORDATION TO ENSURE THE INSTALLATION OF THE MONUMENTS.

RAYMOND A. JOHNSON, P.L.S.
NEVADA LICENSE NO. 18983

RAYMOND A. JOHNSON
18983

06/06/2019

DISTRICT BOARD OF HEALTH CERTIFICATE

THIS FINAL MAP IS APPROVED BY THE SOUTHERN NEVADA HEALTH DISTRICT. THIS APPROVAL CONCERNS SEWAGE DISPOSAL, WATER POLLUTION, WATER QUALITY, AND WATER SUPPLY FACILITIES AND IS PREDICATED UPON PLANS FOR A PUBLIC WATER SUPPLY AND COMMUNITY SYSTEM FOR DISPOSAL OF SEWAGE.

____ DATE
SOUTHERN NEVADA HEALTH DISTRICT

DIVISION OF WATER RESOURCES CERTIFICATE

THIS FINAL MAP IS APPROVED BY THE DIVISION OF WATER RESOURCES OF THE DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES CONCERNING WATER QUANTITY SUBJECT TO THE REVIEW OF APPROVAL ON FILE IN THIS OFFICE.

____ DATE
DIVISION OF WATER RESOURCES

ZONING APPROVAL

THIS IS TO CERTIFY THAT THE CLARK COUNTY ZONING ADMINISTRATOR APPROVED AND ACCEPTED ON BEHALF OF THE PUBLIC, THIS MAP AND ANY PARCELS OF LAND OFFERED FOR DEDICATION AND EASEMENTS GRANTED FOR PUBLIC USE IN CONFORMITY WITH THE TERMS OF THE OFFER OF DEDICATION SHOWN HEREON.

APPROVED BY THE CLARK COUNTY ZONING ADMINISTRATOR IN CONFORMITY WITH THE TENTATIVE MAP AND ALL CONDITIONS OF APPROVAL.

____
TINA GARRISON-BERMUDEZ DATE
FOR THE ZONING ADMINISTRATOR

COUNTY RECORDER'S NOTE

ANY SUBSEQUENT CHANGES TO THIS MAP SHOULD BE EXAMINED AND MAY BE DETERMINED BY REFERENCE TO THE COUNTY RECORDER'S CUMULATIVE INDEX. N.R.S. 278.5695

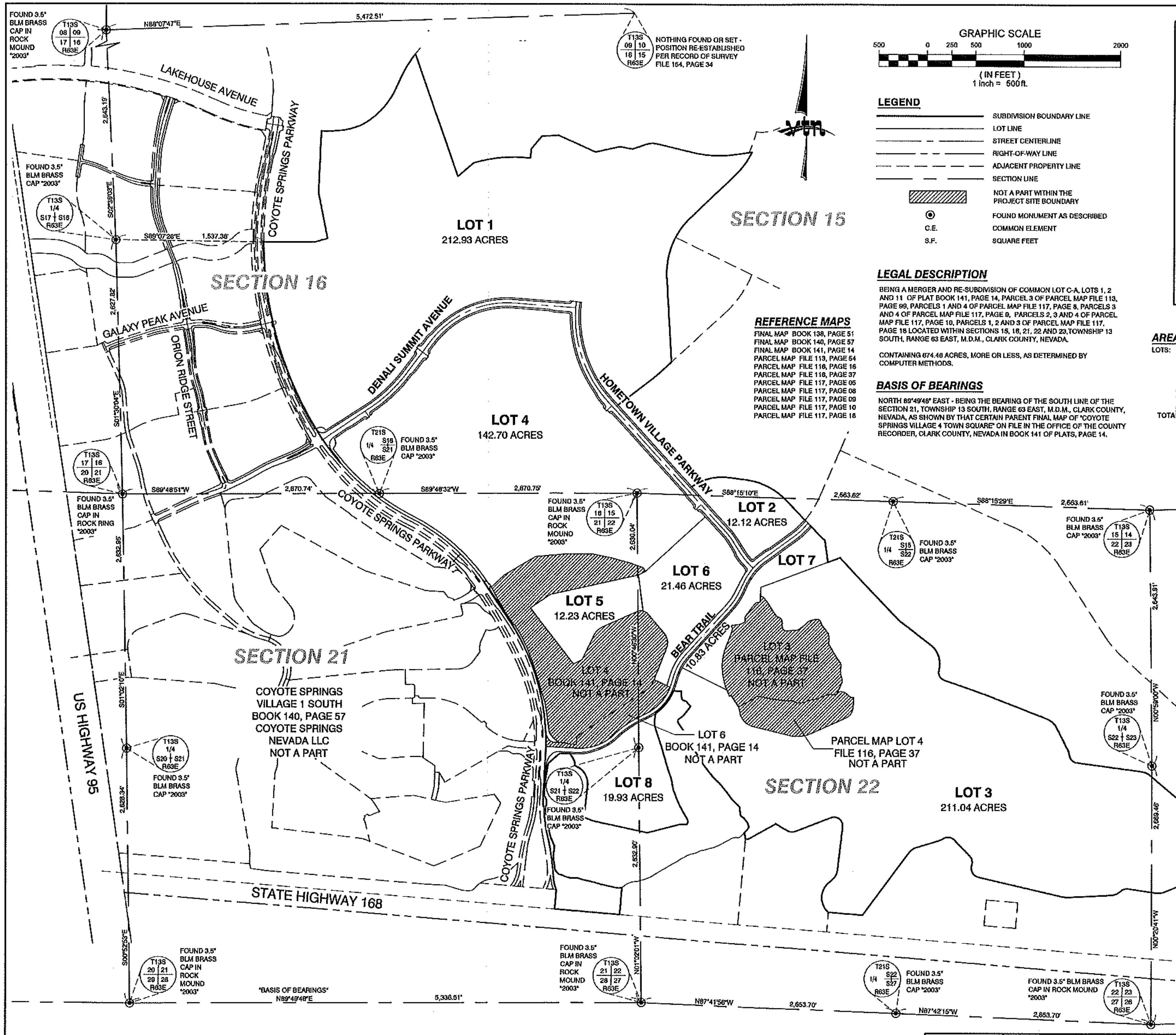
NFM-18-500155

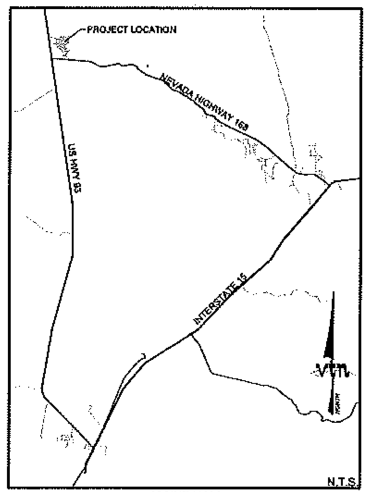
VTN
CONSULTING ENGINEERS • PLANNERS • LAND SURVEYORS
2727 SOUTH RAINBOW BOULEVARD
LAS VEGAS, NEVADA, 89146-5148
(702) 873-7550 FAX (702) 362-2597

LARGE LOT FINAL MAP OF
COYOTE SPRINGS VILLAGE A
(COMMON INTEREST COMMUNITY)
BEING A MERGER AND RE-SUBDIVISION OF COMMON LOT C-A, LOTS 1, 2 AND 11 OF PLAT BOOK 141, PAGE 14, PARCEL 3 OF PARCEL MAP FILE 113, PAGE 99, PARCELS 1 AND 4 OF PARCEL MAP FILE 117, PAGE 8, PARCELS 3 AND 4 OF PARCEL MAP FILE 117, PAGE 9, PARCELS 2, 3 AND 4 OF PARCEL MAP FILE 117, PAGE 10, PARCELS 1, 2 AND 3 OF PARCEL MAP FILE 117, PAGE 18 LOCATED WITHIN SECTIONS 15, 16, 21, 22 AND 23, TOWNSHIP 13 SOUTH, RANGE 63 EAST, M.D.M., CLARK COUNTY, NEVADA

FILE: G:\7720\MAPPING	W.O.# 7720	DATE: AUG 2018	SHEET	OF
FINAL MAP\7720-VIL-A-FM.DWG	DRN. BY: TJ	REV:	1	21
	CKD. BY:			

NO. ________________
FILED AT THE REQUEST OF
VTN
DATED ____________ AT ______M
BOOK __________ PAGE __________
OF PLATS
OFFICIAL RECORDS
BOOK NO.________________
CLARK COUNTY, NEVADA RECORDS
DEBBIE CONWAY - RECORDER
FEE $__________ DEPUTY __________





VICINITY MAP

GRAPHIC SCALE

500 0 250 500 1000 2000

(IN FEET)
1 inch = 500 ft.

LEGEND

━━━━	SUBDIVISION BOUNDARY LINE
────	LOT LINE
── ─ ──	STREET CENTERLINE
── ─ ─ ──	RIGHT-OF-WAY LINE
─ ─ ─ ─	ADJACENT PROPERTY LINE
── ─ ──	SECTION LINE
▨	NOT A PART WITHIN THE PROJECT SITE BOUNDARY
◉	FOUND MONUMENT AS DESCRIBED
C.E.	COMMON ELEMENT
S.F.	SQUARE FEET

LEGAL DESCRIPTION

BEING A MERGER AND RE-SUBDIVISION OF COMMON LOT C-A, LOTS 1, 2 AND 11 OF PLAT BOOK 141, PAGE 14, PARCEL 3 OF PARCEL MAP FILE 113, PAGE 99, PARCELS 1 AND 4 OF PARCEL MAP FILE 117, PAGE 8, PARCELS 3 AND 4 OF PARCEL MAP FILE 117, PAGE 9, PARCELS 2, 3 AND 4 OF PARCEL MAP FILE 117, PAGE 10, PARCELS 1, 2 AND 3 OF PARCEL MAP FILE 117, PAGE 18 LOCATED WITHIN SECTIONS 15, 16, 21, 22 AND 23, TOWNSHIP 13 SOUTH, RANGE 63 EAST, M.D.M., CLARK COUNTY, NEVADA.

CONTAINING 674.46 ACRES, MORE OR LESS, AS DETERMINED BY COMPUTER METHODS.

REFERENCE MAPS

FINAL MAP BOOK 138, PAGE 51
FINAL MAP BOOK 140, PAGE 57
FINAL MAP BOOK 141, PAGE 14
PARCEL MAP FILE 113, PAGE 54
PARCEL MAP FILE 116, PAGE 16
PARCEL MAP FILE 116, PAGE 37
PARCEL MAP FILE 117, PAGE 05
PARCEL MAP FILE 117, PAGE 08
PARCEL MAP FILE 117, PAGE 09
PARCEL MAP FILE 117, PAGE 10
PARCEL MAP FILE 117, PAGE 18

BASIS OF BEARINGS

NORTH 89°49'48" EAST - BEING THE BEARING OF THE SOUTH LINE OF THE SECTION 21, TOWNSHIP 13 SOUTH, RANGE 63 EAST, M.D.M., CLARK COUNTY, NEVADA, AS SHOWN BY THAT CERTAIN PARENT FINAL MAP OF "COYOTE SPRINGS VILLAGE 4 TOWN SQUARE" ON FILE IN THE OFFICE OF THE COUNTY RECORDER, CLARK COUNTY, NEVADA IN BOOK 141 OF PLATS, PAGE 14.

AREA BREAKDOWN

LOTS:	1 - 212.93 ACRES	C.E. LOTS:	1 -	304,445 S.F.
	2 - 12.12 ACRES		2 -	35,275 S.F.
	3 - 211.04 ACRES		3 -	74,767 S.F.
	4 - 142.70 ACRES		4 -	24,420 S.F.
	5 - 12.23 ACRES		5 -	13,515 S.F.
	6 - 21.46 ACRES		6 -	28,157 S.F.
	7 - 10.83 ACRES		7 -	43,850 S.F.
	8 - 19.93 ACRES		8 -	64,057 S.F.
TOTAL	643.24 ACRES		9 -	21,574 S.F.
			10 -	13,250 S.F.
		TOTAL		623,330 S.F. = 14.30 ACRES

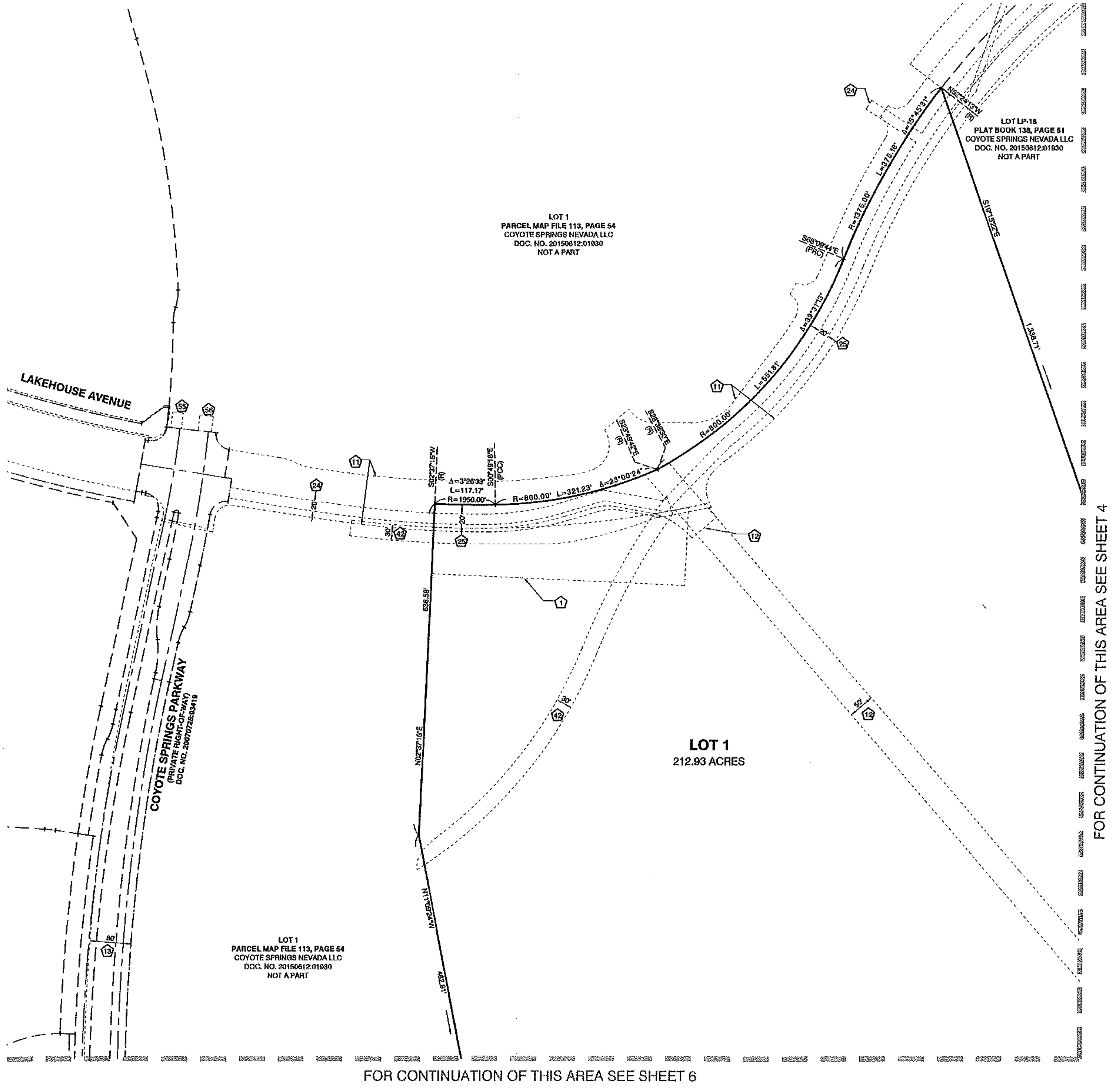
PRIVATE STREETS:	1 - 16.80 ACRES
	2 - 0.12 ACRES
TOTAL	=16.92 ACRES

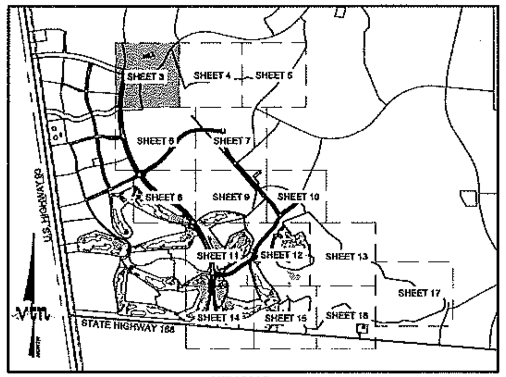
LOT TYPE AREA TABULATION

C.E. LOTS (10) = 14.30 ACRES
LOTS (8) = 643.24 ACRES
PRIVATE STREETS (2) = 16.92 ACRES
TOTAL = 674.46 ACRES

FILE: G:\7720\MAPPING\	W.O.# 7720	DATE: AUG 2018	SHEET	OF
FINAL MAP\VILLAGE A\	DRN. BY: TJ		2	21
	CKD. BY: RAJ			

RAYMOND A. JOHNSON
18983
06/10/2018





KEY MAP
N.T.S.

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

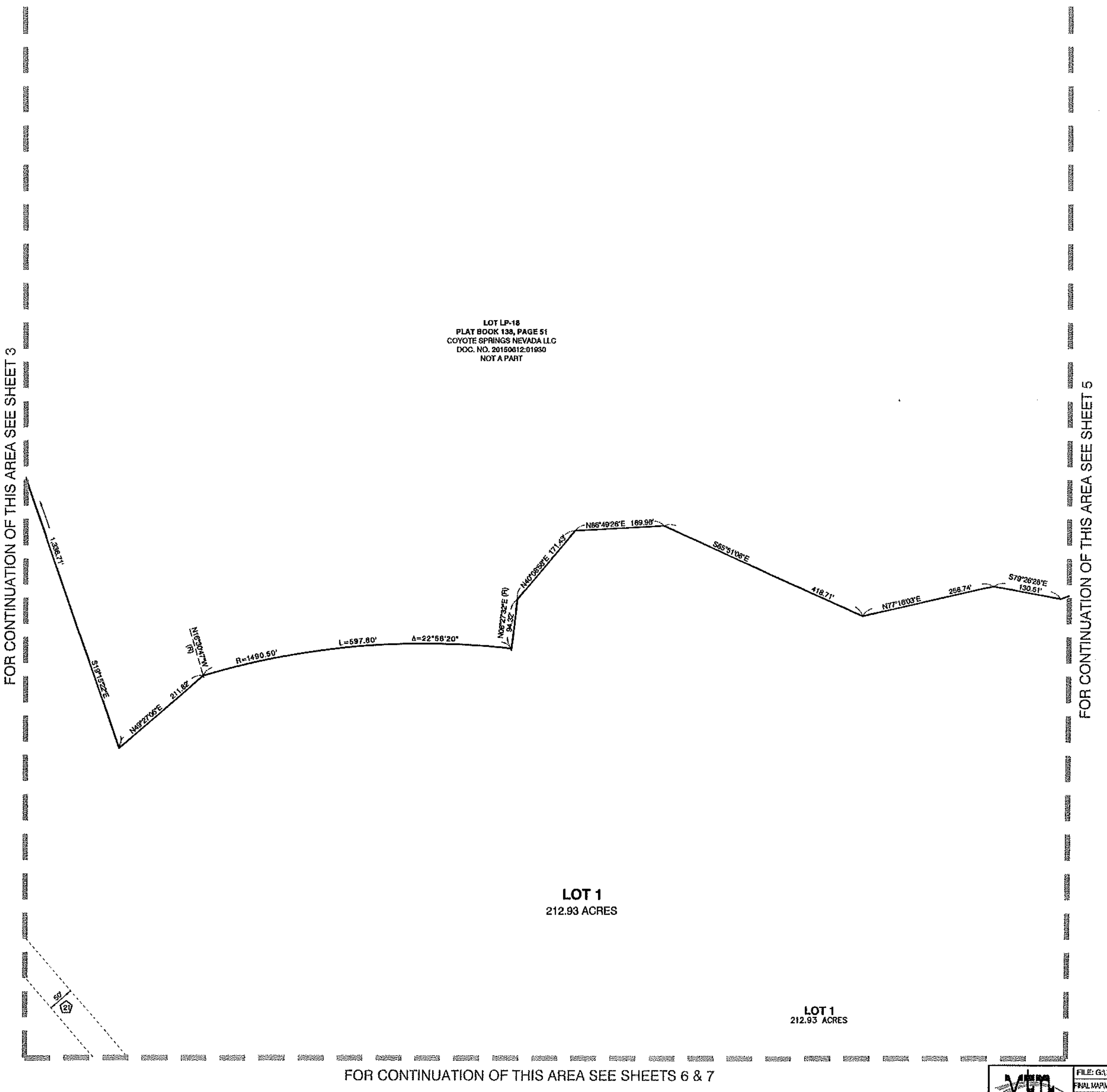
LEGEND

━━━━	SUBDIVISION BOUNDARY LINE
────	LOT LINE
── ─ ──	STREET CENTERLINE
── – – ──	RIGHT-OF-WAY LINE
— — — —	ADJACENT PROPERTY LINE
- - - - -	EXISTING EASEMENT LINE AS NOTED
▨ ▨ ▨	MATCH LINE
⬠ #	EASEMENT DESCRIPTION SYMBOL (SEE TABLE SHEET 21)
S.F.	SQUARE FEET
C.E.	COMMON ELEMENT
DOC. NO.	DOCUMENT NUMBER

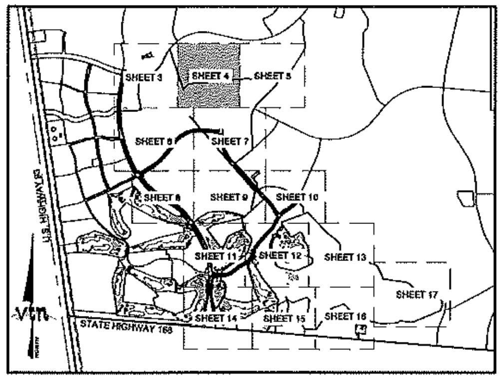
vtn	FILE: G:\7720\MAPPING\	W.O.# 7720	DATE: AUG 2018	SHEET	OF
	FINAL MAP\VILLAGE A\	DRN. BY: TJ		3	21
		CKD. BY: RAJ			

PROFESSIONAL LAND SURVEYOR STATE OF NEVADA
RAYMOND A. JOHNSON
EXP. 06-30-21
18983

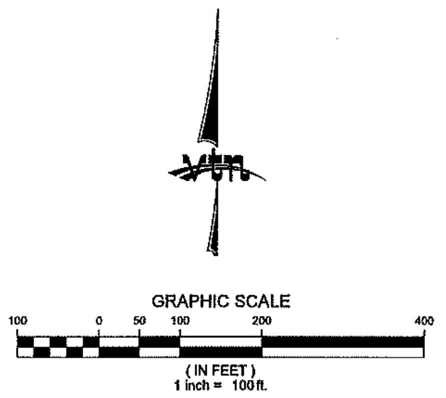
06/10/2019



FOR CONTINUATION OF THIS AREA SEE SHEETS 6 & 7



KEY MAP
N.T.S.

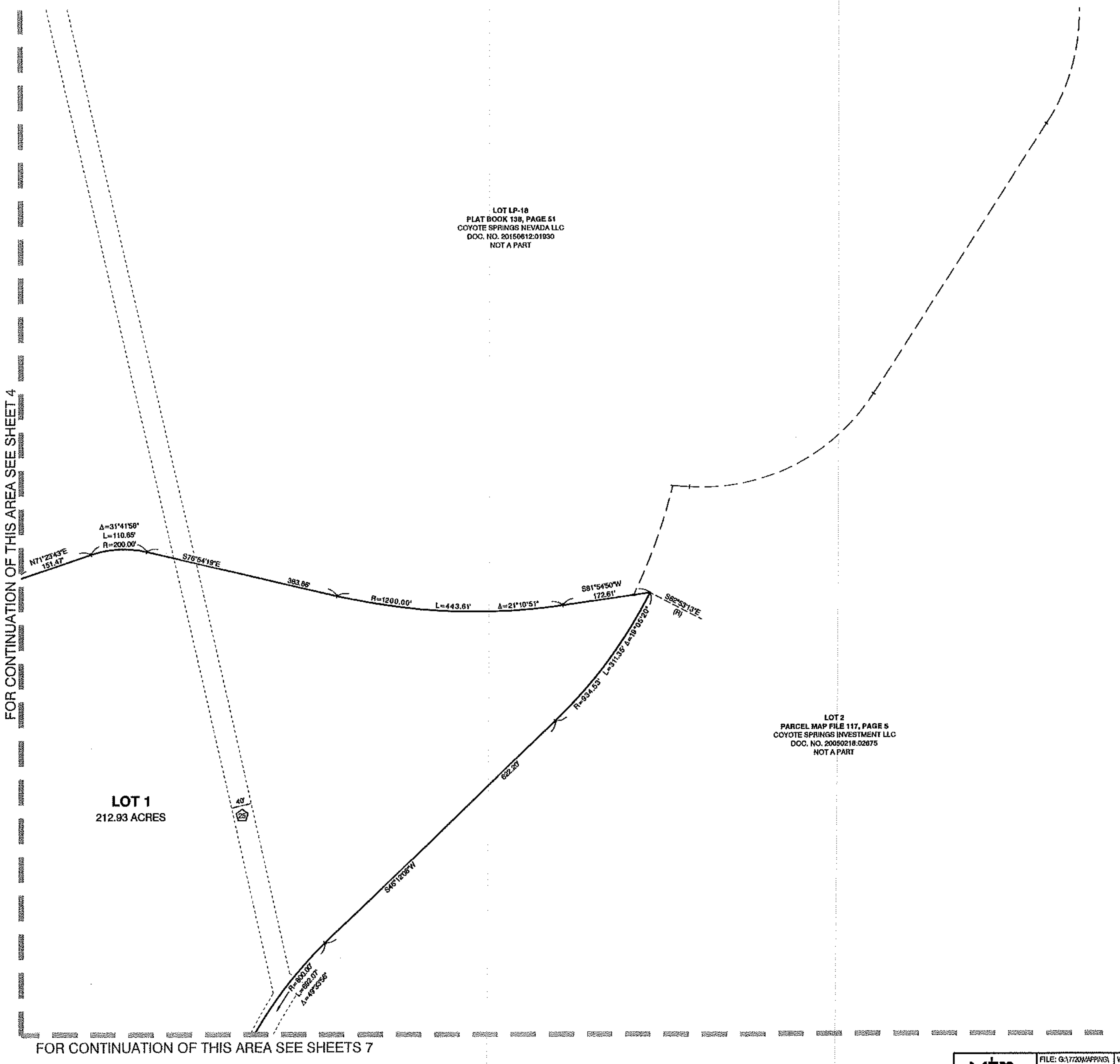


LEGEND

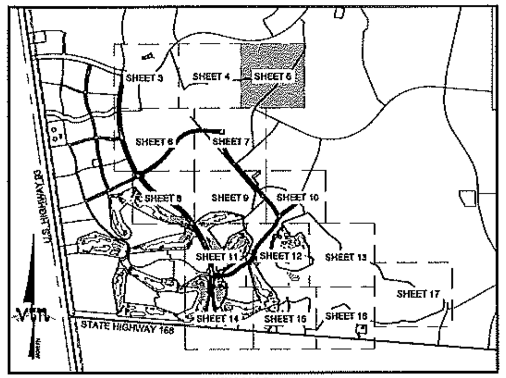
▬▬▬	SUBDIVISION BOUNDARY LINE
- - - - -	EASEMENT LINE AS NOTED
▨ ▨ ▨	MATCH LINE
⬠	EASEMENT DESCRIPTION SYMBOL (SEE TABLE SHEET 21)
S.F.	SQUARE FEET
C.E.	COMMON ELEMENT
DOC. NO.	DOCUMENT NUMBER
(R)	RADIAL LINE
N.T.S.	NOT TO SCALE

VTN	FILE: G:\7720\MAPPING\	W.O.# 7720	DATE: AUG 2018	SHEET	OF
	FINAL MAP\VILLAGE A\	DRN. BY: TJ		4	21
		CKD. BY: RAJ			

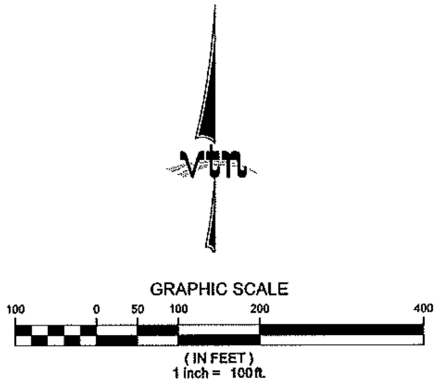
RAYMOND A. JOHNSON
18983
06/10/2019



FOR CONTINUATION OF THIS AREA SEE SHEETS 7



KEY MAP
N.T.S.

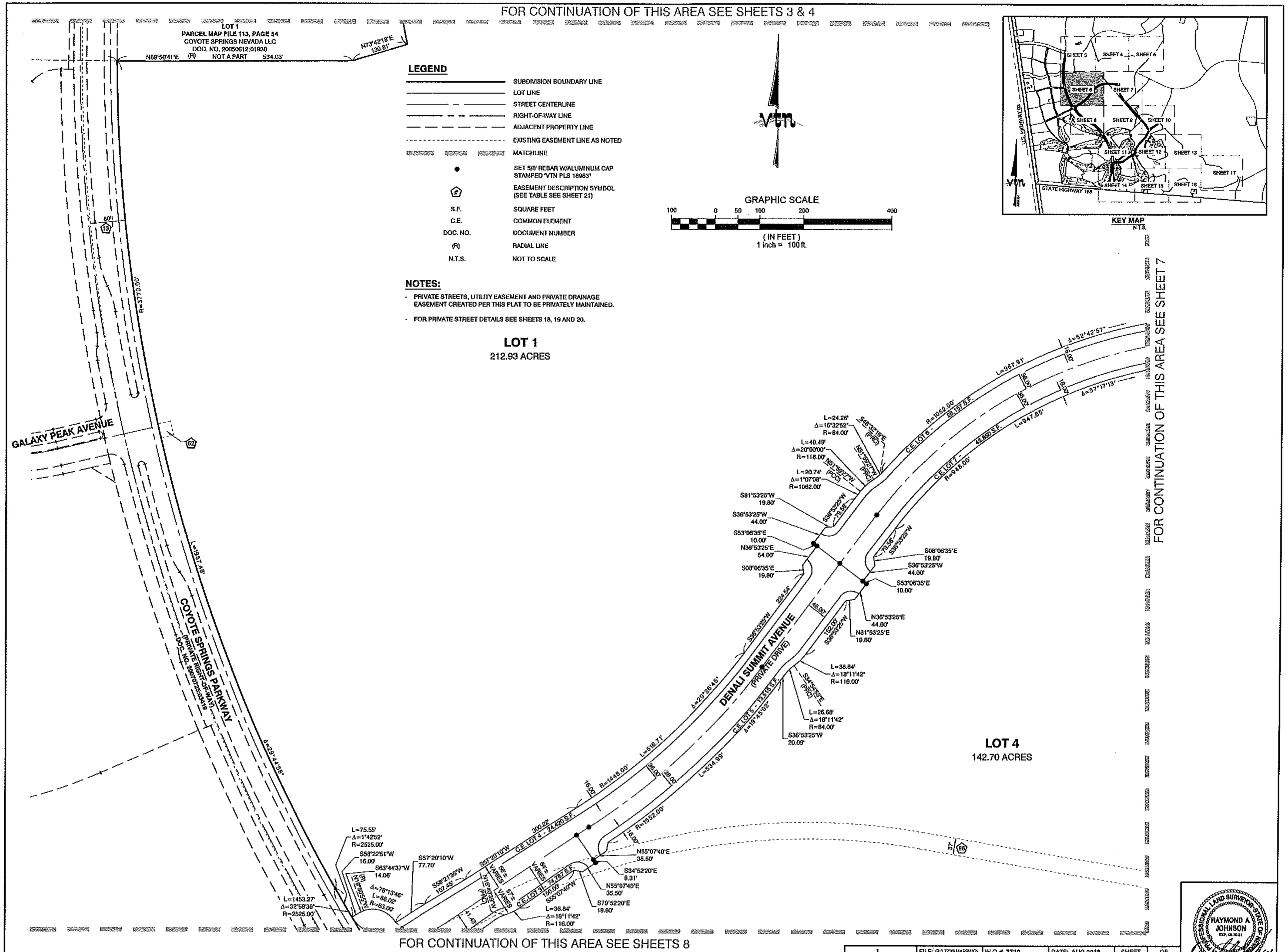


LEGEND

━━━━━━	SUBDIVISION BOUNDARY LINE
──────	LOT LINE
──── ─ ────	STREET CENTERLINE
──── ─ ─ ────	RIGHT-OF-WAY LINE
── ── ── ──	ADJACENT PROPERTY LINE
- - - - - - - -	EXISTING EASEMENT LINE AS NOTED
▨ ▨ ▨	MATCHLINE
⬠	EASEMENT DESCRIPTION SYMBOL (SEE TABLE SEE SHEET 21)
S.F.	SQUARE FEET
C.E.	COMMON ELEMENT
DOC. NO.	DOCUMENT NUMBER
(R)	RADIAL LINE
N.T.S.	NOT TO SCALE

vtn	FILE: G:\7720\MAPPING\	W.O.# 7720	DATE: AUG 2016	SHEET	OF
	FINAL MAP\VILLAGE A\	DRN. BY: TJ		5	21
		CKD. BY: RAJ			

RAYMOND A. JOHNSON
EXP. 06-30-21
No. 18983
06/10/2019



LEGEND

▬▬▬	SUBDIVISION BOUNDARY LINE
———	LOT LINE
—— – ——	STREET CENTERLINE
—— - - ——	RIGHT-OF-WAY LINE
— — —	ADJACENT PROPERTY LINE
- - - - - - -	EXISTING EASEMENT LINE AS NOTED
▨ ▨ ▨	MATCHLINE
●	SET 5/8" REBAR W/ALUMINUM CAP STAMPED "VTN PLS 18983"
⬠	EASEMENT DESCRIPTION SYMBOL (SEE TABLE SEE SHEET 21)
S.F.	SQUARE FEET
C.E.	COMMON ELEMENT
DOC. NO.	DOCUMENT NUMBER
(R)	RADIAL LINE
N.T.S.	NOT TO SCALE

NOTES:

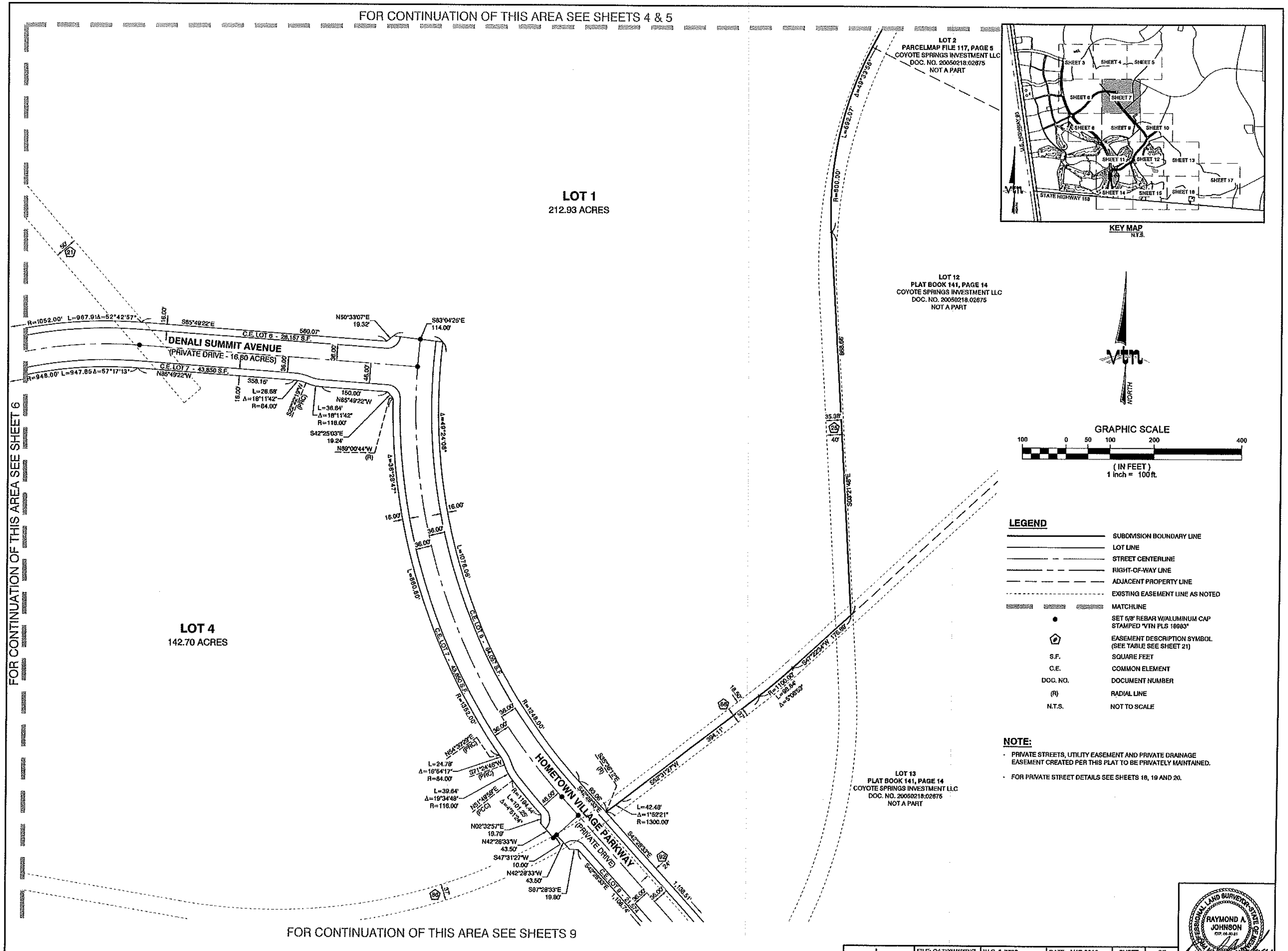
- PRIVATE STREETS, UTILITY EASEMENT AND PRIVATE DRAINAGE EASEMENT CREATED PER THIS PLAT TO BE PRIVATELY MAINTAINED.
- FOR PRIVATE STREET DETAILS SEE SHEETS 18, 19 AND 20.

LOT 1
212.93 ACRES

LOT 4
142.70 ACRES

VTN	FILE: G:\7720\MAPPING\ FINAL MAP\VILLAGE A\	W.O.# 7720	DATE: AUG 2018	SHEET	OF
		DRN. BY: TJ		6	21
		CKD. BY: RAJ			

PROFESSIONAL LAND SURVEYOR STATE OF NEVADA
RAYMOND A. JOHNSON
EXP. 06-30-21
No. 18983
06/10/2019



LEGEND

▬	SUBDIVISION BOUNDARY LINE
—	LOT LINE
— - —	STREET CENTERLINE
— - - —	RIGHT-OF-WAY LINE
— — —	ADJACENT PROPERTY LINE
- - - -	EXISTING EASEMENT LINE AS NOTED
▨ ▨ ▨	MATCHLINE
●	SET 5/8" REBAR W/ALUMINUM CAP STAMPED "VTN PLS 18983"
⬠	EASEMENT DESCRIPTION SYMBOL (SEE TABLE SEE SHEET 21)
S.F.	SQUARE FEET
C.E.	COMMON ELEMENT
DOC. NO.	DOCUMENT NUMBER
(R)	RADIAL LINE
N.T.S.	NOT TO SCALE

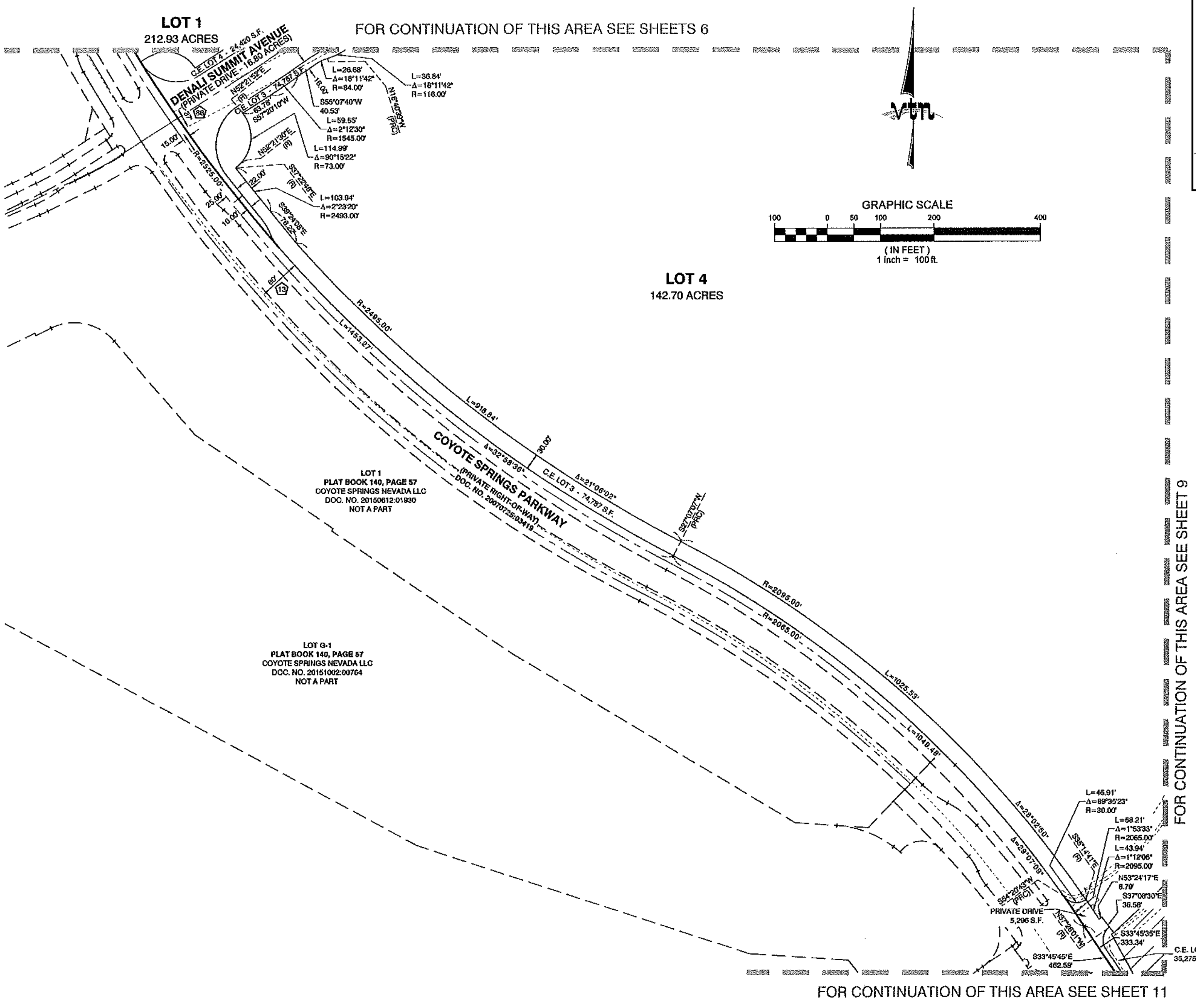
NOTE:

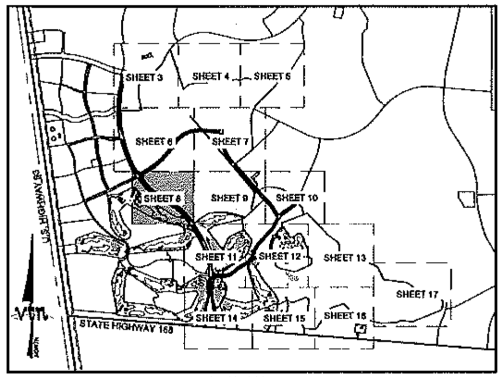
- PRIVATE STREETS, UTILITY EASEMENT AND PRIVATE DRAINAGE EASEMENT CREATED PER THIS PLAT TO BE PRIVATELY MAINTAINED.
- FOR PRIVATE STREET DETAILS SEE SHEETS 18, 19 AND 20.

FILE: G:\7720\MAPPING\ FINAL MAP\VILLAGE A\	W.O.# 7720	DATE: AUG 2018	SHEET	OF
	DRN. BY: TJ		7	21
	CKD. BY: RAJ			

RAYMOND A. JOHNSON

06/10/2019





KEY MAP
N.T.S.

LEGEND

━━━━━━━━	SUBDIVISION BOUNDARY LINE
────────	LOT LINE
───── — ─────	STREET CENTERLINE
──── — — ────	RIGHT-OF-WAY LINE
— — — — — —	ADJACENT PROPERTY LINE
- - - - - - - - - - - -	EXISTING EASEMENT LINE AS NOTED
▨▨▨ ▨▨▨ ▨▨▨	MATCHLINE
●	SET 5/8" REBAR W/ALUMINUM CAP STAMPED "VTN PLS 18983"
⬠	EASEMENT DESCRIPTION SYMBOL (SEE TABLE SHEET 21)
S.F.	SQUARE FEET
C.E.	COMMON ELEMENT
DOC. NO.	DOCUMENT NUMBER
(R)	RADIAL LINE
N.T.S.	NOT TO SCALE

NOTE:

- PRIVATE STREETS, UTILITY EASEMENT AND PRIVATE DRAINAGE EASEMENT CREATED PER THIS PLAT TO BE PRIVATELY MAINTAINED.
- FOR PRIVATE STREET DETAILS SEE SHEETS 18, 19 AND 20.

VTN	FILE: G:\7720\MAPPING\	W.O.# 7720	DATE: AUG 2016	SHEET	OF
	FINAL MAP\VILLAGE A\	DRN. BY: TJ		8	21
		CKD. BY: RAJ			

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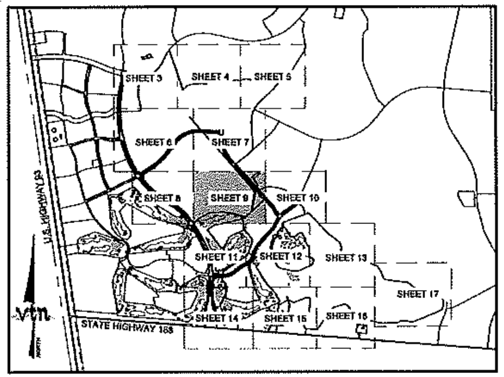
18983
06/10/2019



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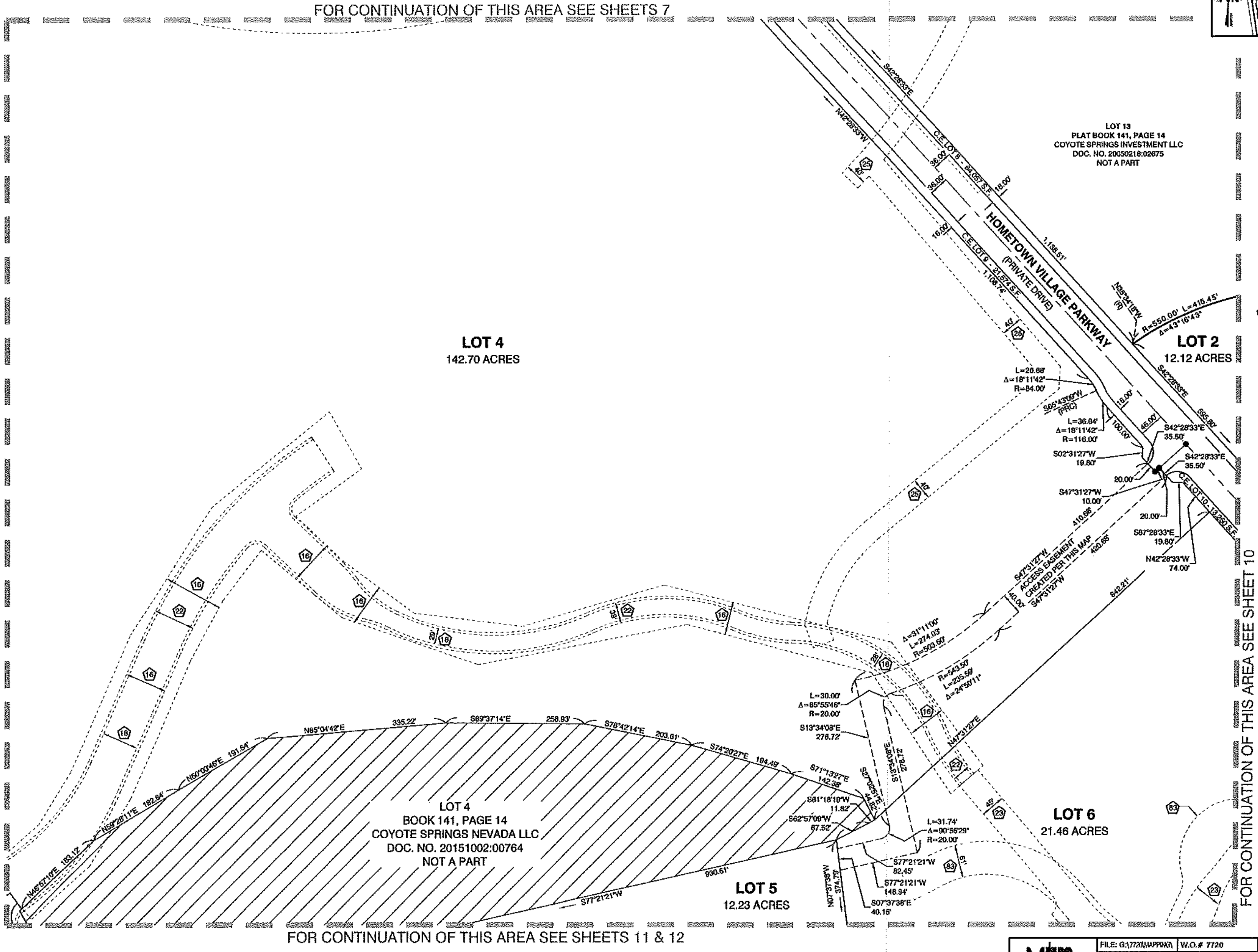
N.T.S.



GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

LEGEND

▬	SUBDIVISION BOUNDARY LINE
―	LOT LINE
— - —	STREET CENTERLINE
— - - —	RIGHT-OF-WAY LINE
— — —	ADJACENT PROPERTY LINE
- - - -	PROPOSED EASEMENT LINE AS NOTED
......	EXISTING EASEMENT LINE AS NOTED
▨ ▨ ▨	MATCHLINE
●	SET 5/8" REBAR W/ALUMINUM CAP STAMPED "VTN PLS 18983"
⬠	EASEMENT DESCRIPTION SYMBOL (SEE TABLE SHEET 21)
S.F.	SQUARE FEET
C.E.	COMMON ELEMENT
DOC. NO.	DOCUMENT NUMBER
(R)	RADIAL LINE
N.T.S.	NOT TO SCALE
▨	NOT A PART WITHIN THE PROJECT SITE BOUNDARY

NOTE:

- PRIVATE STREETS, UTILITY EASEMENT AND PRIVATE DRAINAGE EASEMENT CREATED PER THIS PLAT TO BE PRIVATELY MAINTAINED.
- FOR PRIVATE STREET DETAILS SEE SHEETS 18, 19 AND 20.

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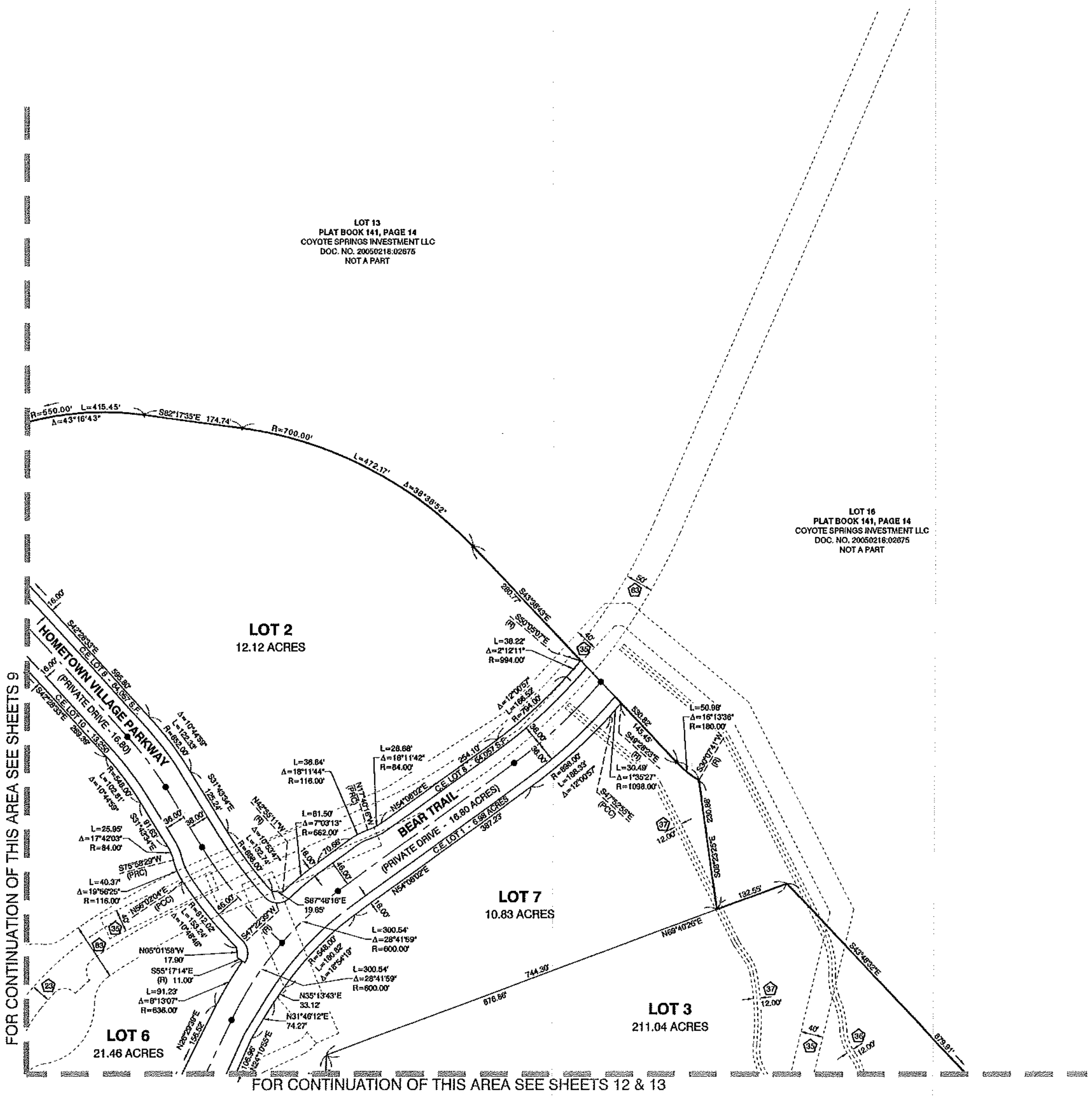
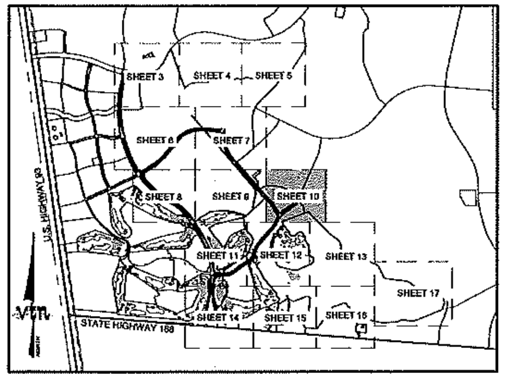
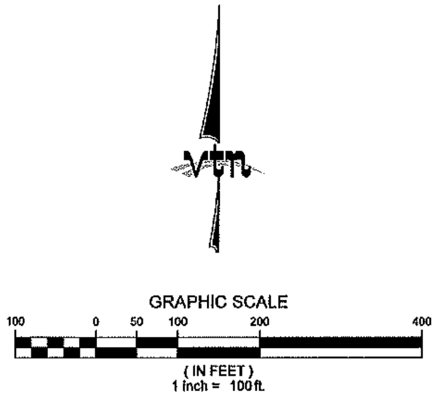
VTN	FILE: G:\7720\MAPPING\	W.O.# 7720	DATE: AUG 2018	SHEET	OF
	FINAL MAP\VILLAGE A\	DRN. BY: TJ		9	21
		CKD. BY: RAJ			





KEY MAP
N.T.S.



(IN FEET)
1 inch = 100 ft.

LEGEND

━━━━━━	SUBDIVISION BOUNDARY LINE
──────	LOT LINE
──── — ────	STREET CENTERLINE
──────	RIGHT-OF-WAY LINE
— — — — —	ADJACENT PROPERTY LINE
- - - - - - -	EASEMENT LINE AS NOTED
▨ ▨ ▨	MATCHLINE
●	SET 5/8' REBAR W/ALUMINUM CAP STAMPED "VTN PLS 18983"
⬠ #	EASEMENT DESCRIPTION SYMBOL (SEE TABLE SHEET 21)
S.F.	SQUARE FEET
C.E.	COMMON ELEMENT
DOC. NO.	DOCUMENT NUMBER
(R)	RADIAL LINE
N.T.S.	NOT TO SCALE
PCC	POINT OF COMPOUND CURVATURE
PRC	POINT OF REVERSE CURVATURE

NOTE:

- PRIVATE STREETS, UTILITY EASEMENT AND PRIVATE DRAINAGE EASEMENT CREATED PER THIS PLAT TO BE PRIVATELY MAINTAINED.
- FOR PRIVATE STREET DETAILS SEE SHEETS 18, 19 AND 20.

VTN	FILE: G:\7720\MAPPING\ FINAL MAP\VILLAGE A\	W.O.# 7720	DATE: AUG 2018	SHEET	OF
		DRN. BY: TJ		10	21
		CKD. BY: RAJ			

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EXP. 06-30-21
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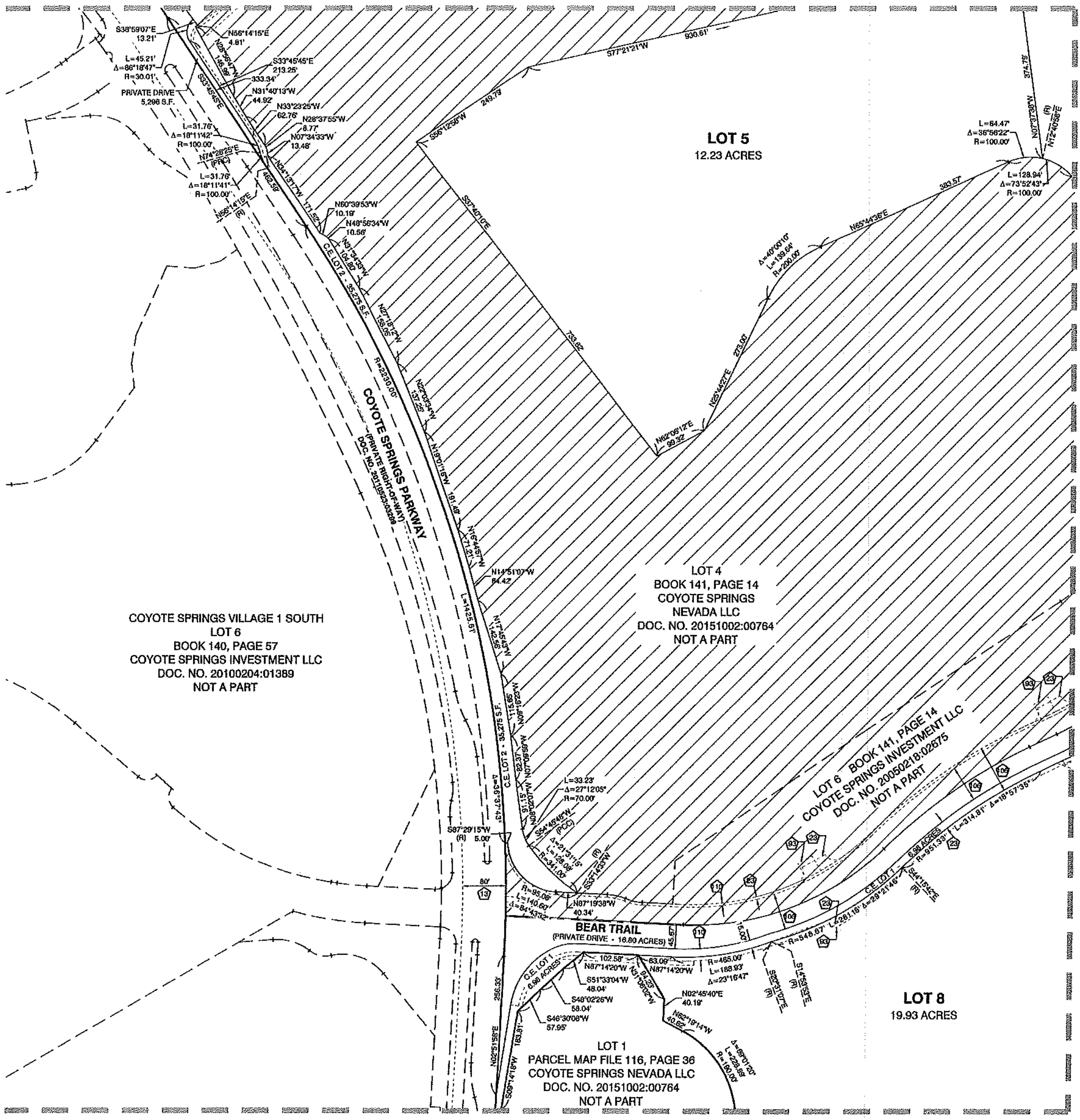
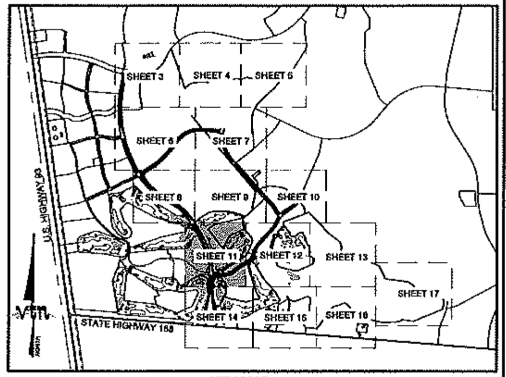
FOR CONTINUATION OF THIS AREA SEE SHEETS 8 & 9

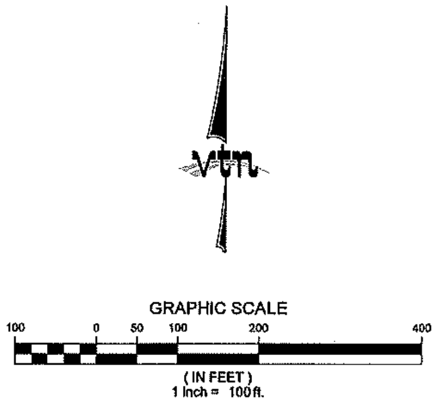


FOR CONTINUATION OF THIS AREA SEE SHEET 12

FOR CONTINUATION OF THIS AREA SEE SHEETS 14



KEY MAP
N.T.S.



LEGEND

━━━━━━━━	SUBDIVISION BOUNDARY LINE
────────	LOT LINE
──── ─ ────	STREET CENTERLINE
──── ─ ─ ────	RIGHT-OF-WAY LINE
— — — — — —	ADJACENT PROPERTY LINE
- - - - - - - - -	EASEMENT LINE AS NOTED
▨▨ ▨▨ ▨▨	MATCHLINE
●	SET 5/8" REBAR W/ALUMINUM CAP STAMPED "VTN PLS 18983"
⬠ #	EASEMENT DESCRIPTION SYMBOL (SEE TABLE SHEET 21)
S.F.	SQUARE FEET
C.E.	COMMON ELEMENT
DOC. NO.	DOCUMENT NUMBER
(R)	RADIAL LINE
N.T.S.	NOT TO SCALE
▨	NOT A PART WITHIN THE PROJECT SITE BOUNDARY

NOTE:

PRIVATE STREETS, UTILITY EASEMENT AND PRIVATE DRAINAGE EASEMENT CREATED PER THIS PLAT TO BE PRIVATELY MAINTAINED.

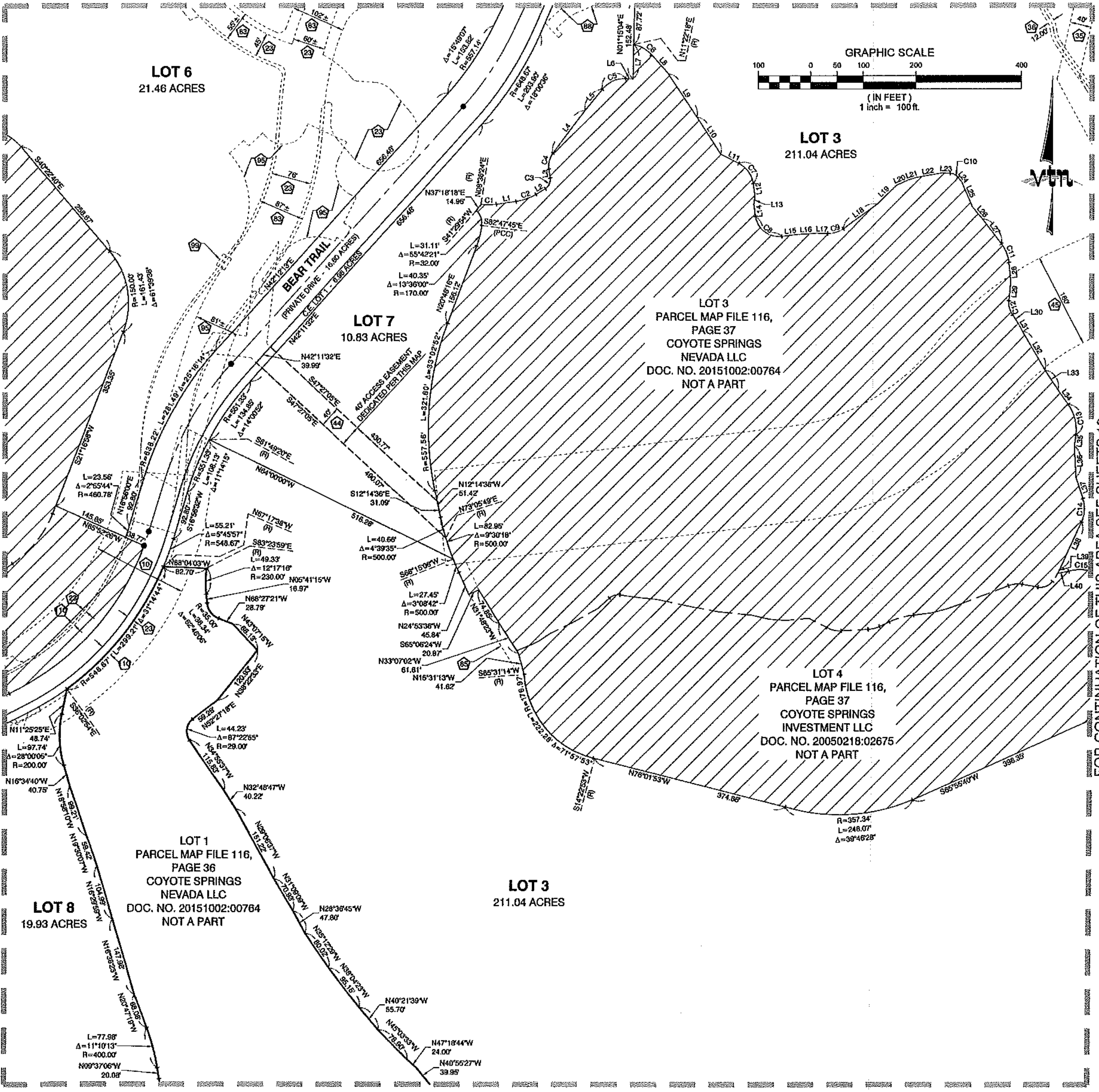
VTN	FILE: G:\7720\MAPPING\ FINAL MAP\VILLAGE A\	W.O.# 7720	DATE: AUG 2018	SHEET 11 OF 21
		DRN. BY: TJ		
		CKD. BY: RAJ		

PROFESSIONAL LAND SURVEYOR STATE OF NEVADA
RAYMOND A. JOHNSON
EXP. 06-30-21
No. 18983

06/10/2019

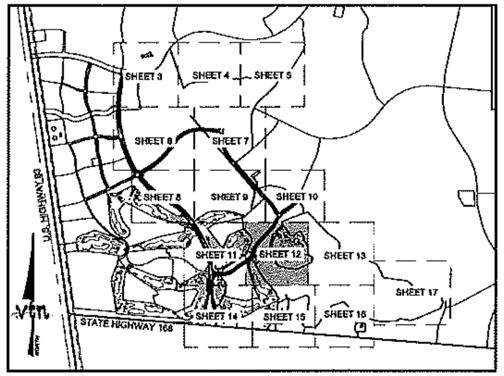
FOR CONTINUATION OF THIS AREA SEE SHEETS 9 & 10

FOR CONTINUATION OF THIS AREA SEE SHEETS 11



FOR CONTINUATION OF THIS AREA SEE SHEETS 13

FOR CONTINUATION OF THIS AREA SEE SHEETS 14 & 15



KEY MAP
N.T.S.

LEGEND

━━━━	SUBDIVISION BOUNDARY LINE
────	LOT LINE
── - ──	STREET CENTERLINE
── — — ──	RIGHT-OF-WAY LINE
- - - -	ADJACENT PROPERTY LINE
- - - - - -	EASEMENT LINE AS NOTED
▨ ▨ ▨	MATCHLINE
●	SET 5/8' REBAR W/ALUMINUM CAP STAMPED "VTN PLS 18983"
⬠#	EASEMENT DESCRIPTION SYMBOL (SEE TABLE SHEET 21)
S.F.	SQUARE FEET
C.E.	COMMON ELEMENT
DOC. NO.	DOCUMENT NUMBER
(R)	RADIAL LINE
N.T.S.	NOT TO SCALE
C#	CURVE TABLE REFERENCE NUMBER
L#	COURSE TABLE REFERENCE NUMBER
▨	NOT A PART WITHIN THE PROJECT SITE BOUNDARY

NOTE:

- PRIVATE STREETS, UTILITY EASEMENT AND PRIVATE DRAINAGE EASEMENT CREATED PER THIS PLAT TO BE PRIVATELY MAINTAINED.
- FOR PRIVATE STREET DETAILS SEE SHEETS 18, 19 AND 20.

COURSE TABLE

NO.	BEARING	LENGTH
L1	N81°47'23"E	38.01'
L2	N59°36'56"E	21.38'
L3	N8°15'04"W	17.32'
L4	N36°39'24"E	101.37'
L5	N39°00'51"E	50.90'
L6	S87°46'54"E	13.36'
L7	N1°15'04"E	64.76'
L8	S41°45'49"E	48.15'
L9	S33°43'55"E	98.42'
L10	S33°07'53"E	64.18'
L11	S63°27'05"E	38.24'
L12	S7°45'41"E	23.46'
L13	S7°46'53"W	15.98'
L14	S8°15'21"E	22.88'

COURSE TABLE

NO.	BEARING	LENGTH
L15	N82°58'43"E	26.66'
L16	N66°07'44"E	39.96'
L17	S88°47'54"E	21.18'
L18	N54°42'51"E	78.73'
L19	N45°51'49"E	51.75'
L20	N66°29'07"E	26.02'
L21	N72°35'41"E	14.43'
L22	N79°58'27"E	48.53'
L23	S87°30'06"E	15.66'
L24	S38°13'22"E	10.84'
L25	S23°23'10"E	51.28'
L26	S40°17'22"E	29.85'
L27	S37°32'12"E	58.97'
L28	S6°01'43"E	35.29'

COURSE TABLE

NO.	BEARING	LENGTH
L29	S5°22'28"W	37.42'
L30	S34°48'30"E	20.37'
L31	S28°32'10"E	15.63'
L32	S30°26'34"E	85.43'
L33	S33°47'30"E	45.15'
L34	S36°10'46"E	33.64'
L35	S7°32'03"W	20.40'
L36	S3°03'01"E	60.21'
L37	S18°18'33"E	42.13'
L38	S24°34'39"W	98.98'
L39	S28°48'52"W	10.37'
L40	N79°17'00"E	22.17'

CURVE TABLE

CURVE	RADIUS	DELTA	LENGTH	TANGENT
C1	99.90'	16°51'01"	29.38'	14.80'
C2	103.90'	22°10'27"	40.21'	20.36'
C3	19.90'	67°52'00"	23.57'	13.39'
C4	40.10'	44°54'28"	31.43'	16.57'
C5	55.10'	53°12'15"	51.17'	27.59'
C6	60.00'	36°51'52"	38.60'	20.00'
C7	50.00'	55°41'24"	48.60'	26.41'
C8	45.00'	88°45'56"	69.72'	44.04'

CURVE TABLE

CURVE	RADIUS	DELTA	LENGTH	TANGENT
C9	50.00'	36°29'14"	31.84'	16.48'
C10	20.00'	49°16'44"	17.20'	9.17'
C11	70.00'	31°30'29"	38.49'	19.75'
C12	40.00'	40°08'56"	28.03'	14.62'
C13	80.00'	43°42'49"	61.04'	32.09'
C14	60.00'	42°53'12"	44.91'	23.57'
C15	76.07'	60°37'21"	80.49'	44.47'

PROFESSIONAL LAND SURVEYOR STATE OF NEVADA
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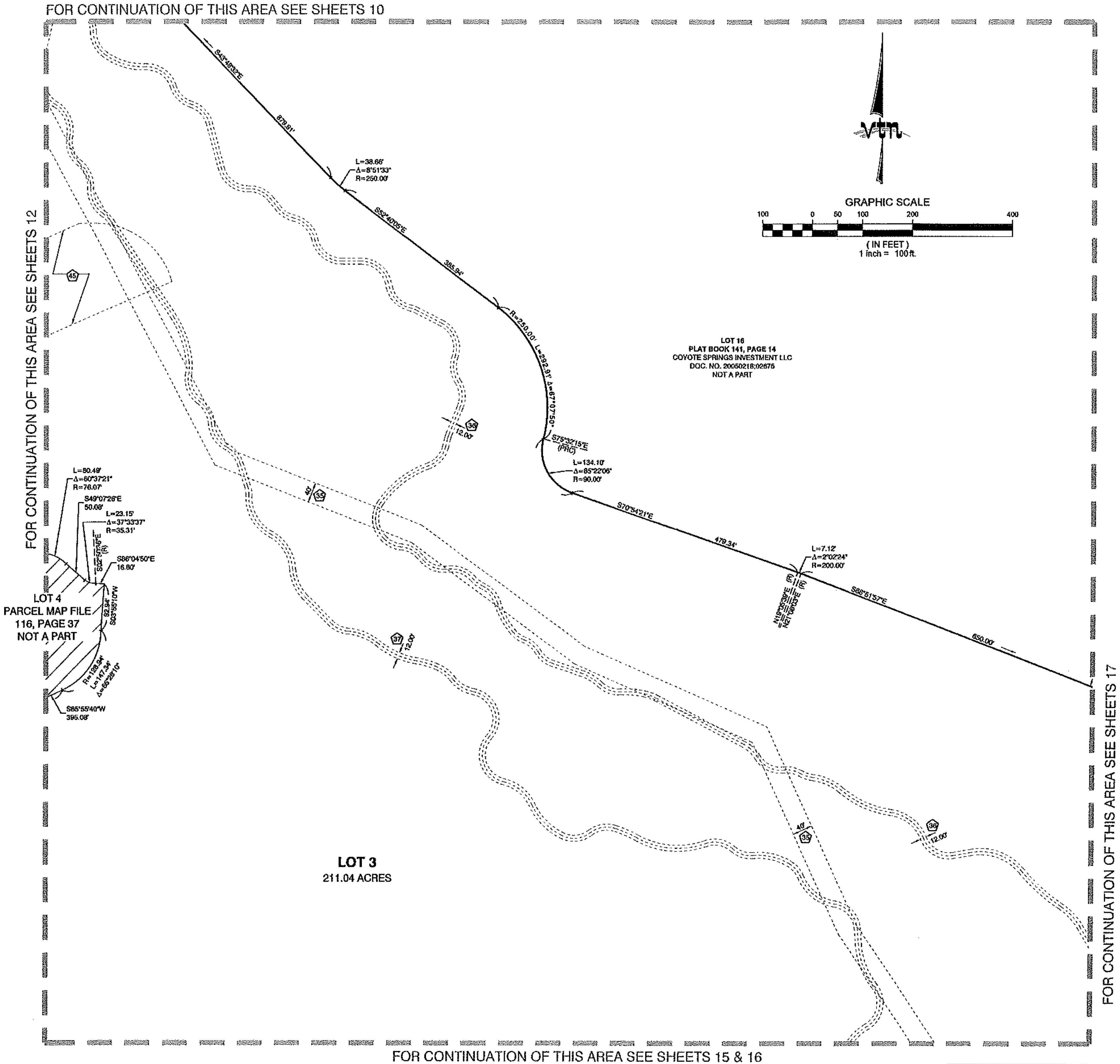
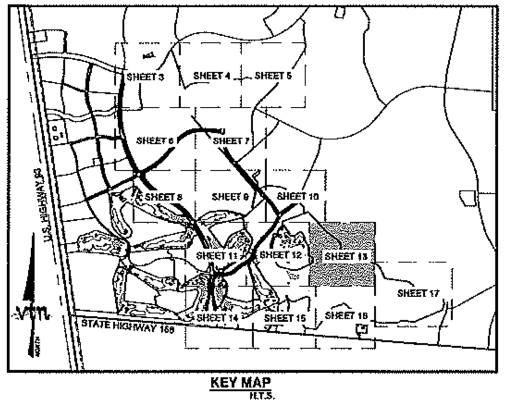
VTN	FILE: G:\7720\MAPPING\ FINAL MAP\VILLAGE A\	W.O.# 7720	DATE: AUG 2018	SHEET 12 OF 21
		DRN. BY: TJ		
		CKD. BY: RAJ		





KEY MAP
N.T.S.

LEGEND

▬▬▬	SUBDIVISION BOUNDARY LINE
┈┈┈	LOT LINE
— - —	STREET CENTERLINE
— — —	RIGHT-OF-WAY LINE
- - - -	ADJACENT PROPERTY LINE
- - - - - -	EASEMENT LINE AS NOTED
▨ ▨ ▨	MATCHLINE
●	SET 5/8" REBAR W/ALUMINUM CAP STAMPED "VTN PLS 18983"
⬠	EASEMENT DESCRIPTION SYMBOL (SEE TABLE SHEET 21)
S.F.	SQUARE FEET
C.E.	COMMON ELEMENT
DOC. NO.	DOCUMENT NUMBER
(R)	RADIAL LINE
N.T.S.	NOT TO SCALE
▨	NOT A PART WITHIN THE PROJECT SITE BOUNDARY

VTN	FILE: G:\7720\MAPPING\	W.O.# 7720	DATE: AUG 2018	SHEET	OF
	21	DRN. BY: TJ		13	21
		CKD. BY: RAJ			

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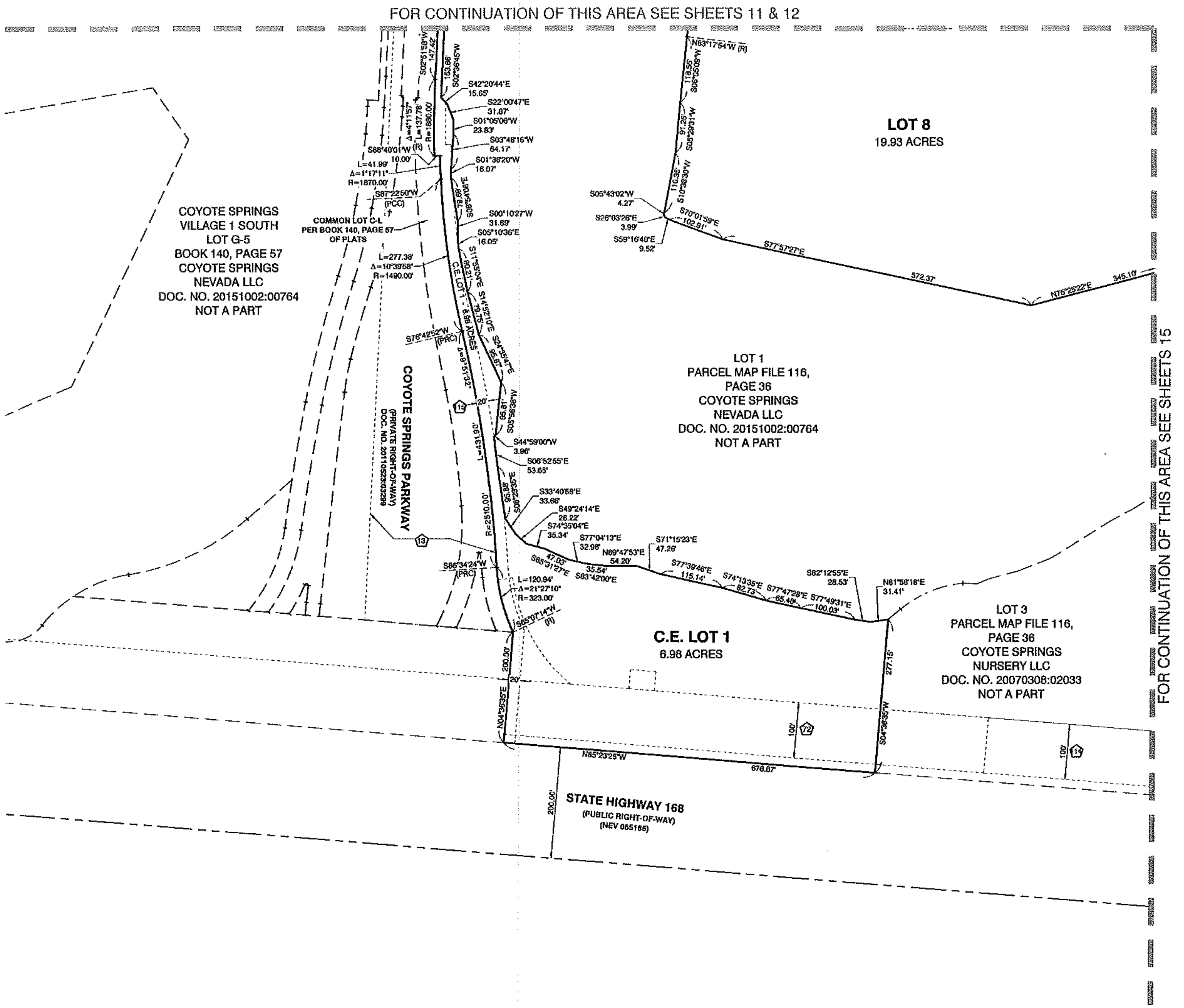
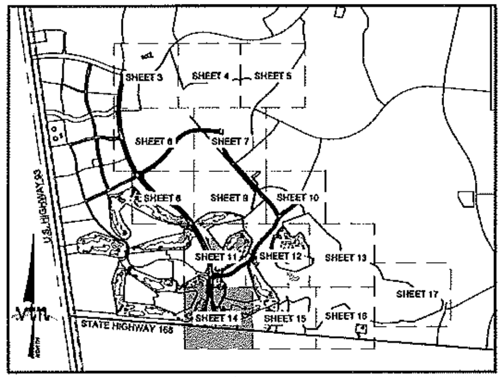
EXP. 06-30-21
18983
06/10/2019





KEY MAP
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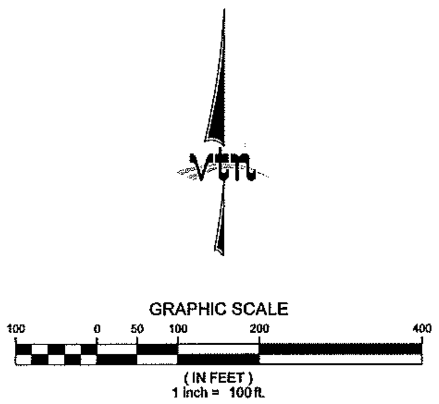

LEGEND

━━━━━━	SUBDIVISION BOUNDARY LINE
──────	LOT LINE
───── ‒ ─────	STREET CENTERLINE
───── ‒ ‒ ─────	RIGHT-OF-WAY LINE
── ── ── ──	ADJACENT PROPERTY LINE
‒ ‒ ‒ ‒ ‒ ‒ ‒	EASEMENT LINE AS NOTED
▨ ▨ ▨	MATCHLINE
●	SET 5/8" REBAR W/ALUMINUM CAP STAMPED "VTN PLS 18983"
⬠#	EASEMENT DESCRIPTION SYMBOL (SEE TABLE SHEET 21)
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C.E.	COMMON ELEMENT
DOC. NO.	DOCUMENT NUMBER
(R)	RADIAL LINE
N.T.S.	NOT TO SCALE
C#	CURVE TABLE REFERENCE NUMBER
L#	COURSE TABLE REFERENCE NUMBER

FILE: G:\7720\MAPPING\ FINAL MAP\VILLAGE A\	W.O.# 7720	DATE: AUG 2018	SHEET	OF
	DRN. BY: TJ		14	21
	CKD. BY: RAJ			

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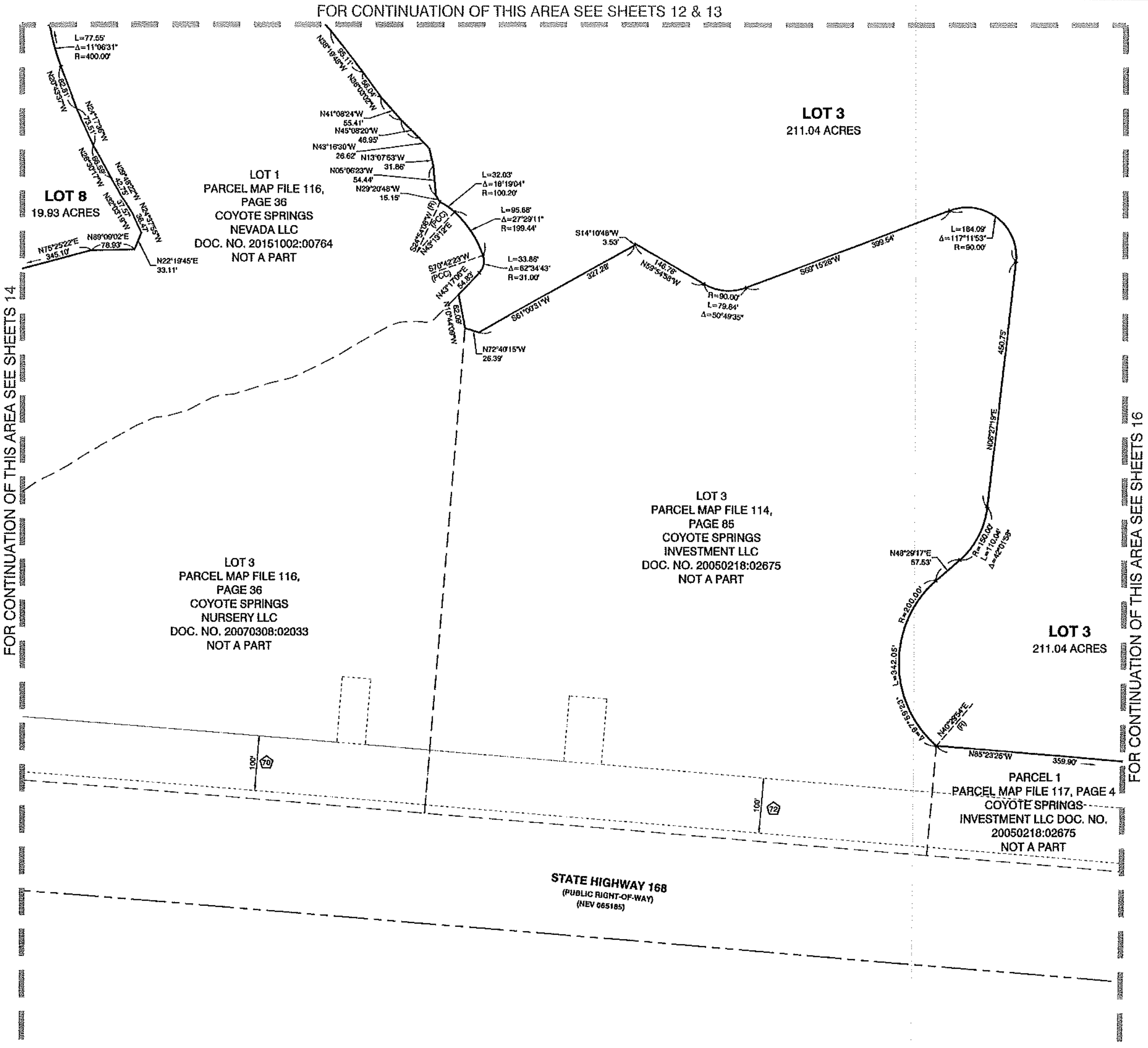
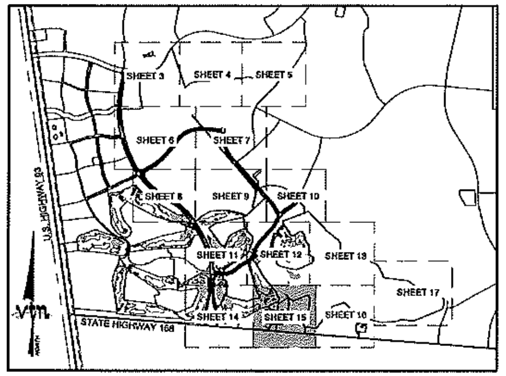
06/10/2019





KEY MAP
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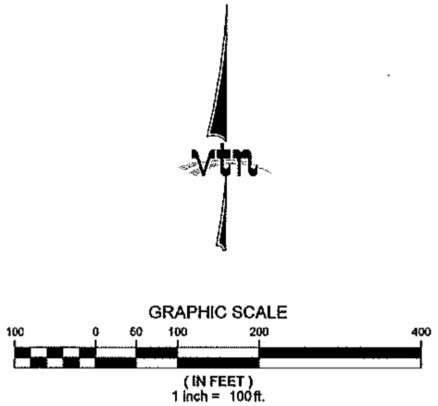

LEGEND

———	SUBDIVISION BOUNDARY LINE
———	LOT LINE
——— – ———	STREET CENTERLINE
——— - - ———	RIGHT-OF-WAY LINE
— — — —	ADJACENT PROPERTY LINE
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●	SET 5/8" REBAR W/ALUMINUM CAP STAMPED "VTN PLS 18983"
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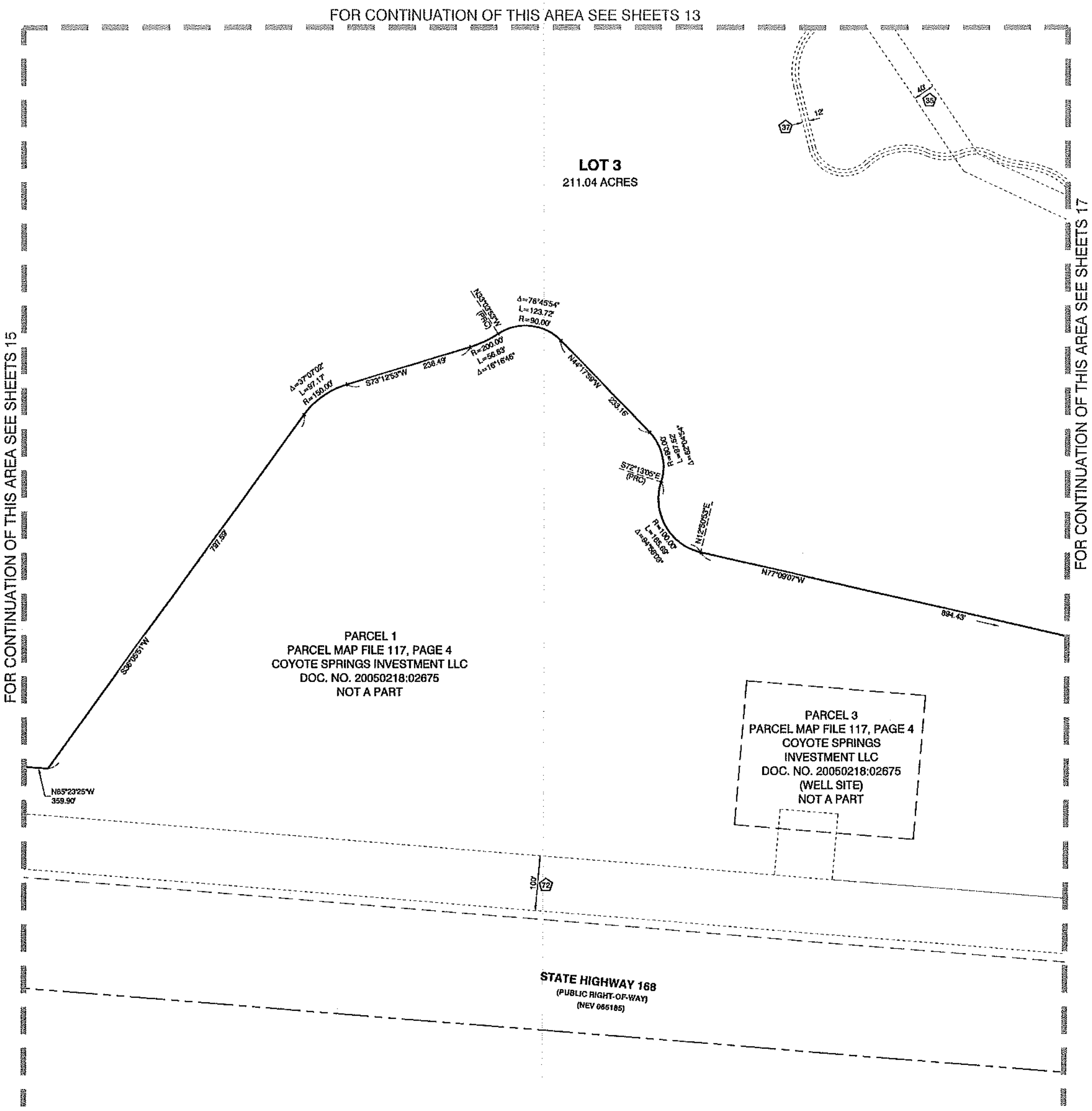
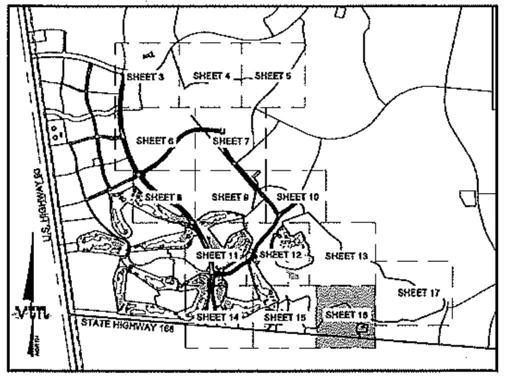
S.F.	SQUARE FEET
C.E.	COMMON ELEMENT
DOC. NO.	DOCUMENT NUMBER
(R)	RADIAL LINE
N.T.S.	NOT TO SCALE

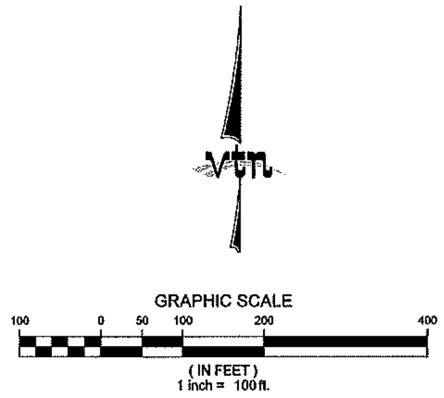
vtn	FILE: G:\7720\MAPPING\ FINAL MAP\VILLAGE A\	W.O.# 7720	DATE: AUG 2018	SHEET	OF
		DRN. BY: TJ		15	21
		CKD. BY: RAJ			

RAYMOND A. JOHNSON
EXP. 06-30-21
No. 18983
06/10/2019





KEY MAP
N.T.S.



LEGEND

━━━━━━━━	SUBDIVISION BOUNDARY LINE
────────	LOT LINE
──── ─ ────	STREET CENTERLINE
──── ‑ ‑ ────	RIGHT-OF-WAY LINE
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S.F.	SQUARE FEET
C.E.	COMMON ELEMENT
DOC. NO.	DOCUMENT NUMBER
(R)	RADIAL LINE
N.T.S.	NOT TO SCALE

VTN	FILE: G:\7720\MAPPING\	W.O.# 7720	DATE: AUG 2018	SHEET	OF
	FINAL MAP\VILLAGE A\	DRN. BY: TJ		16	21
		CKD. BY: RAJ			

RAYMOND A. JOHNSON
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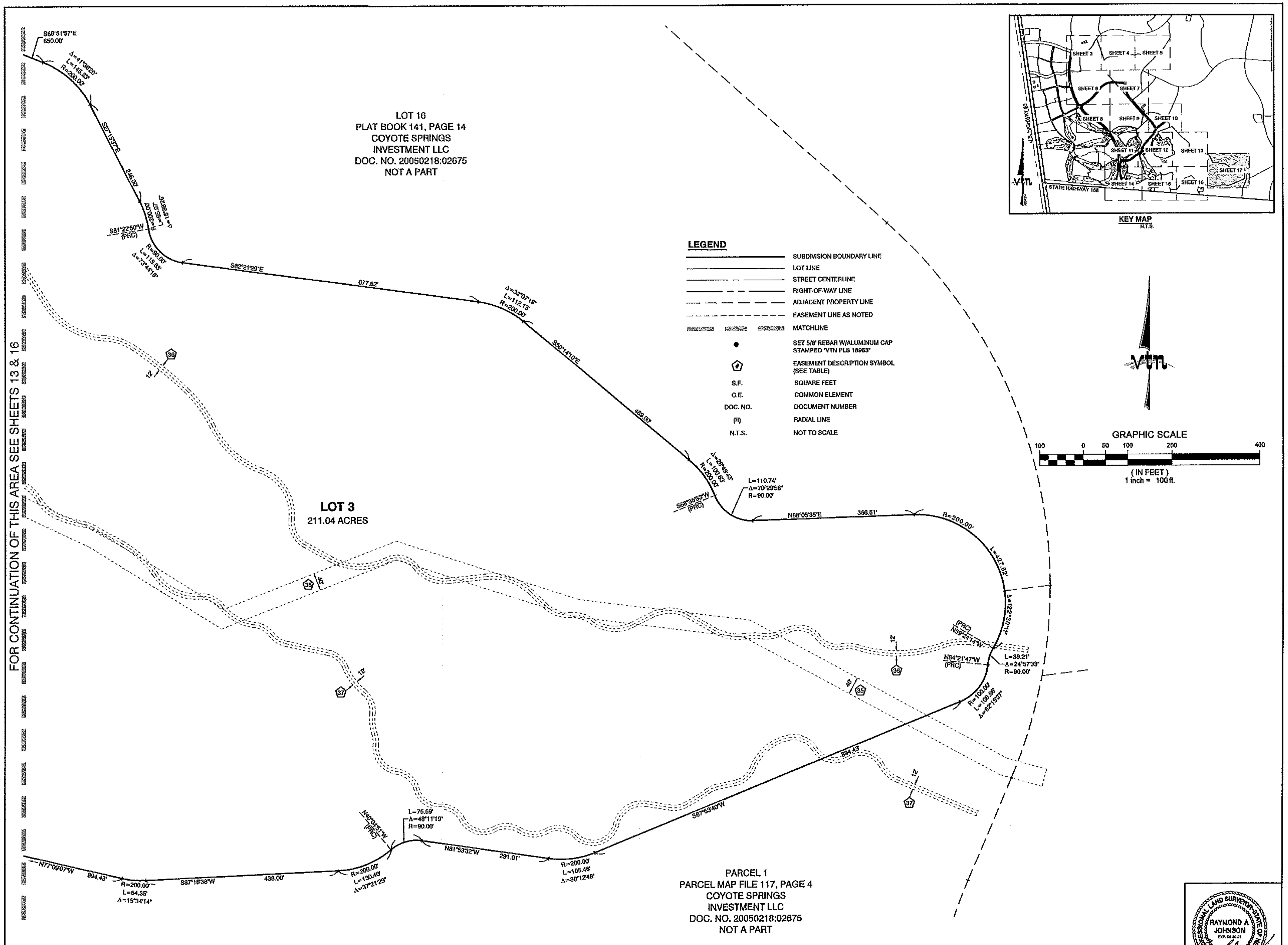
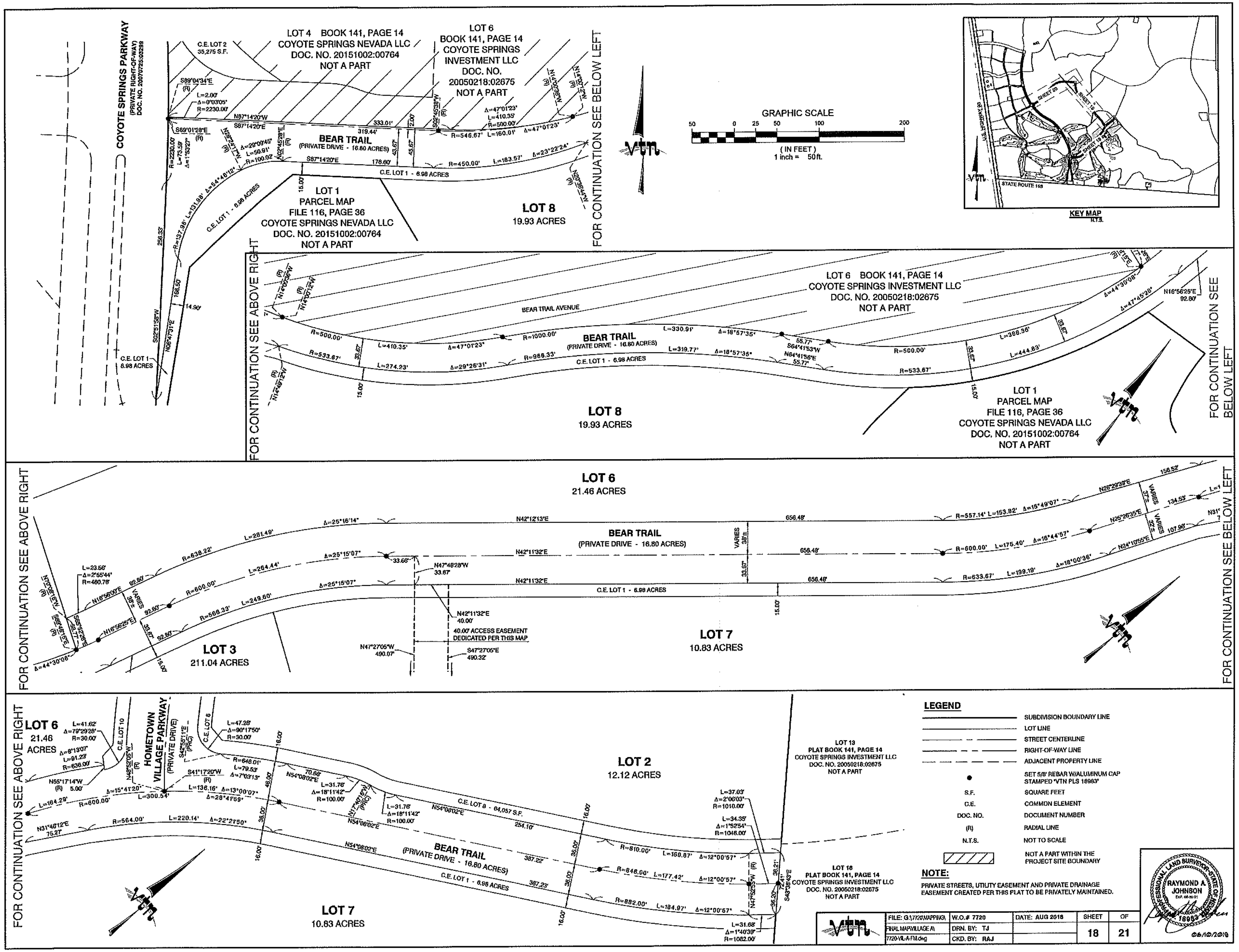
06/10/2019



FILE: G:\7720\MAPPING\FINAL MAP\VILLAGE A\	W.O.# 7720	DATE: AUG 2018	SHEET	OF
	DRN. BY: TJ		17	21
	CKD. BY: RAJ			

RAYMOND A. JOHNSON
18983
06/10/2019



LEGEND

▬	SUBDIVISION BOUNDARY LINE
—	LOT LINE
— - —	STREET CENTERLINE
— – – —	RIGHT-OF-WAY LINE
– – – –	ADJACENT PROPERTY LINE
●	SET 5/8' REBAR W/ALUMINUM CAP STAMPED "VTN PLS 18983"
S.F.	SQUARE FEET
C.E.	COMMON ELEMENT
DOC. NO.	DOCUMENT NUMBER
(R)	RADIAL LINE
N.T.S.	NOT TO SCALE
▨	NOT A PART WITHIN THE PROJECT SITE BOUNDARY

NOTE:

PRIVATE STREETS, UTILITY EASEMENT AND PRIVATE DRAINAGE EASEMENT CREATED PER THIS PLAT TO BE PRIVATELY MAINTAINED.

FILE: G:\7720\MAPPING\	W.O.# 7720	DATE: AUG 2018	SHEET	OF
FINAL MAP\VILLAGE A\	DRN. BY: TJ		18	21
7720-VIL-A-FM.dwg	CKD. BY: RAJ			

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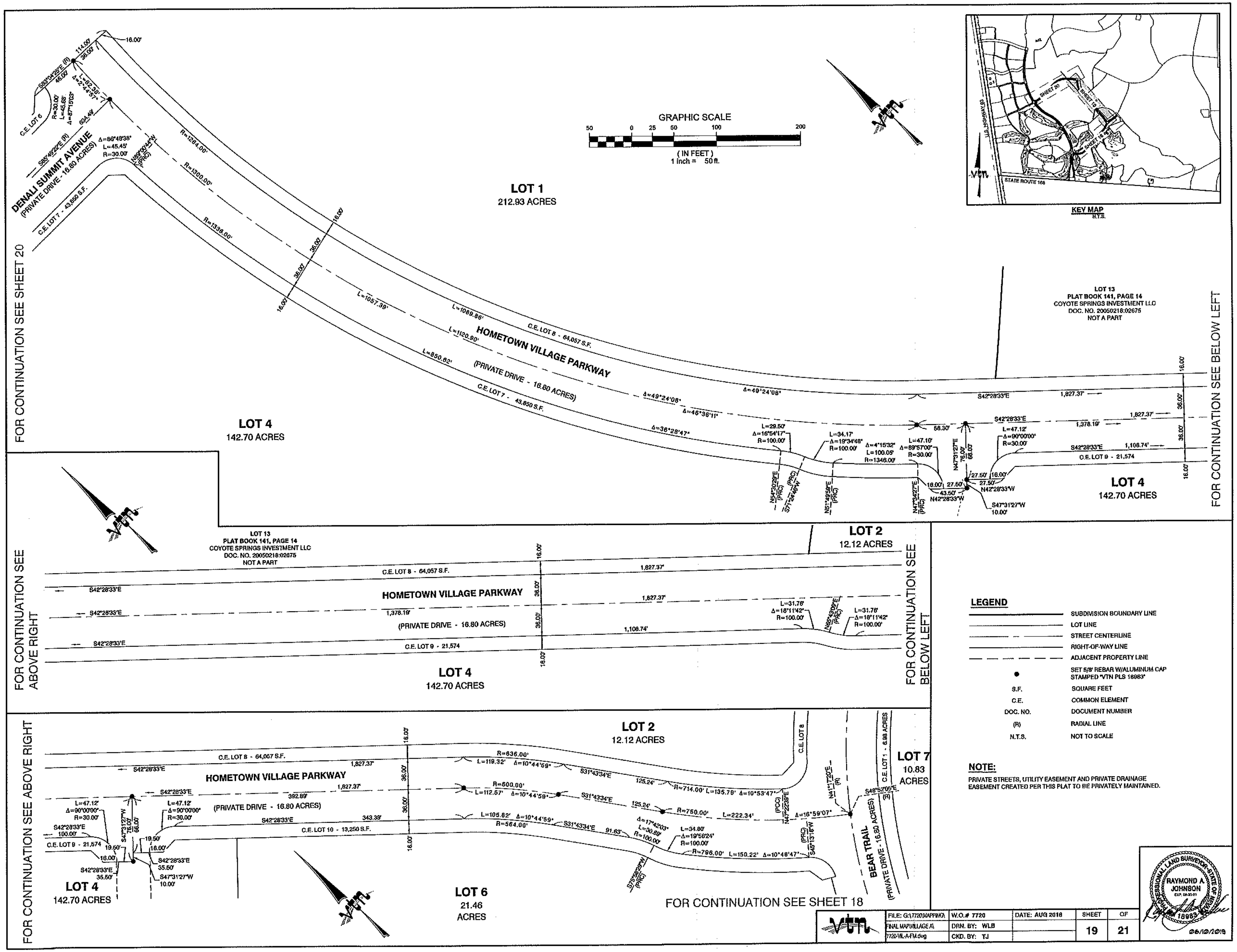
18983
06/10/2019



LEGEND

▬	SUBDIVISION BOUNDARY LINE
—	LOT LINE
— - —	STREET CENTERLINE
—	RIGHT-OF-WAY LINE
— — —	ADJACENT PROPERTY LINE
●	SET 5/8" REBAR W/ALUMINUM CAP STAMPED "VTN PLS 18983"
S.F.	SQUARE FEET
C.E.	COMMON ELEMENT
DOC. NO.	DOCUMENT NUMBER
(R)	RADIAL LINE
N.T.S.	NOT TO SCALE

NOTE:

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FILE: G:\7720\MAPPING\	W.O.# 7720	DATE: AUG 2018	SHEET	OF
FINAL MAP\VILLAGE A\	DRN. BY: WLB		19	21
7720-VIL-A-FM.dwg	CKD. BY: TJ			

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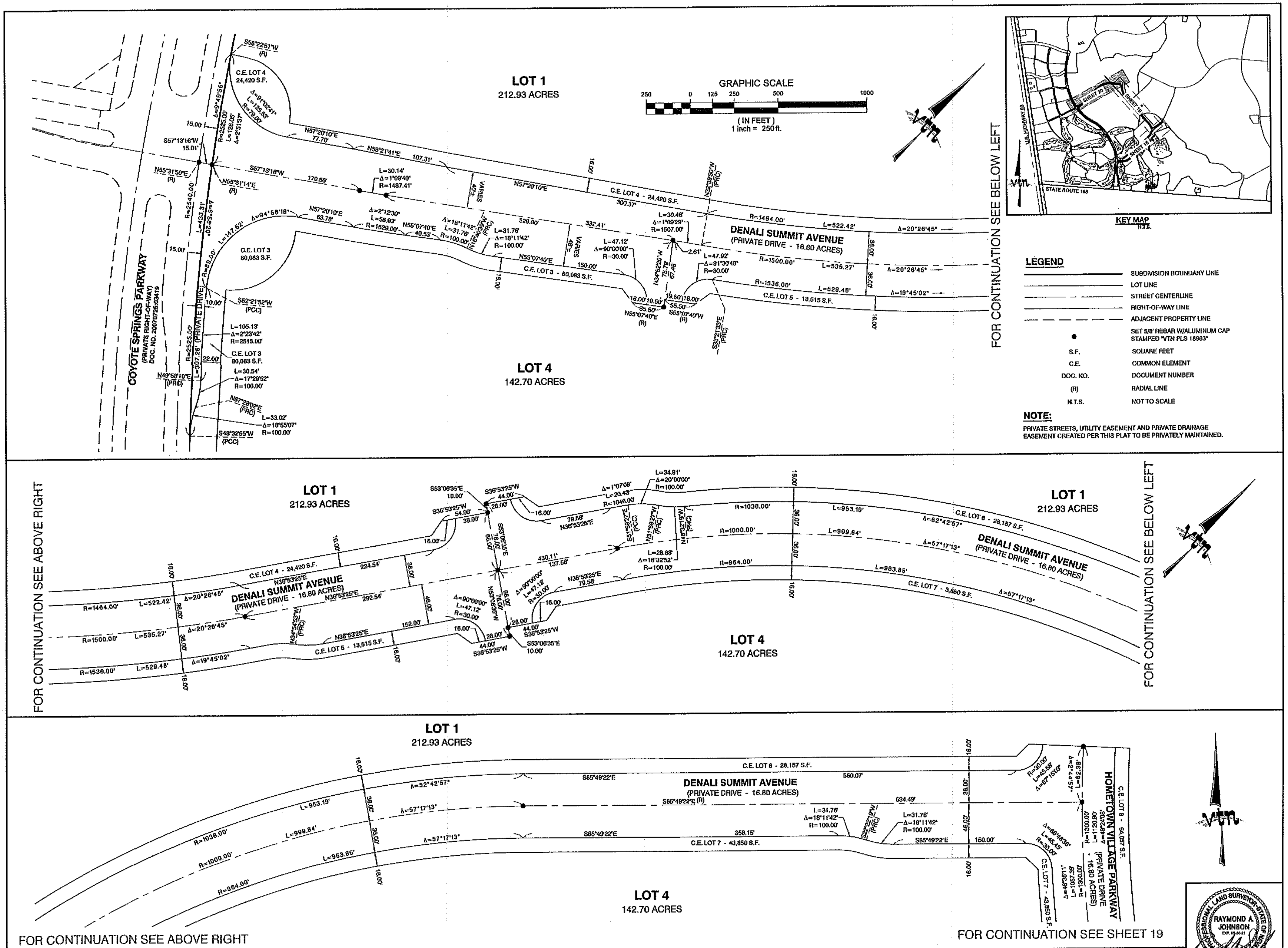
06/10/2019



LEGEND

▬	SUBDIVISION BOUNDARY LINE
―	LOT LINE
― ‐ ―	STREET CENTERLINE
―	RIGHT-OF-WAY LINE
‐ ‐ ‐	ADJACENT PROPERTY LINE
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FILE: G:\7720\MAPPING\	W.O.# 7720	DATE: AUG 2018	SHEET	OF
FINAL MAP\VILLAGE A\	DRN. BY: TJ		20	21
7720-VIL-A-FM.dwg	CKD. BY: RAJ			

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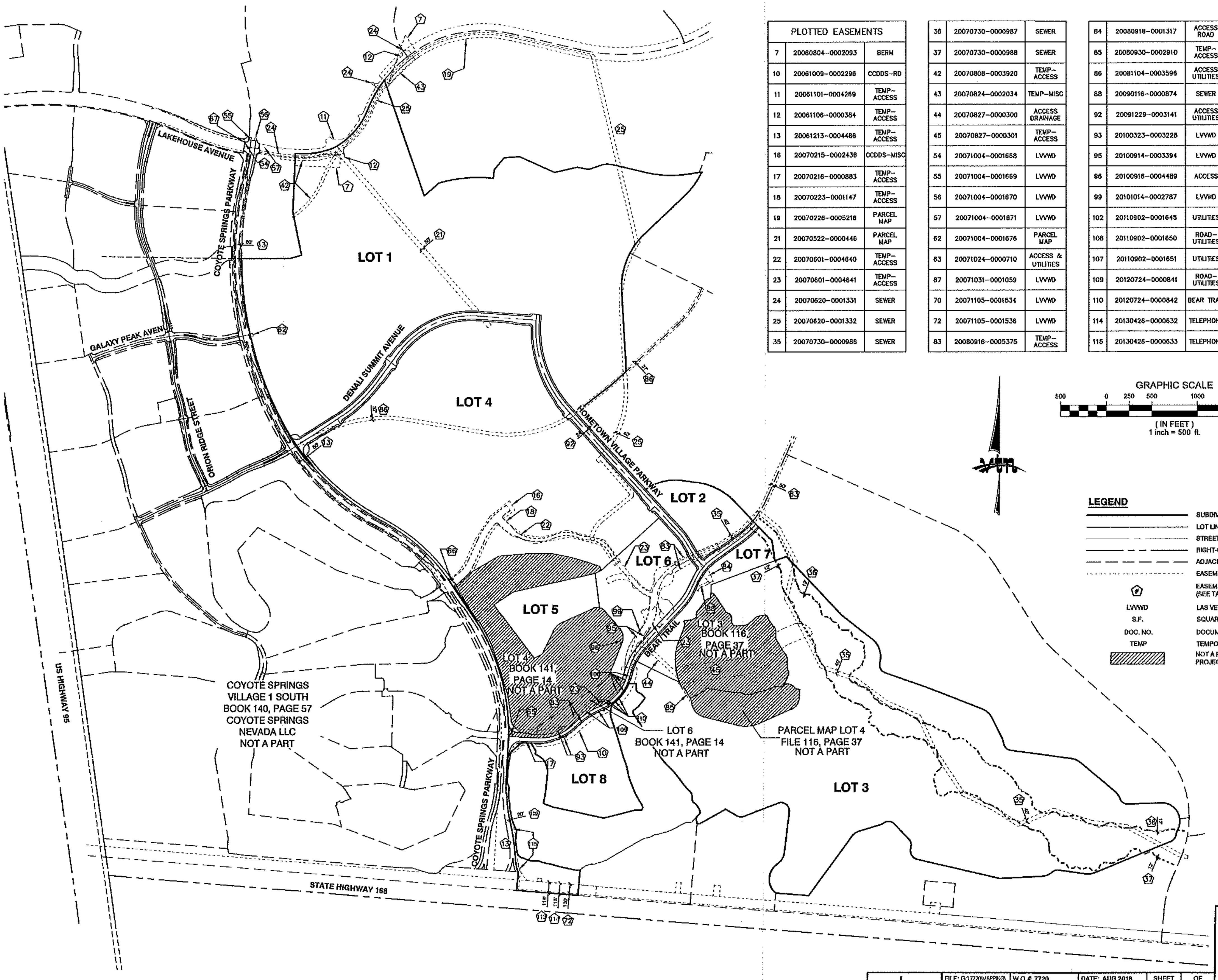
18983
06/10/2019



PLOTTED EASEMENTS		
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12	20061106-0000384	TEMP-ACCESS
13	20061213-0004486	TEMP-ACCESS
16	20070215-0002436	CCDDS-MISC
17	20070216-0000883	TEMP-ACCESS
18	20070223-0001147	TEMP-ACCESS
19	20070226-0005216	PARCEL MAP
21	20070522-0000446	PARCEL MAP
22	20070601-0004640	TEMP-ACCESS
23	20070601-0004641	TEMP-ACCESS
24	20070620-0001331	SEWER
25	20070620-0001332	SEWER
35	20070730-0000986	SEWER

36	20070730-0000987	SEWER
37	20070730-0000988	SEWER
42	20070808-0003920	TEMP-ACCESS
43	20070824-0002034	TEMP-MISC
44	20070827-0000300	ACCESS DRAINAGE
45	20070827-0000301	TEMP-ACCESS
54	20071004-0001668	LVVWD
55	20071004-0001669	LVVWD
56	20071004-0001670	LVVWD
57	20071004-0001671	LVVWD
62	20071004-0001676	PARCEL MAP
63	20071024-0000710	ACCESS & UTILITIES
67	20071031-0001059	LVVWD
70	20071105-0001534	LVVWD
72	20071105-0001536	LVVWD
83	20080916-0005375	TEMP-ACCESS

84	20080918-0001317	ACCESS ROAD
85	20080930-0002910	TEMP-ACCESS
86	20081104-0003598	ACCESS UTILITIES
88	20090116-0000874	SEWER
92	20091229-0003141	ACCESS UTILITIES
93	20100323-0003228	LVVWD
95	20100914-0003394	LVVWD
96	20100916-0004489	ACCESS
99	20101014-0002787	LVVWD
102	20110902-0001645	UTILITIES
106	20110902-0001650	ROAD-UTILITIES
107	20110902-0001651	UTILITIES
109	20120724-0000841	ROAD-UTILITIES
110	20120724-0000842	BEAR TRAIL
114	20130426-0000632	TELEPHONE
115	20130426-0000633	TELEPHONE

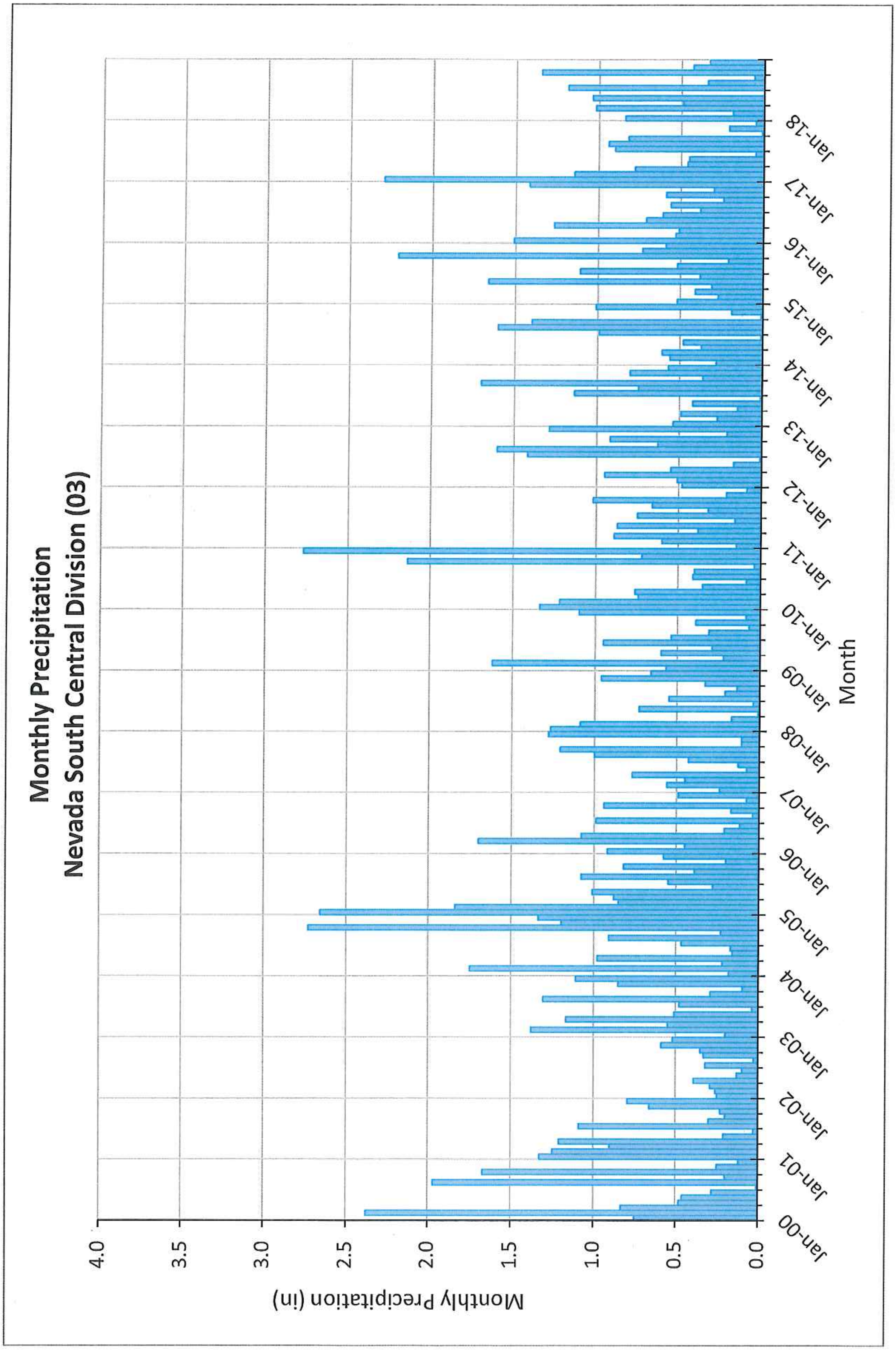
LEGEND

———	SUBDIVISION BOUNDARY LINE
———	LOT LINE
—— – ——	STREET CENTERLINE
—— – – ——	RIGHT-OF-WAY LINE
— — — —	ADJACENT PROPERTY LINE
· · · · · ·	EASEMENT LINE AS NOTED
⬠ #	EASEMENT DESCRIPTION SYMBOL (SEE TABLE)
LVVWD	LAS VEGAS VALLEY WATER DISTRICT
S.F.	SQUARE FEET
DOC. NO.	DOCUMENT NUMBER
TEMP	TEMPORARY
▨	NOT A PART WITHIN THE PROJECT SITE BOUNDARY

FILE: G:\7720\MAPPING\ FINAL MAP\VILLAGE A\	W.O.# 7720	DATE: AUG 2018	SHEET	OF
	DRN. BY: TJ		21	21
	CKD. BY: RAJ			

RAYMOND A. JOHNSON
18983
06/10/2019

SE ROA 35925


Monthly Precipitation
Nevada South Central Division (03)
Monthly Precipitation (in)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Month
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
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Jan-12
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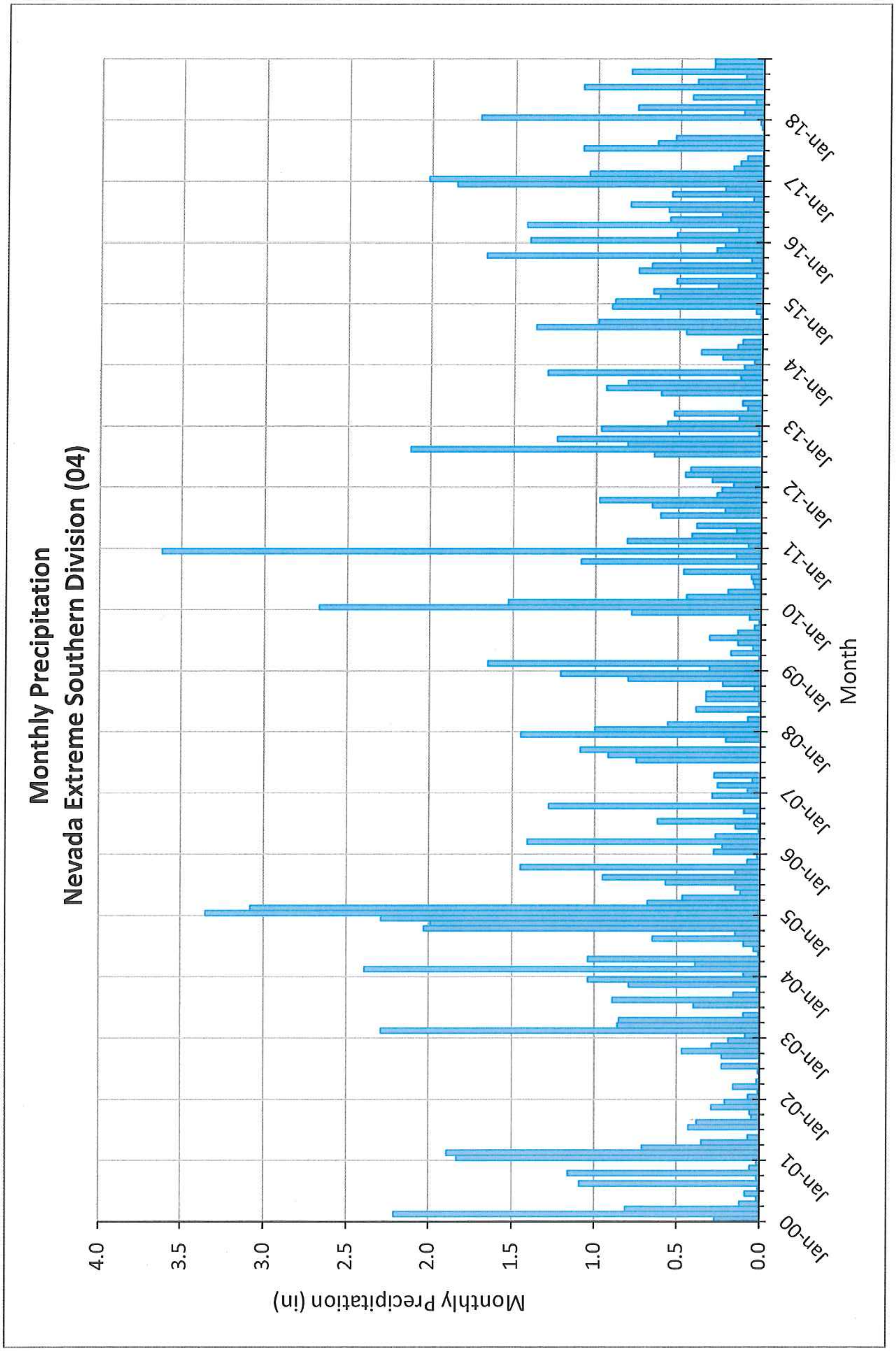
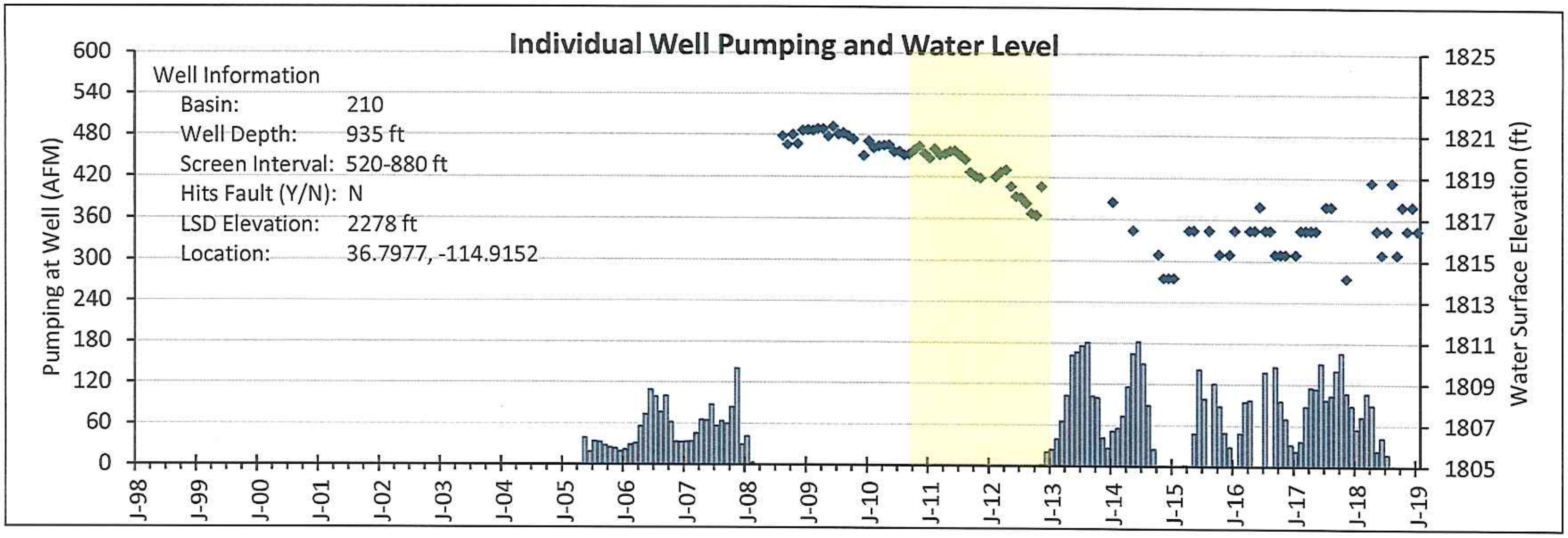
Jan-15
Jan-16
Jan-17
Jan-18

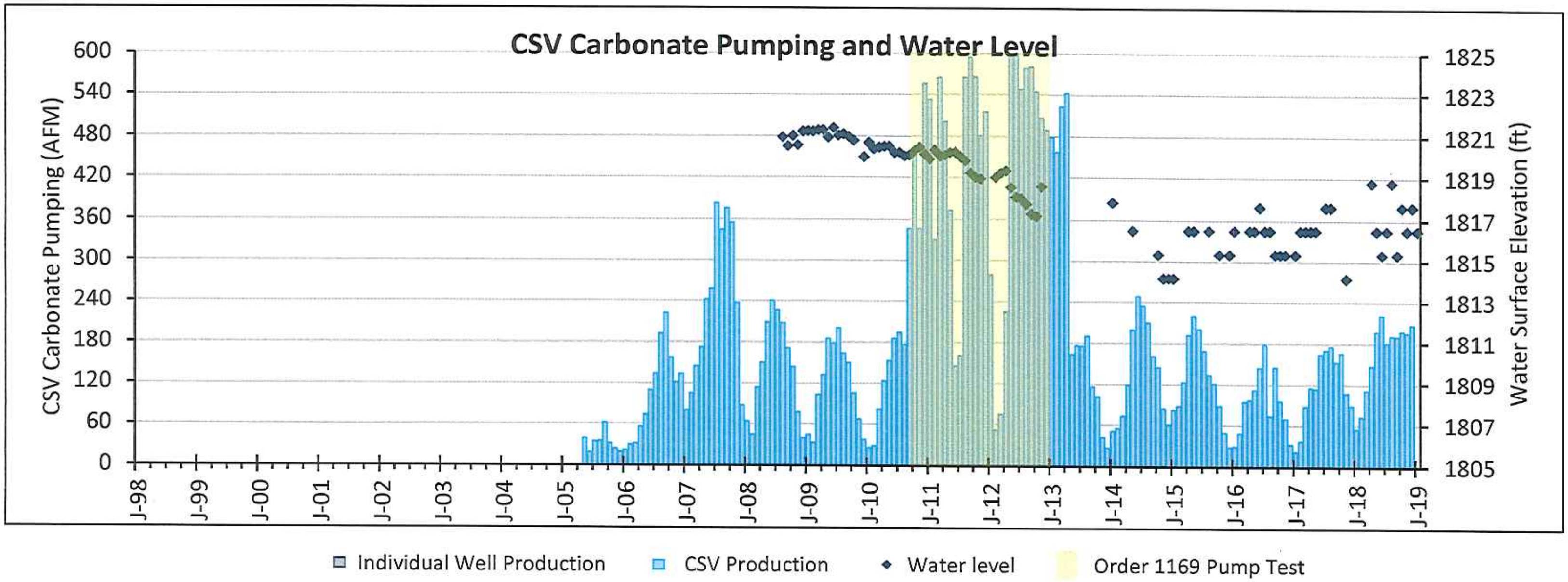

Monthly Precipitation
Nevada Extreme Southern Division (04)
Monthly Precipitation (in)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Month

Basin 210 - Coyote Spring Valley

CSI-1

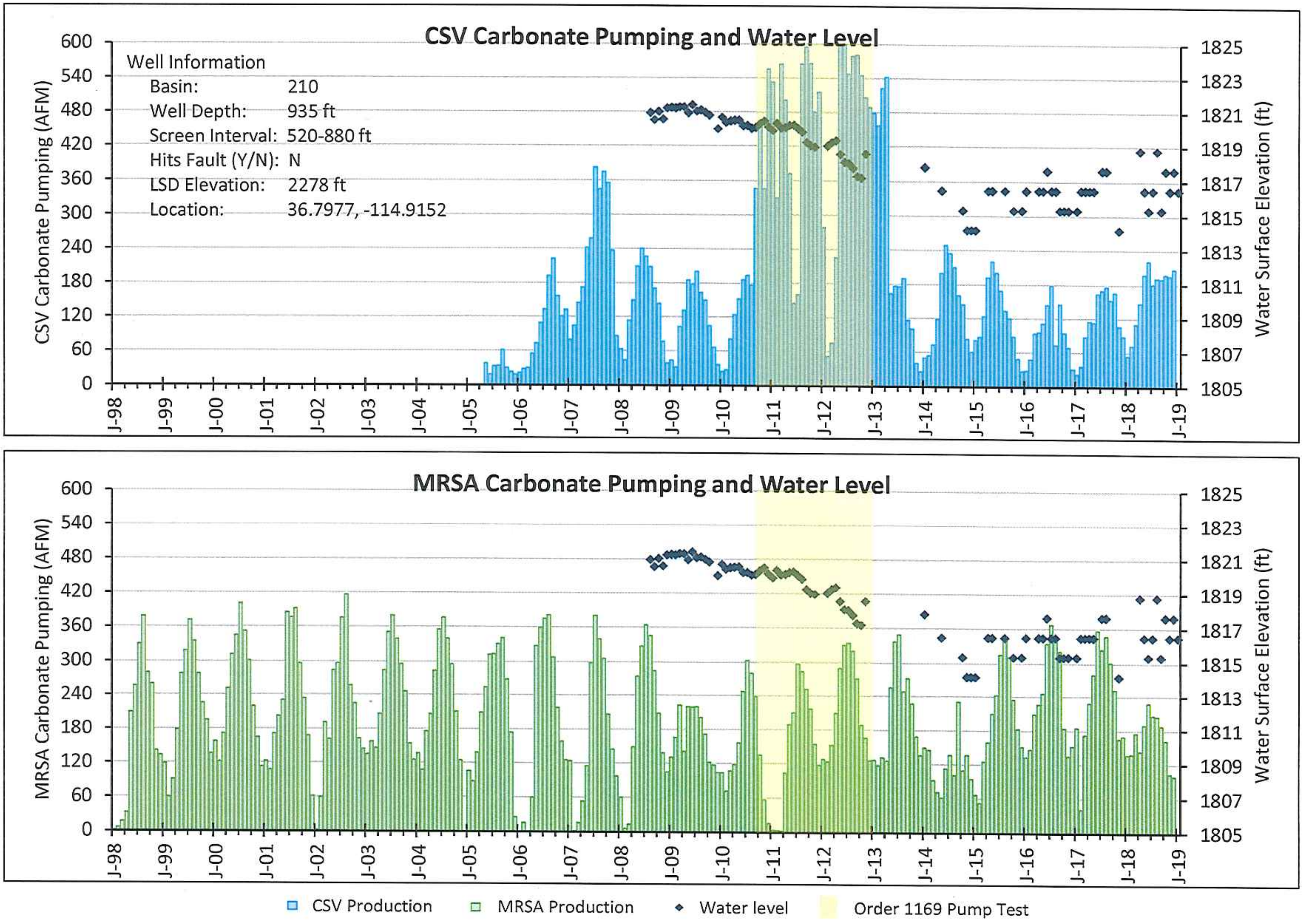


Well Information
Basin: 210
Well Depth: 935 ft
Screen Interval: 520-880 ft
Hits Fault (Y/N): N
LSD Elevation: 2278 ft
Location: 36.7977, -114.9152



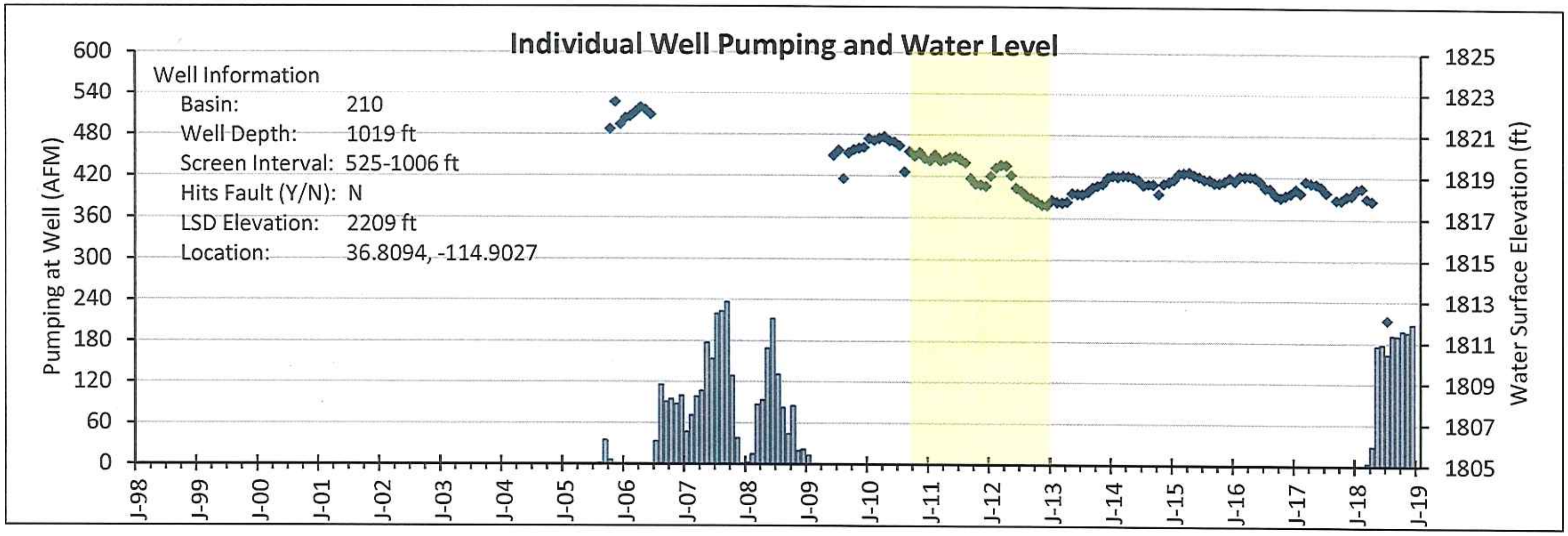
1A

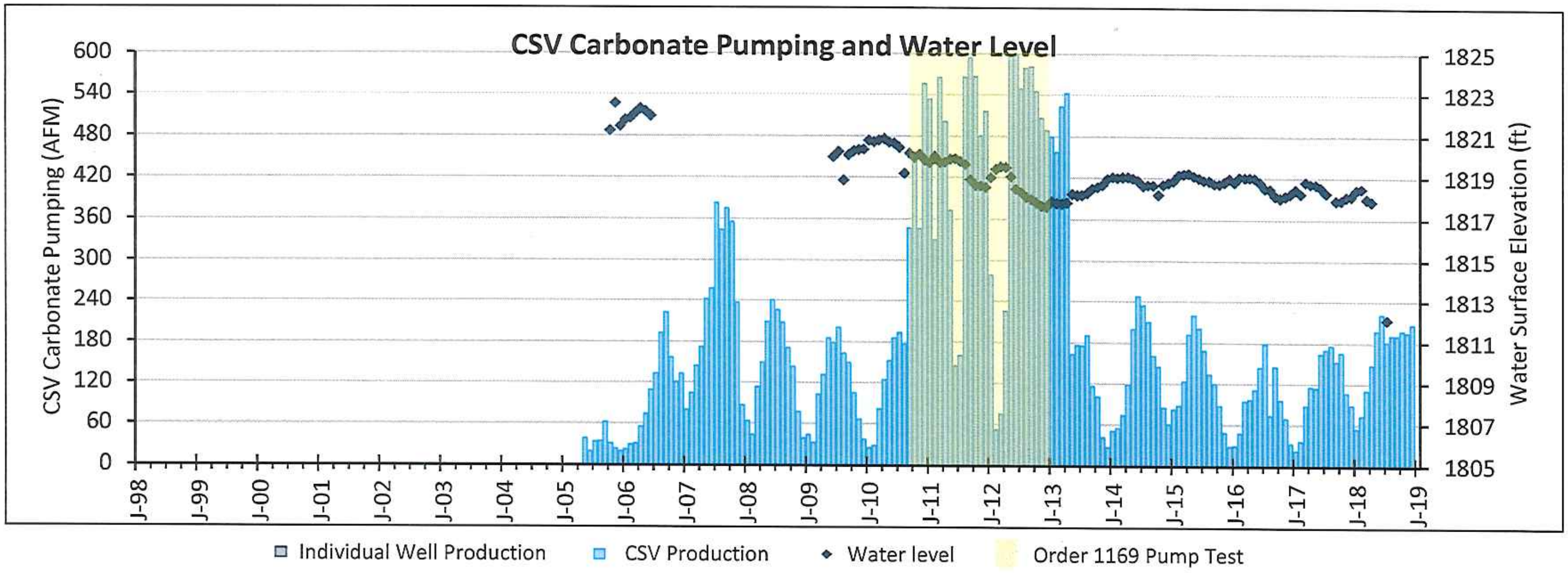
Basin 210 - Coyote Spring Valley



Basin 210 - Coyote Spring Valley

CSI-2

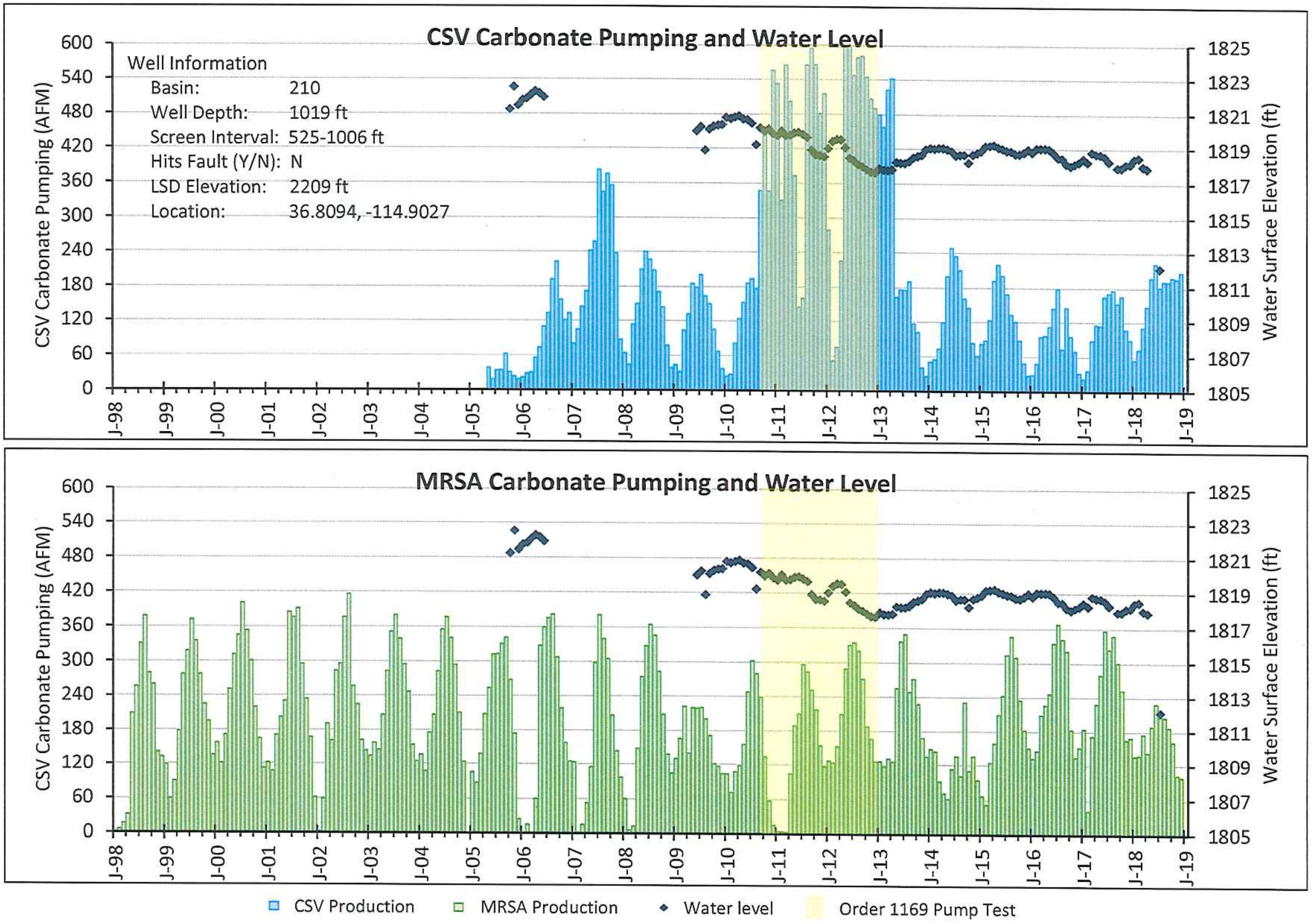




2A

Basin 210 - Coyote Spring Valley

CSI-2

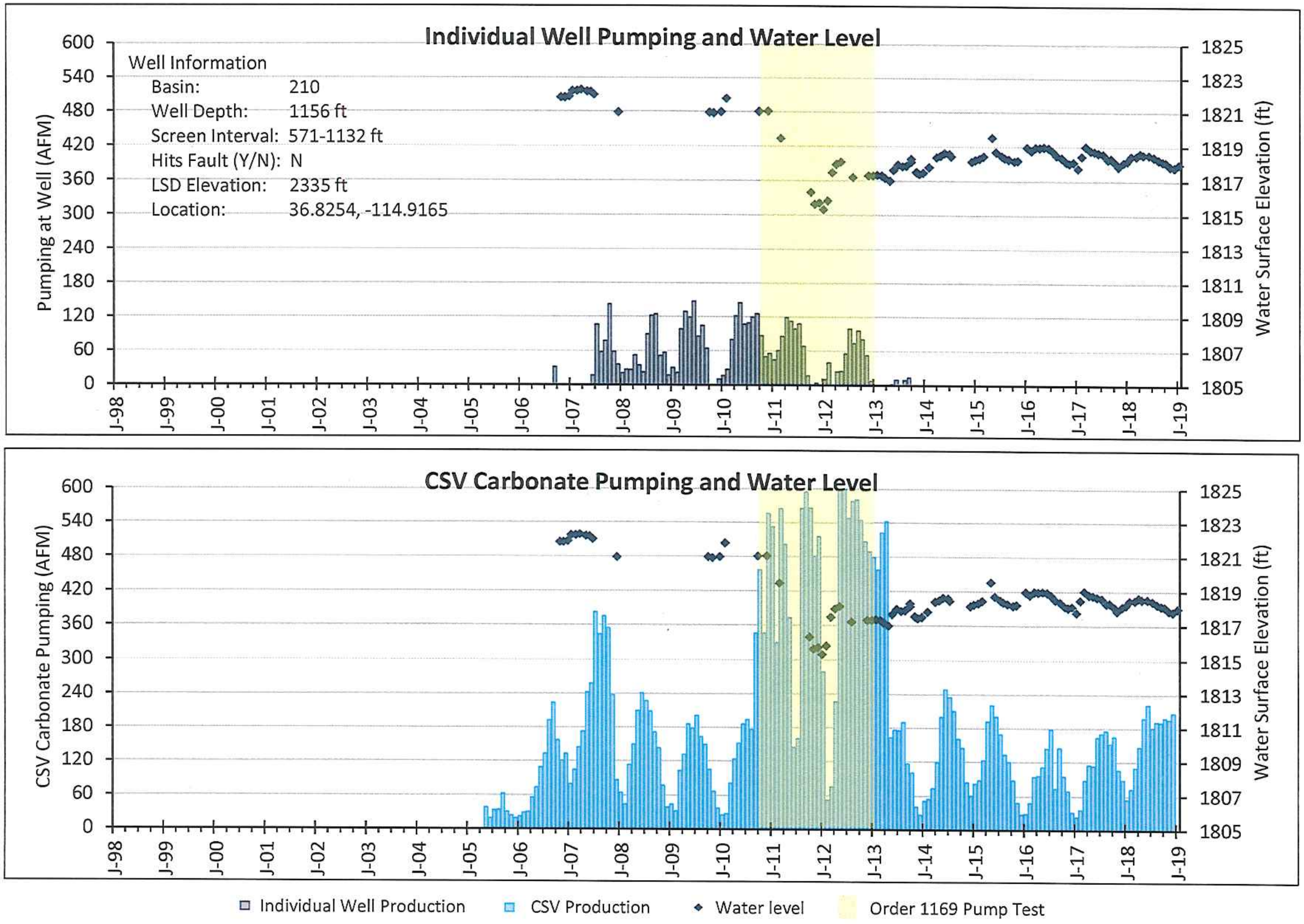


Well Information
Basin: 210
Well Depth: 1019 ft
Screen Interval: 525-1006 ft
Hits Fault (Y/N): N
LSD Elevation: 2209 ft
Location: 36.8094, -114.9027

2B

Basin 210 - Coyote Spring Valley

CSI-3

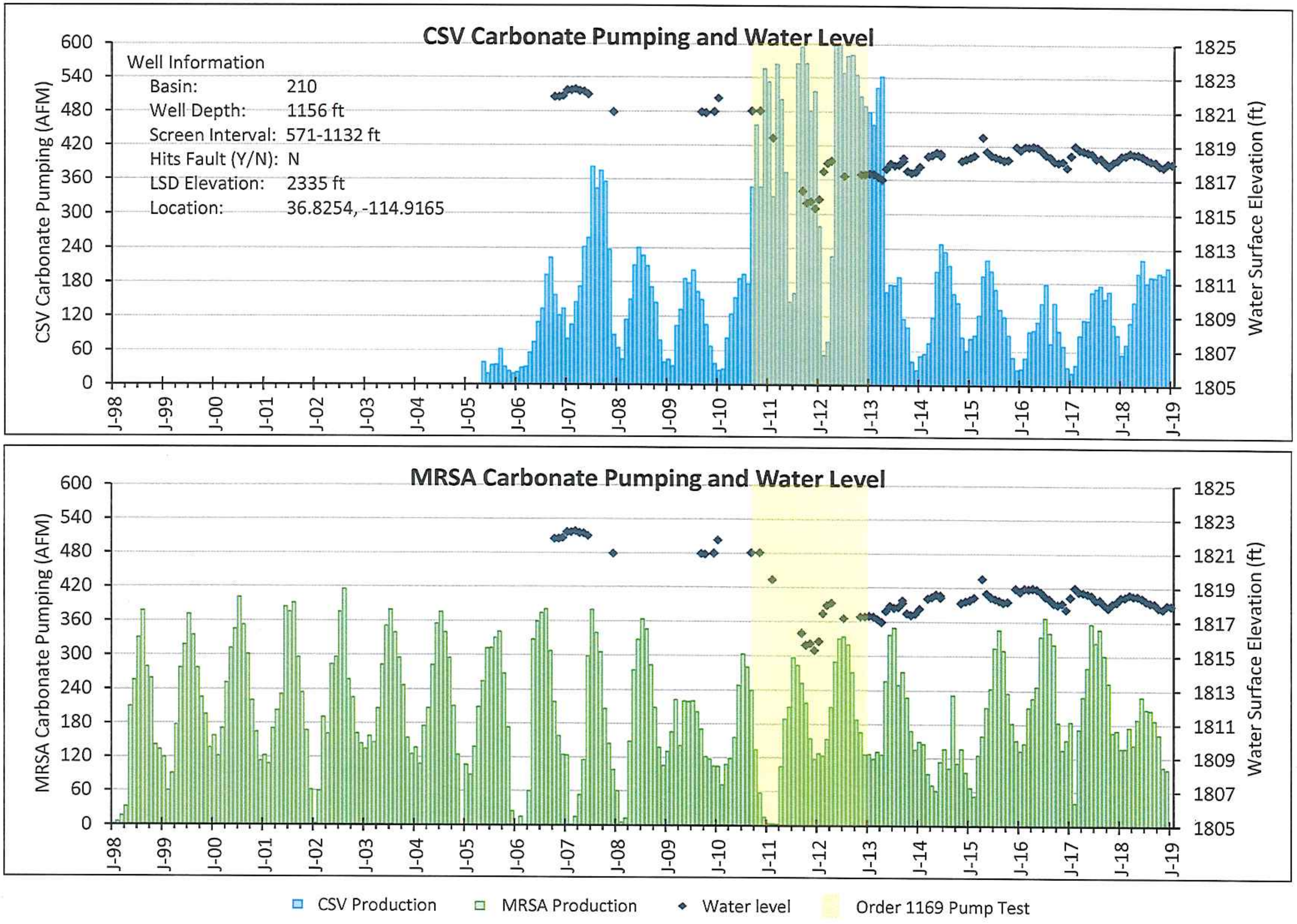


Well Information
Basin: 210
Well Depth: 1156 ft
Screen Interval: 571-1132 ft
Hits Fault (Y/N): N
LSD Elevation: 2335 ft
Location: 36.8254, -114.9165

3A

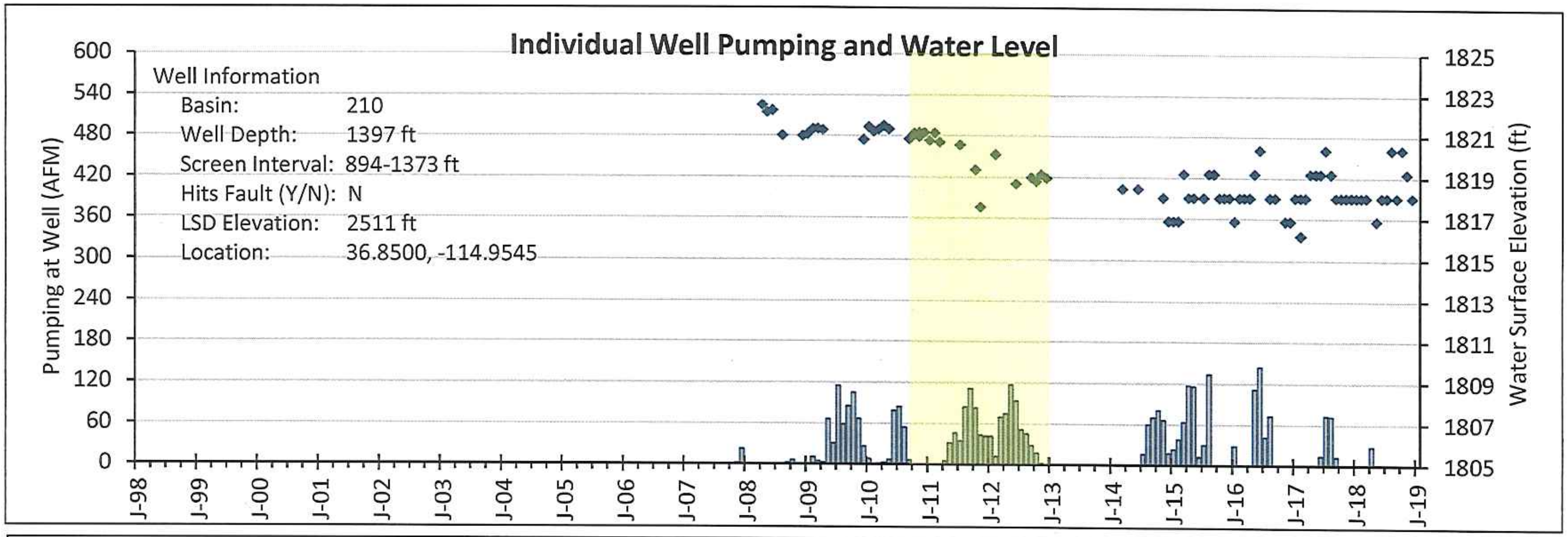
Basin 210 - Coyote Spring Valley

CSI-3



3B

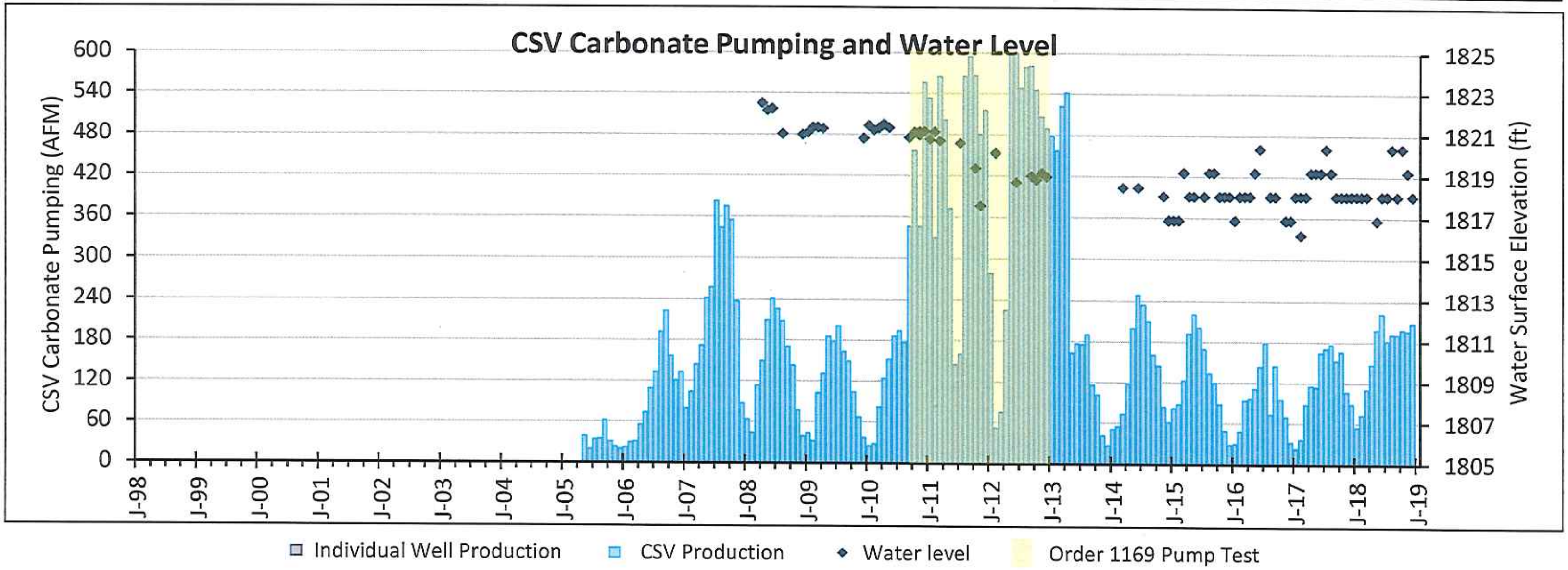
Basin 210 - Coyote Spring Valley



Individual Well Pumping and Water Level

Well Information

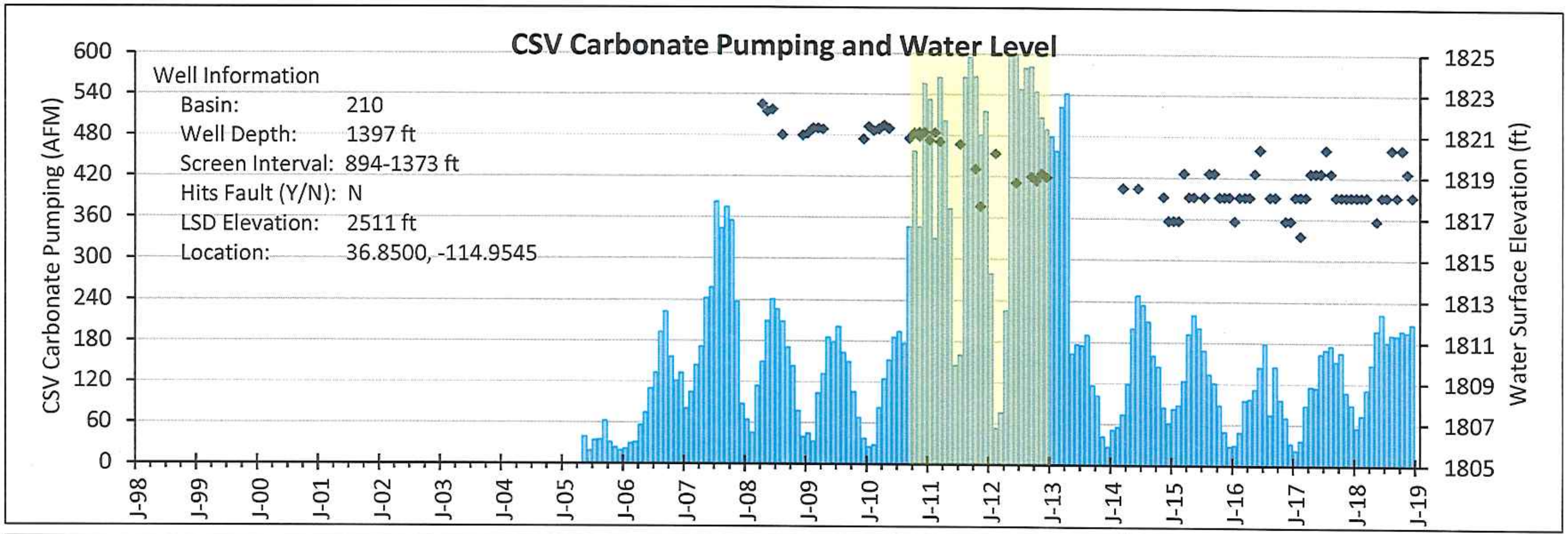
Basin:	210
Well Depth:	1397 ft
Screen Interval:	894-1373 ft
Hits Fault (Y/N):	N
LSD Elevation:	2511 ft
Location:	36.8500, -114.9545

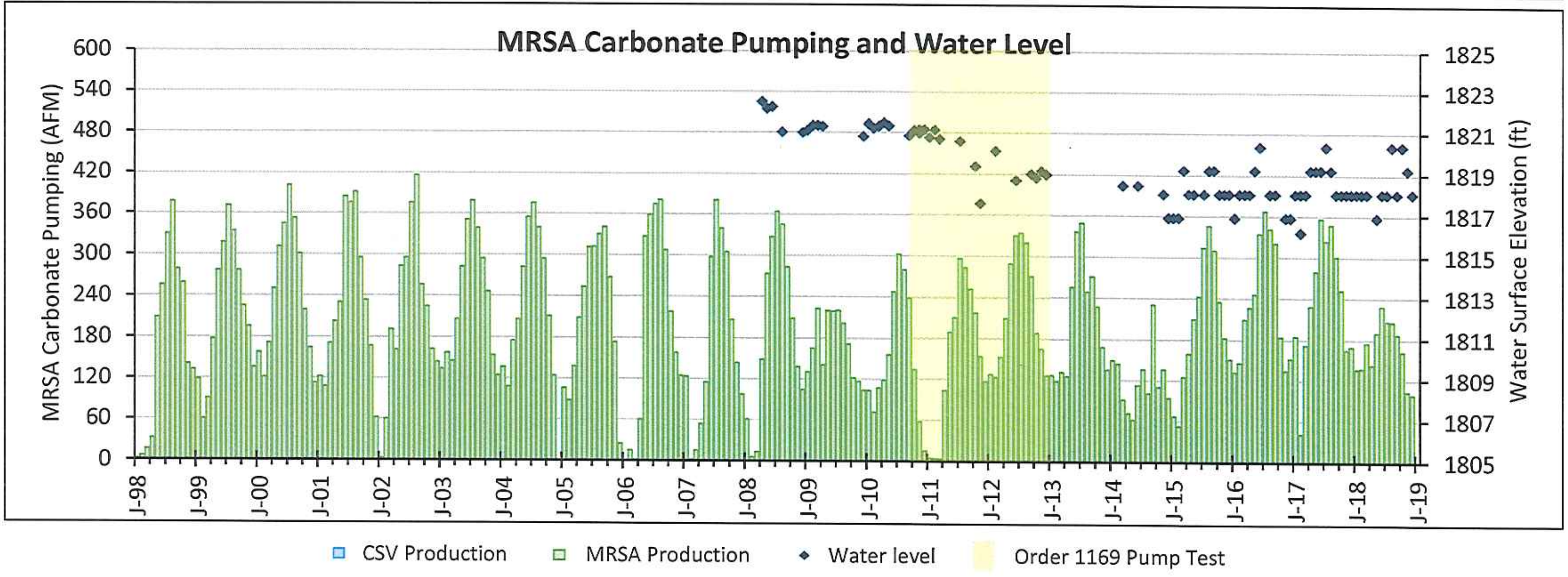


CSV Carbonate Pumping and Water Level

Basin 210 - Coyote Spring Valley

CSI-4

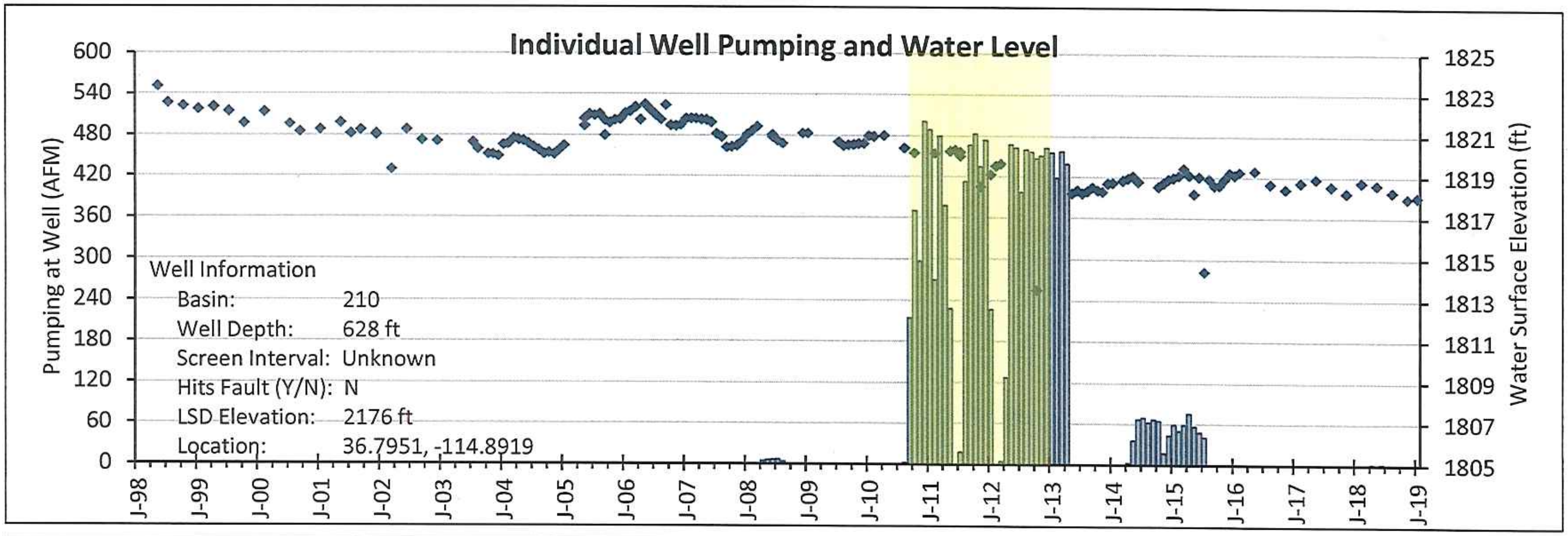




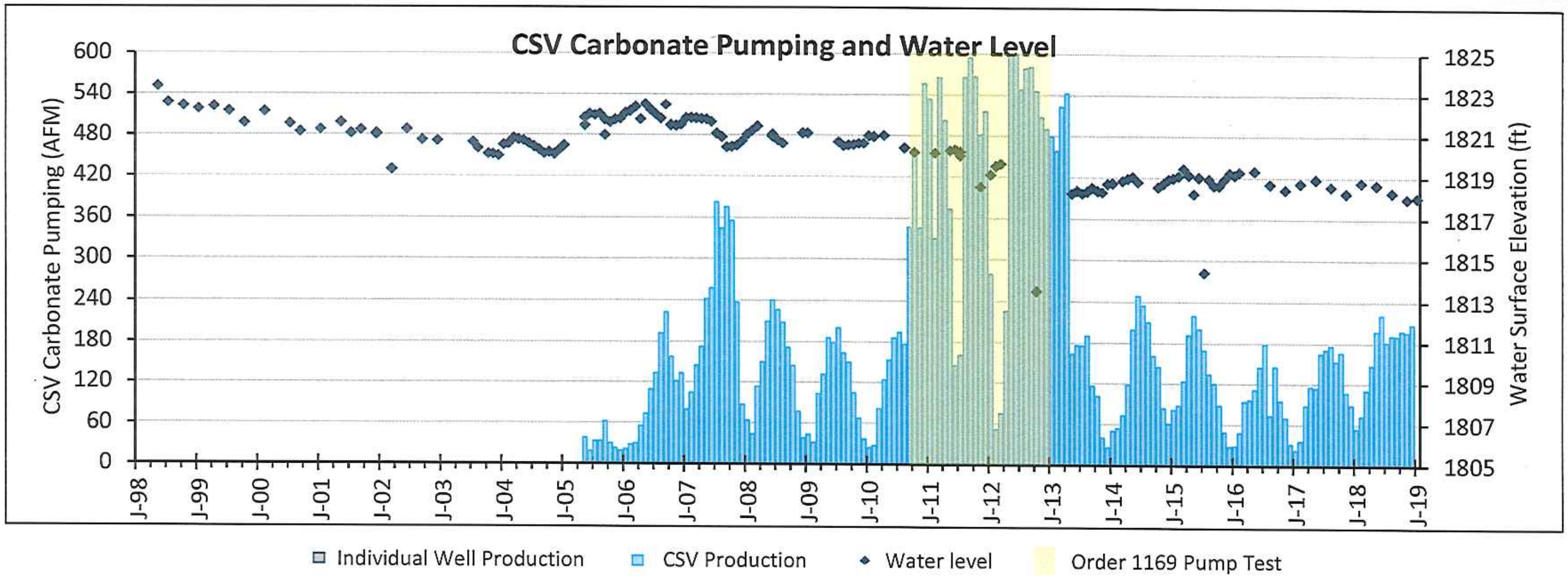
4B

Basin 210 - Coyote Spring Valley

MX-5



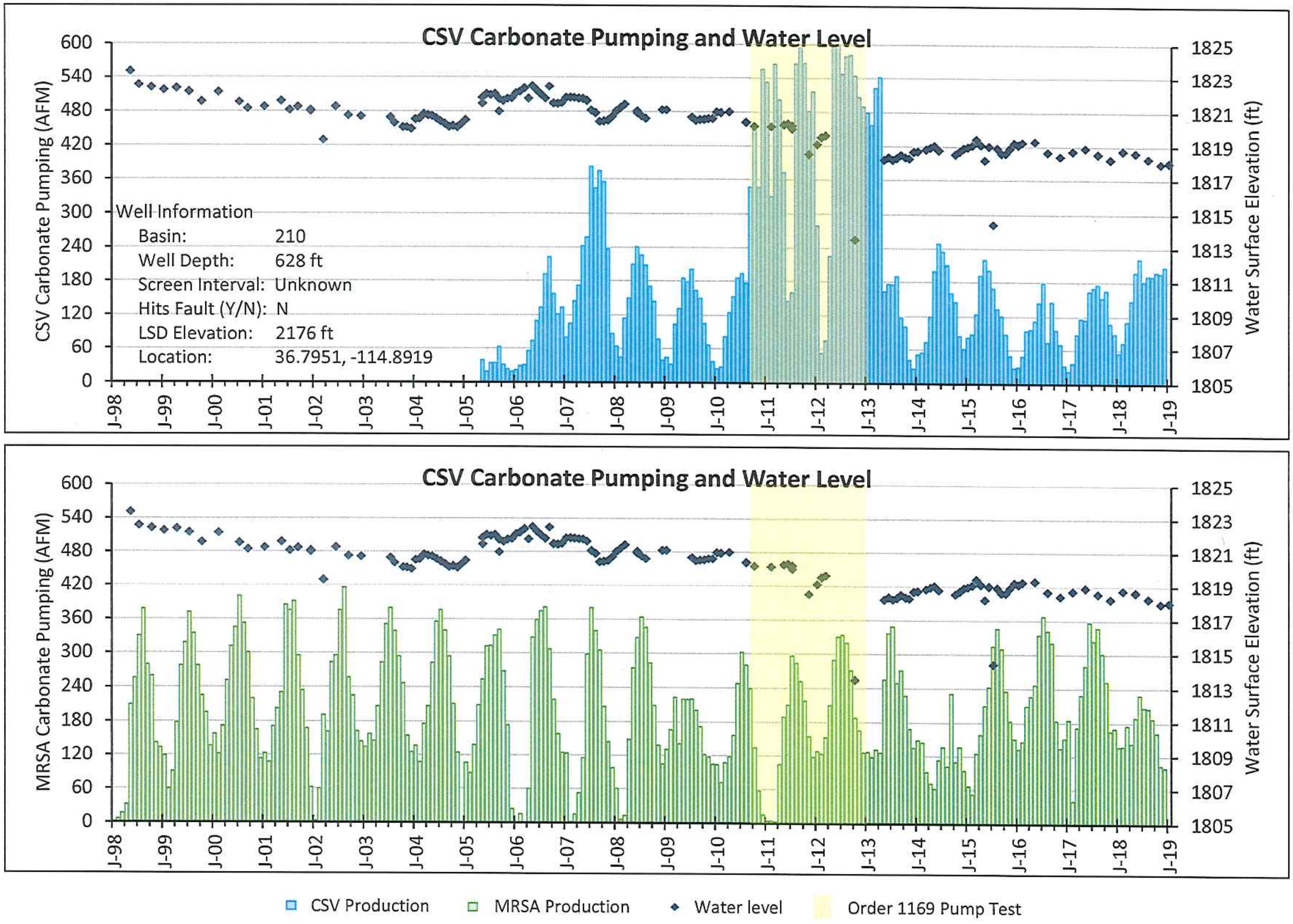
Well Information
Basin: 210
Well Depth: 628 ft
Screen Interval: Unknown
Hits Fault (Y/N): N
LSD Elevation: 2176 ft
Location: 36.7951, -114.8919



5A

Basin 210 - Coyote Spring Valley

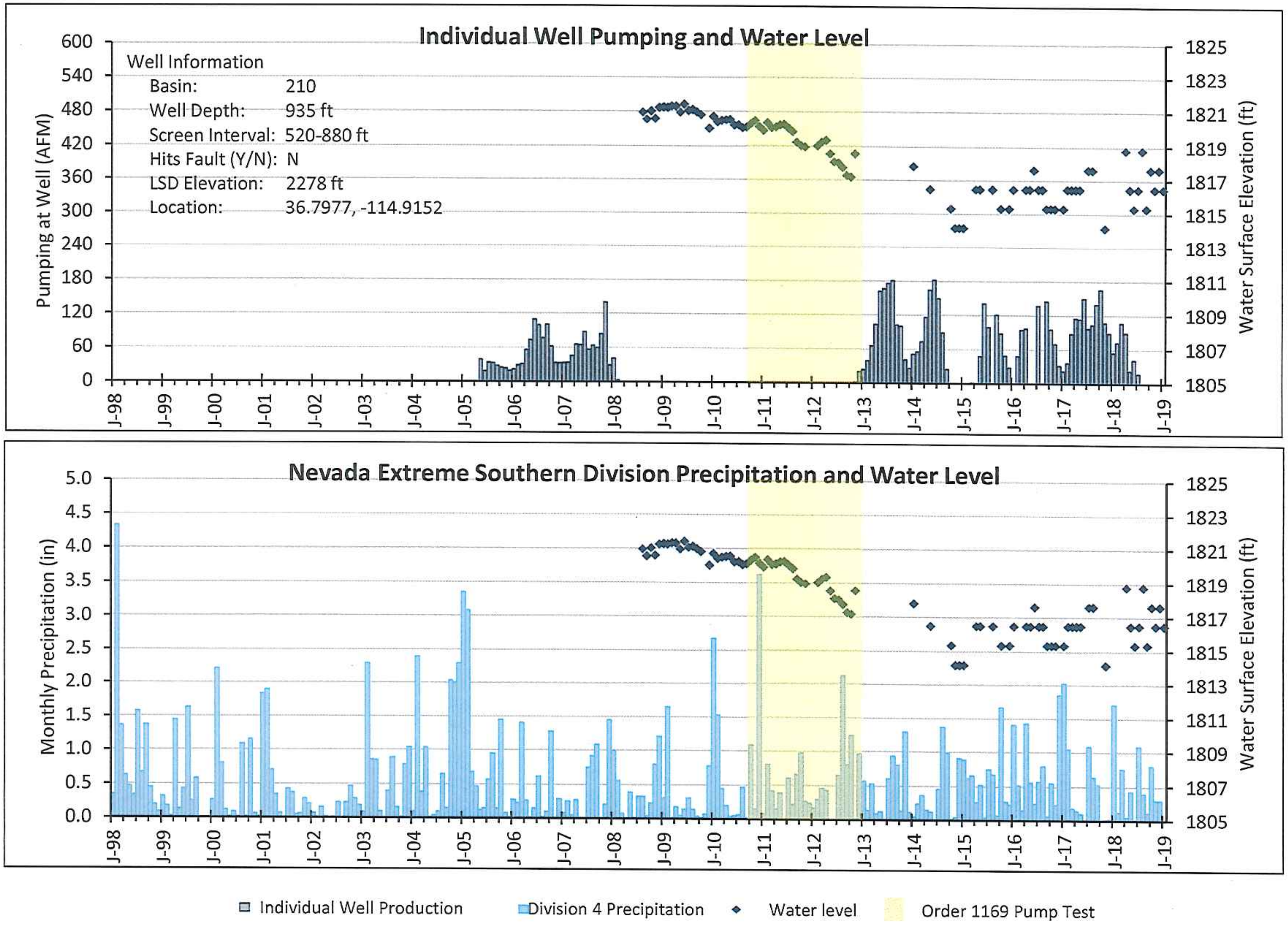
MX-5



5B

Basin 210 - Coyote Spring Valley

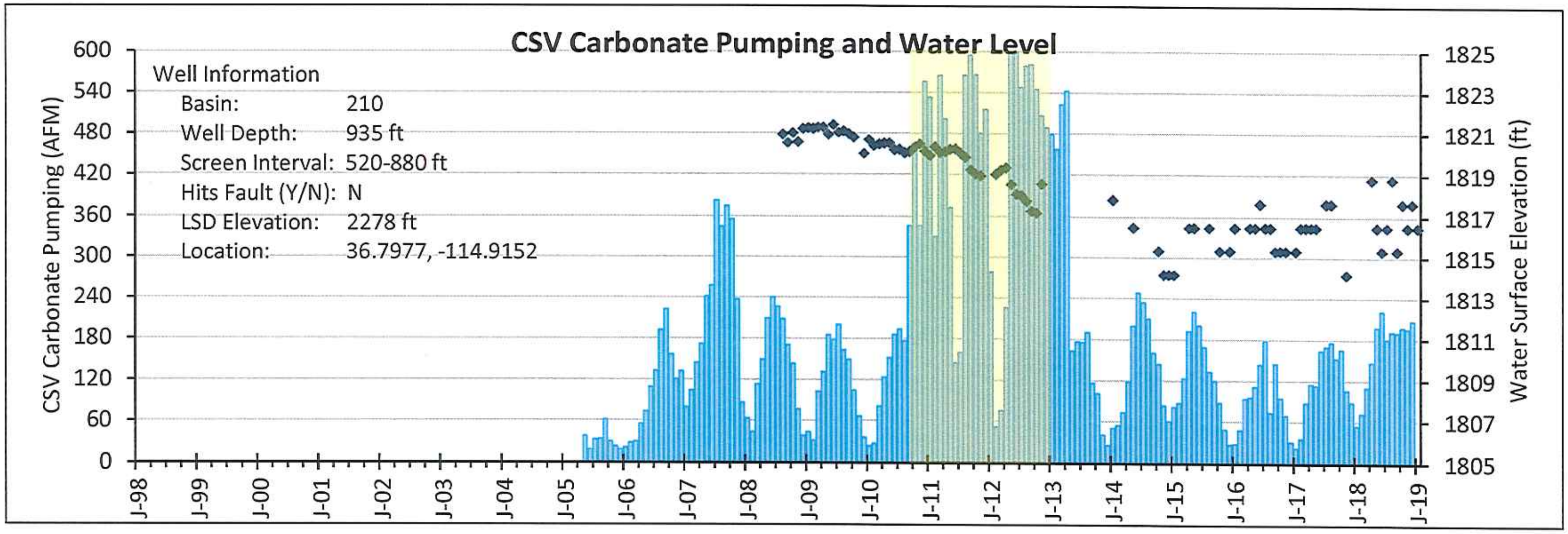
CSI-1

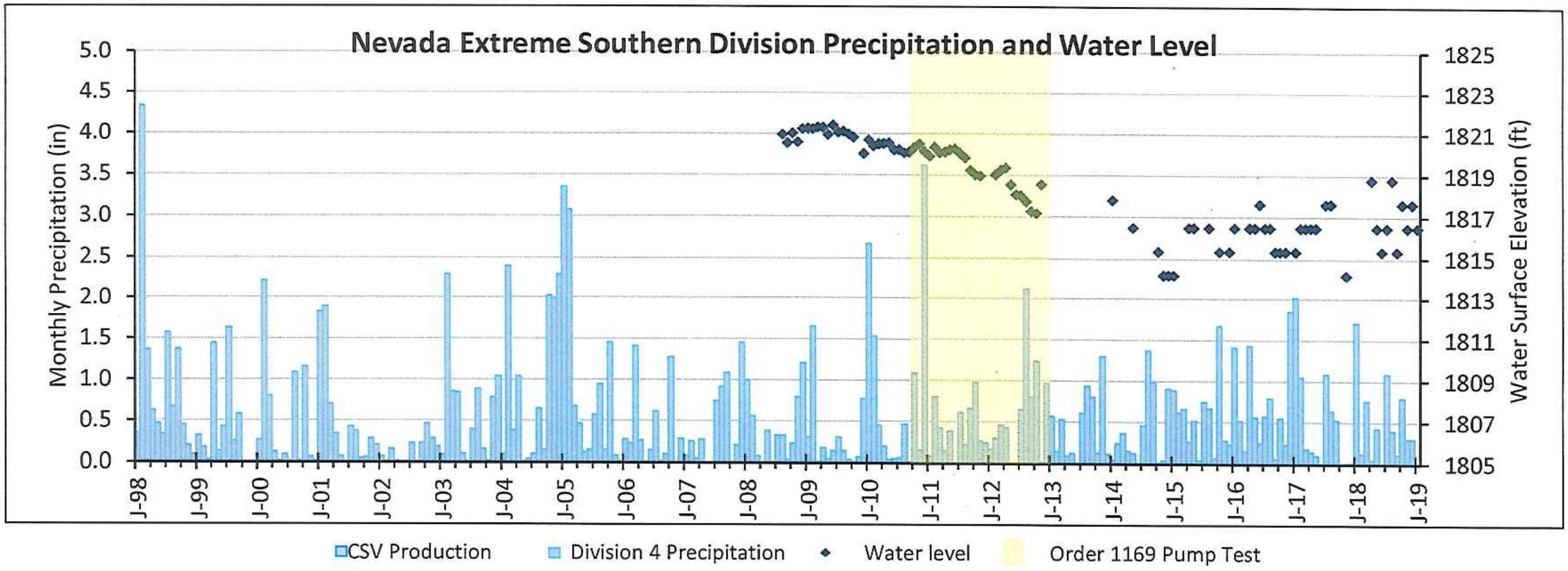


1A

Basin 210 - Coyote Spring Valley

CSI-1

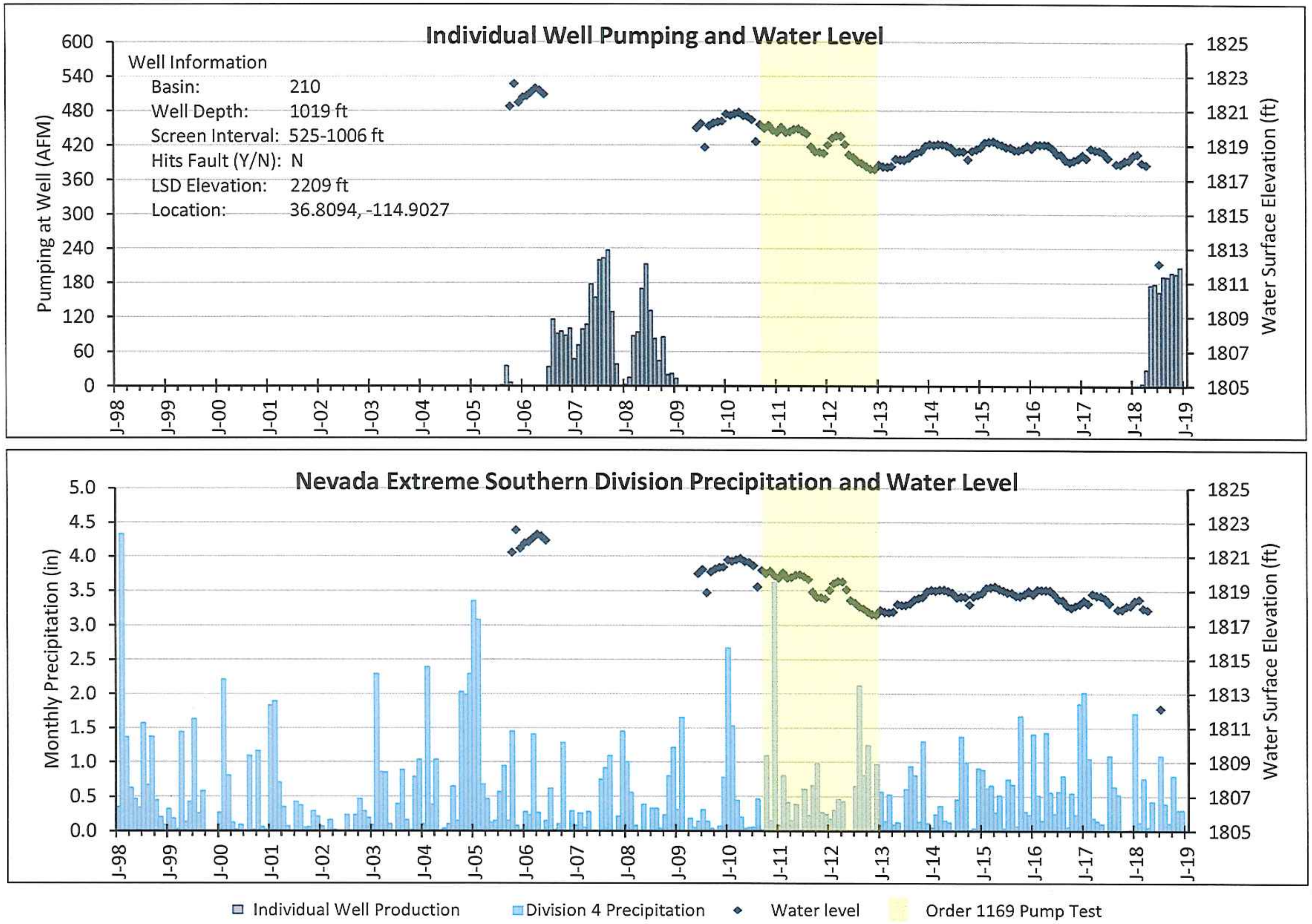




1B

Basin 210 - Coyote Spring Valley

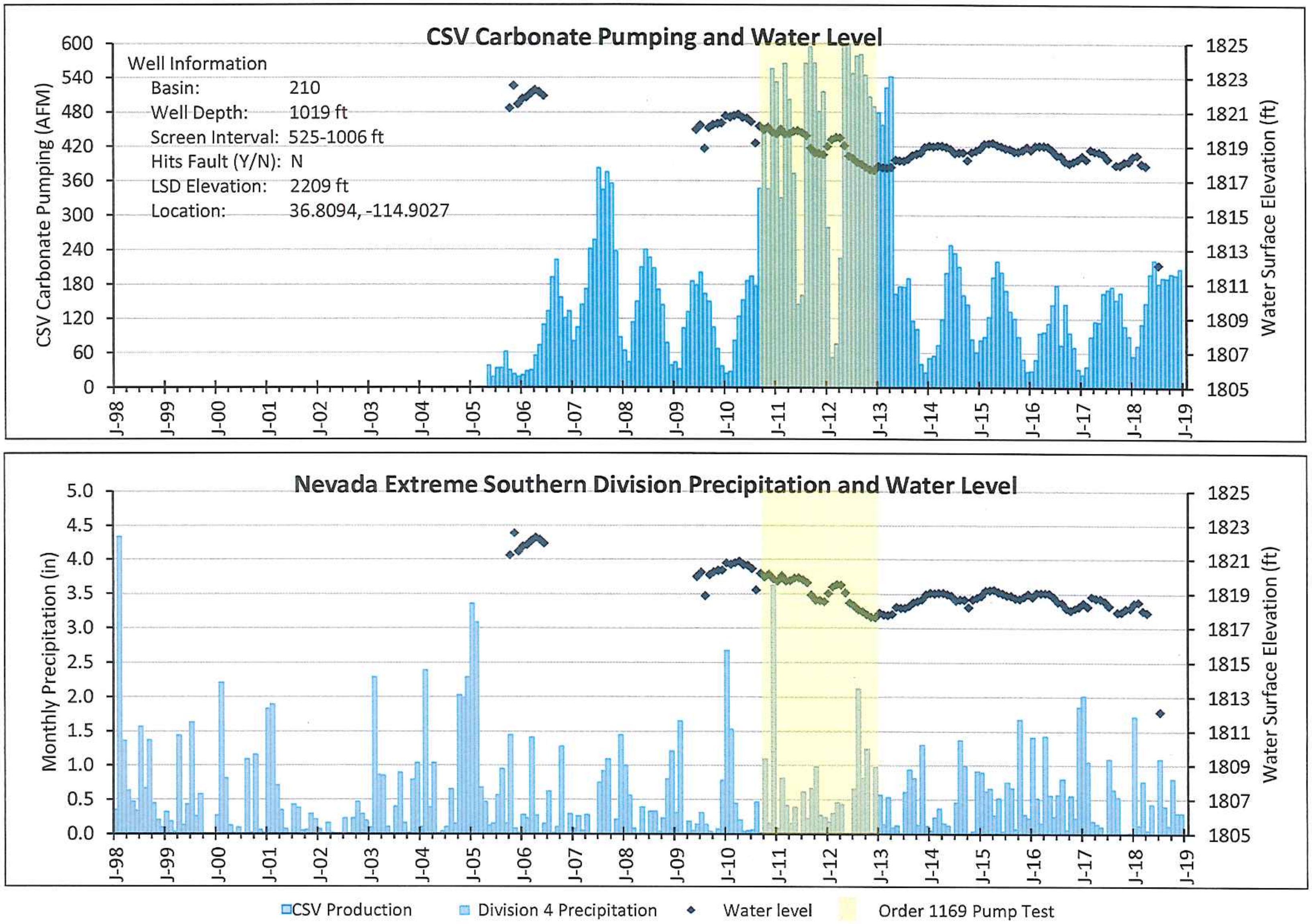
CSI-2



2A

Basin 210 - Coyote Spring Valley

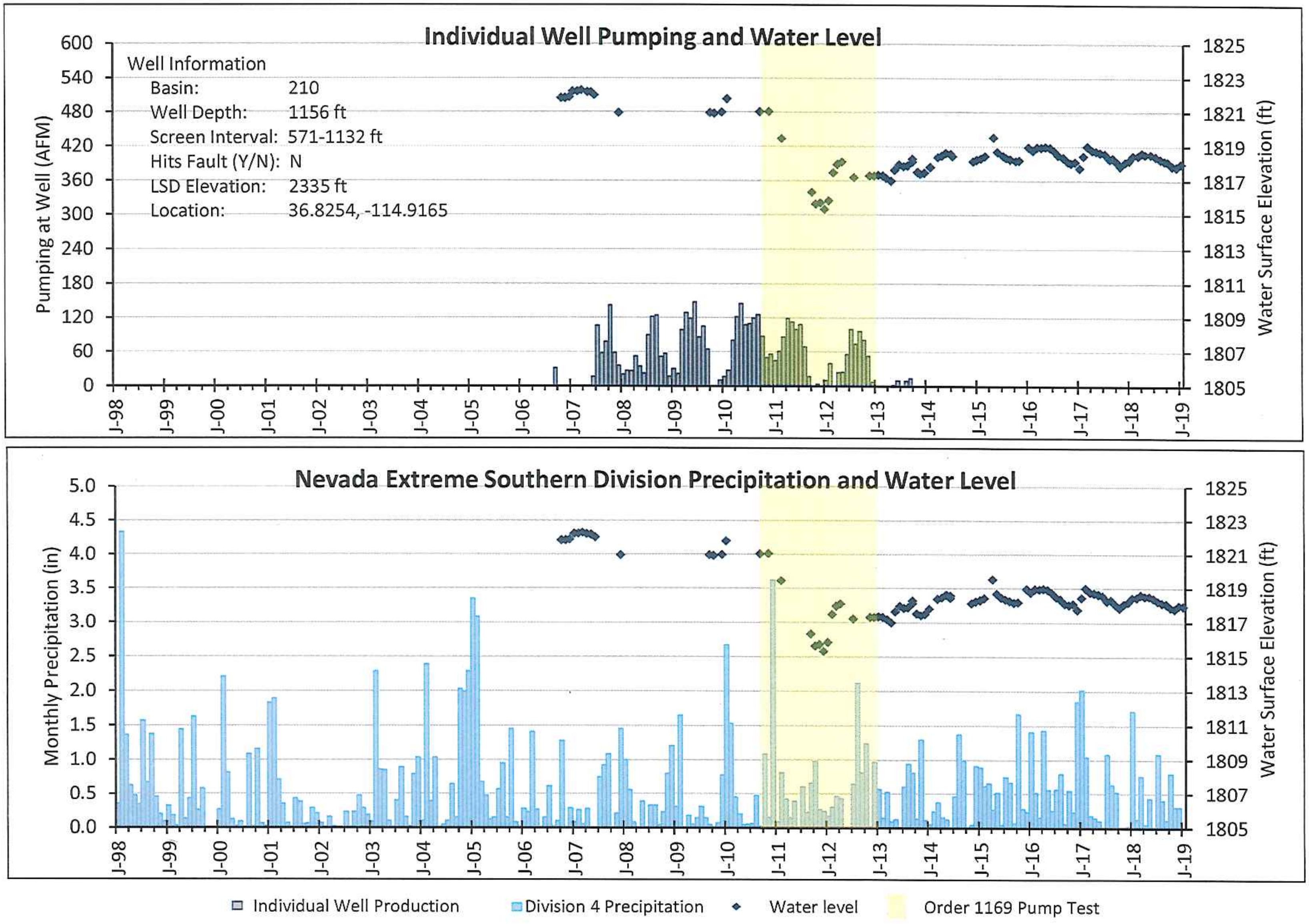
CSI-2



2B

Basin 210 - Coyote Spring Valley

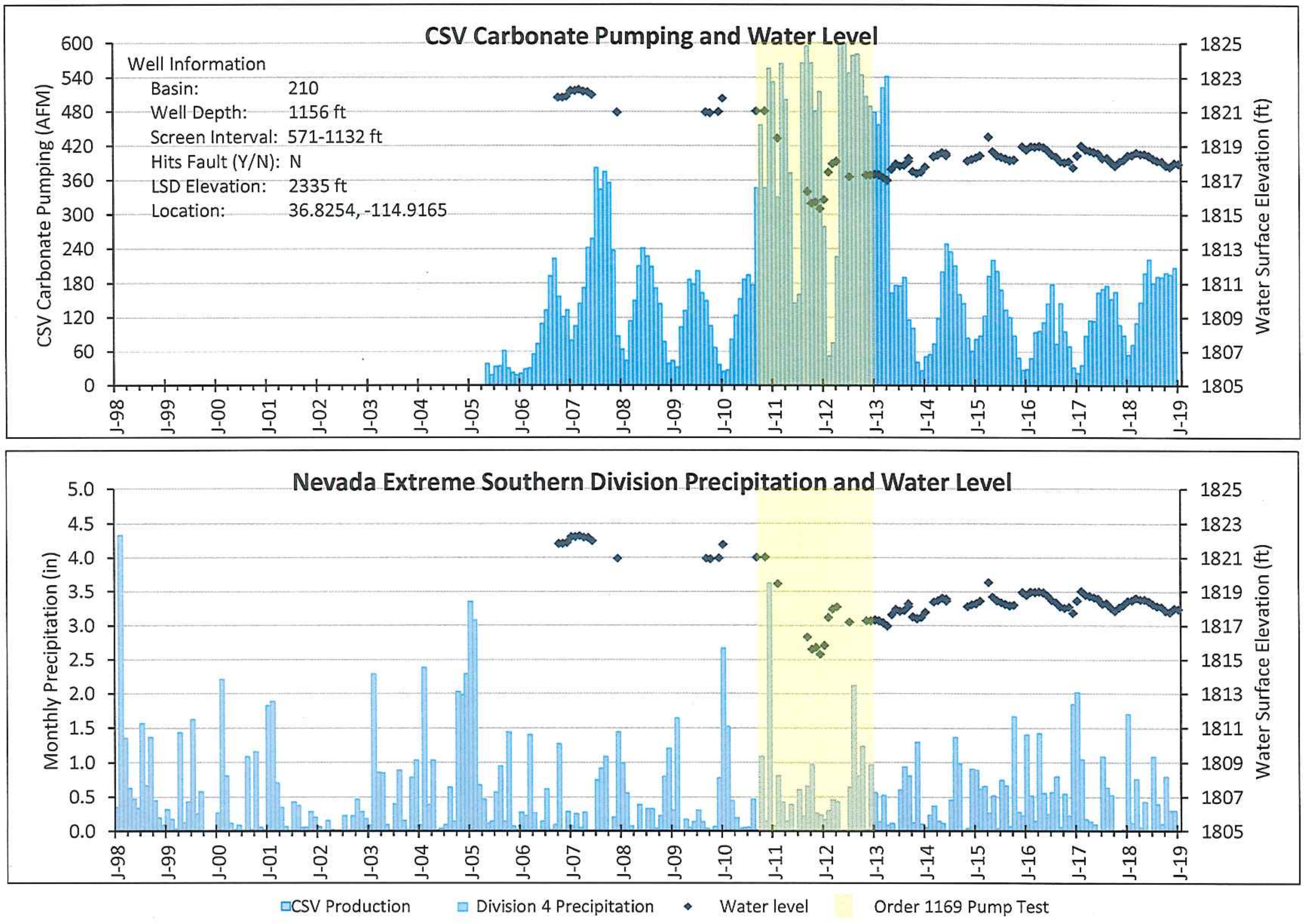
CSI-3



3A

Basin 210 - Coyote Spring Valley

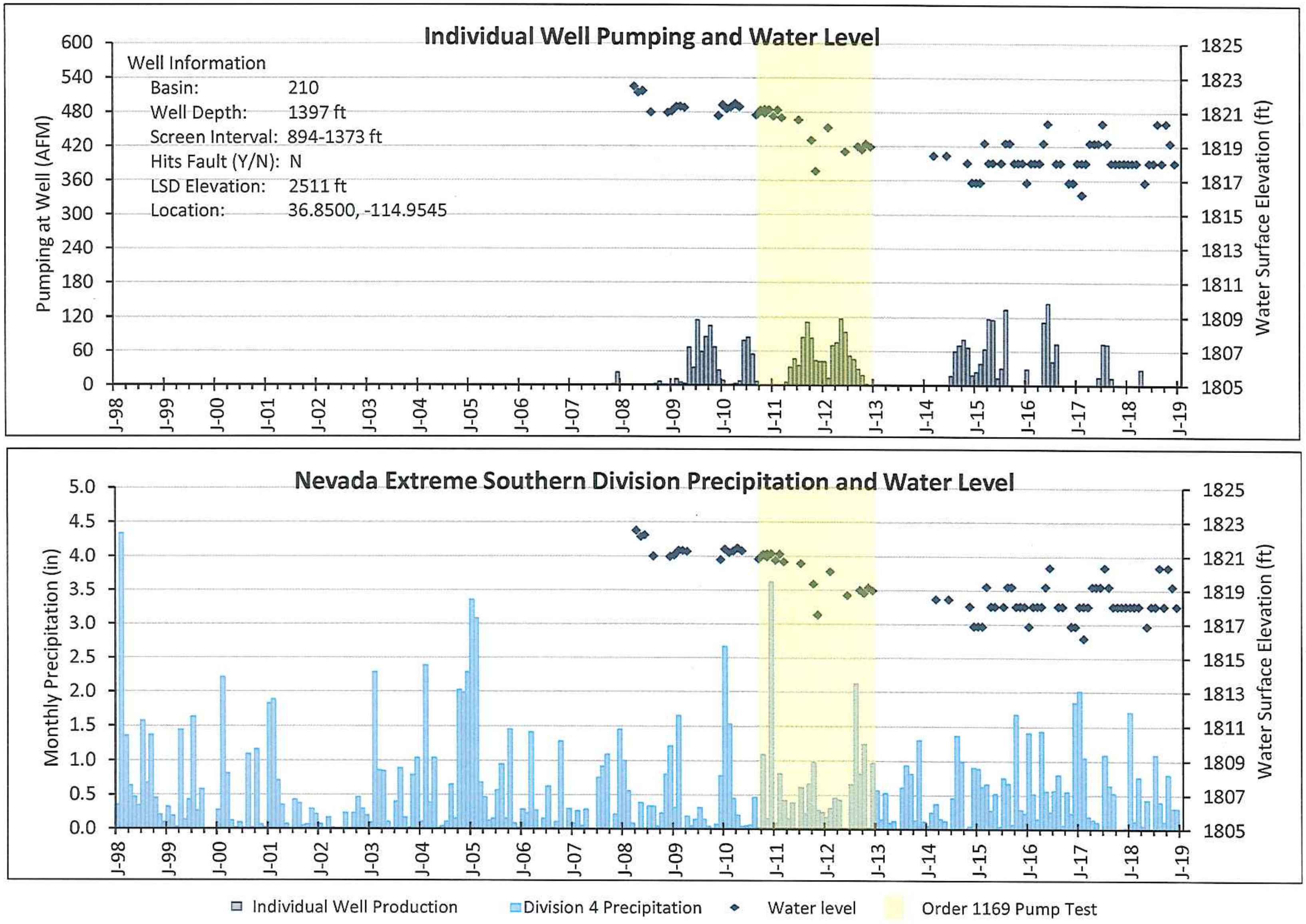
CSI-3



3B

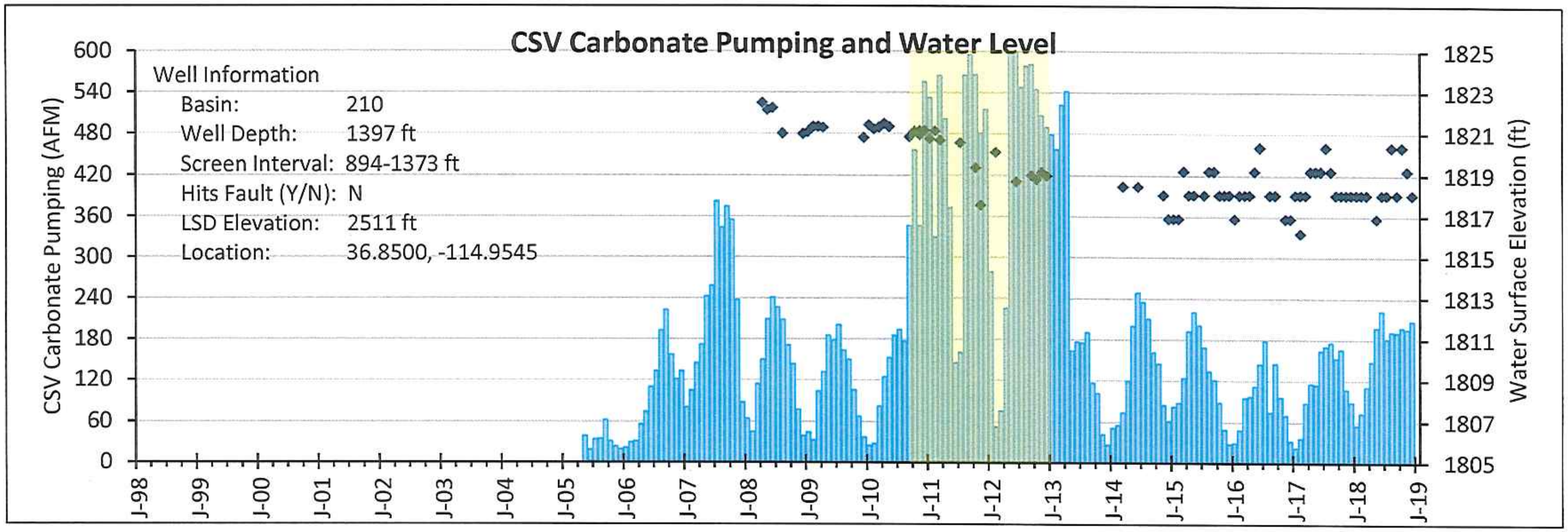
Basin 210 - Coyote Spring Valley

CSI-4



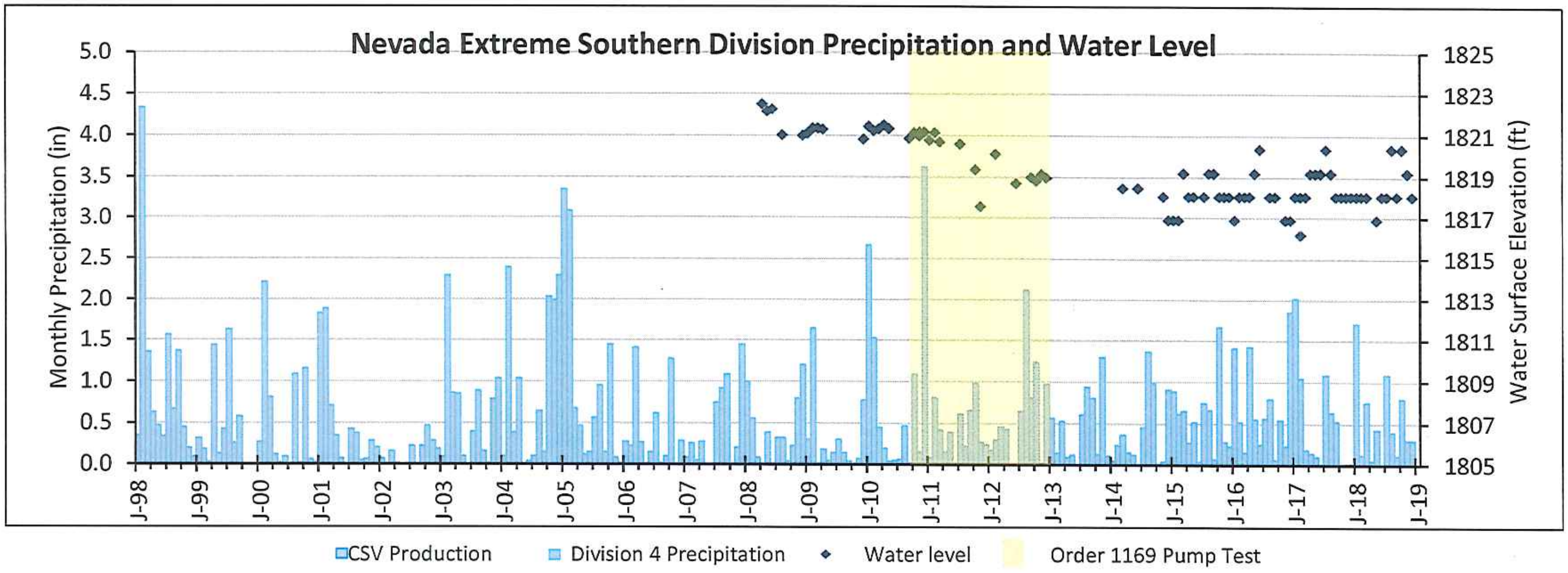
4A

Basin 210 - Coyote Spring Valley



CSV Carbonate Pumping and Water Level

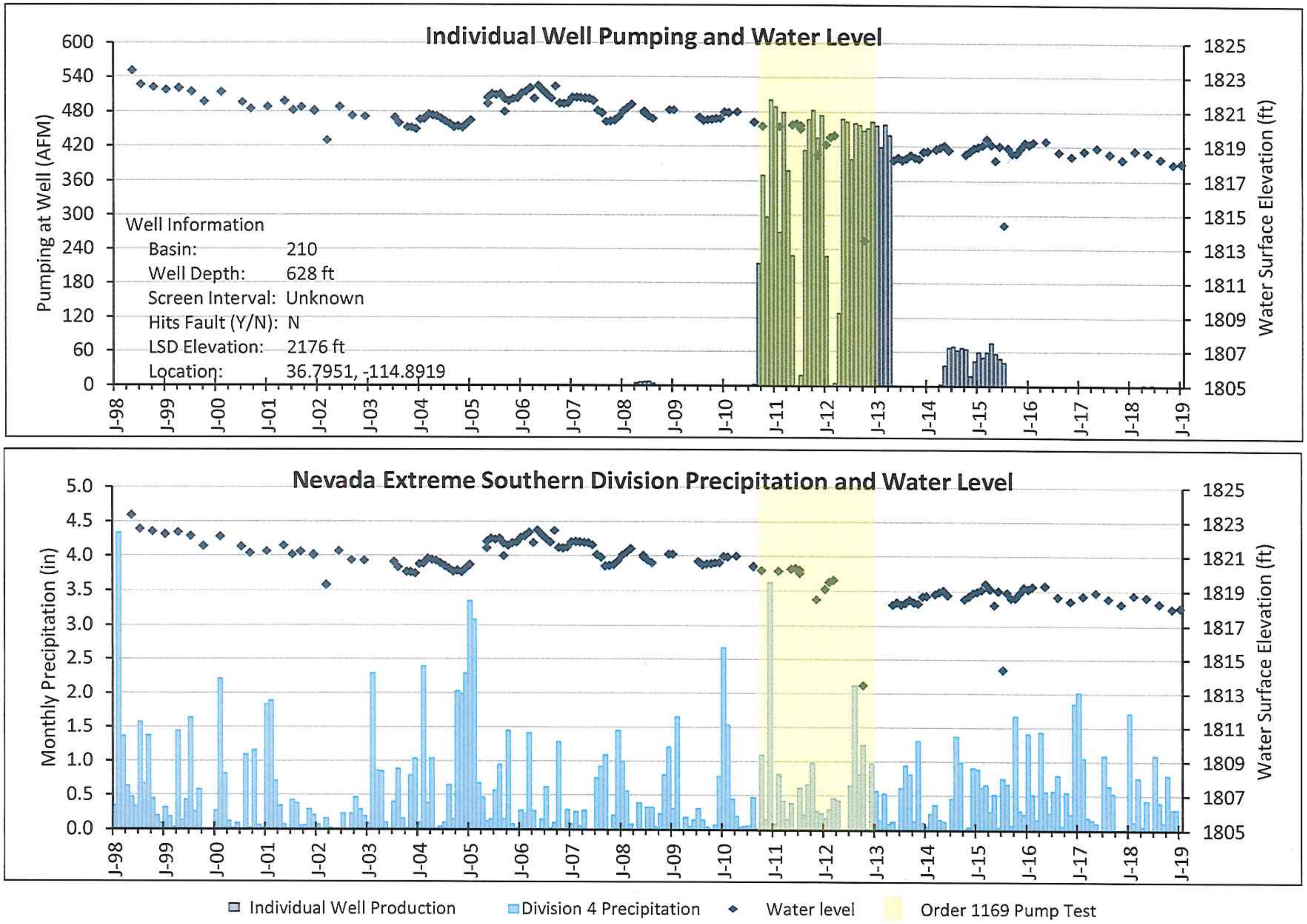
Well Information
Basin: 210
Well Depth: 1397 ft
Screen Interval: 894-1373 ft
Hits Fault (Y/N): N
LSD Elevation: 2511 ft
Location: 36.8500, -114.9545



Nevada Extreme Southern Division Precipitation and Water Level

Basin 210 - Coyote Spring Valley

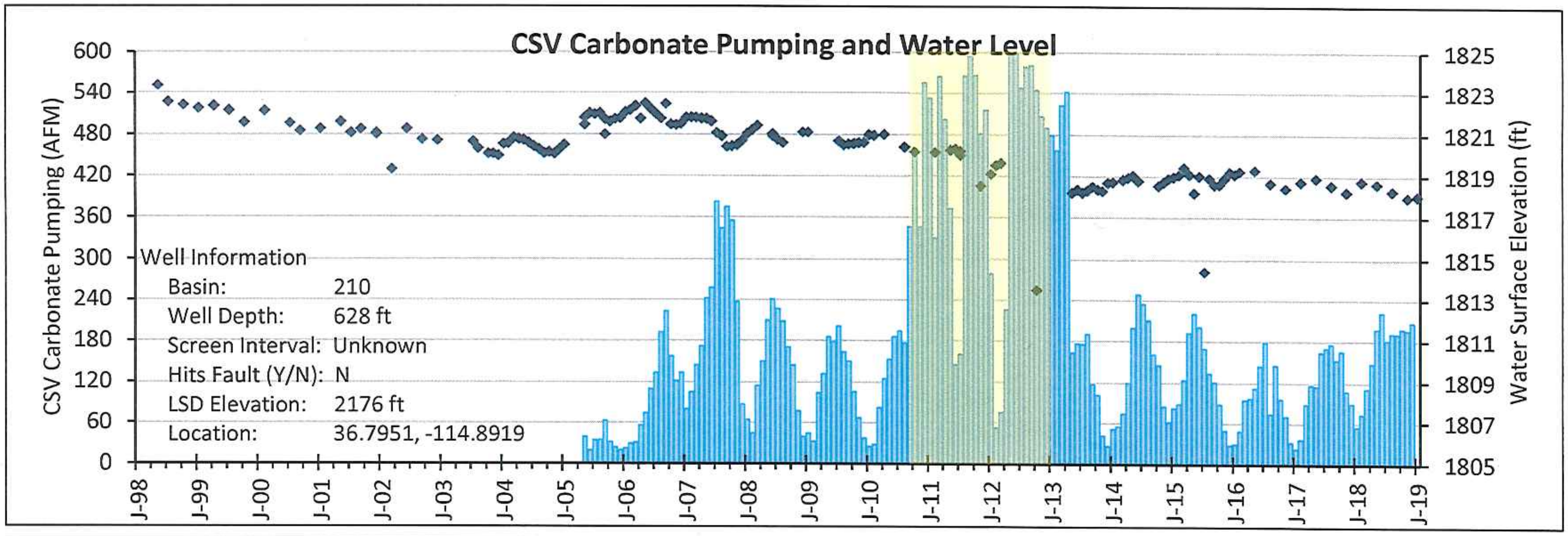
MX-5

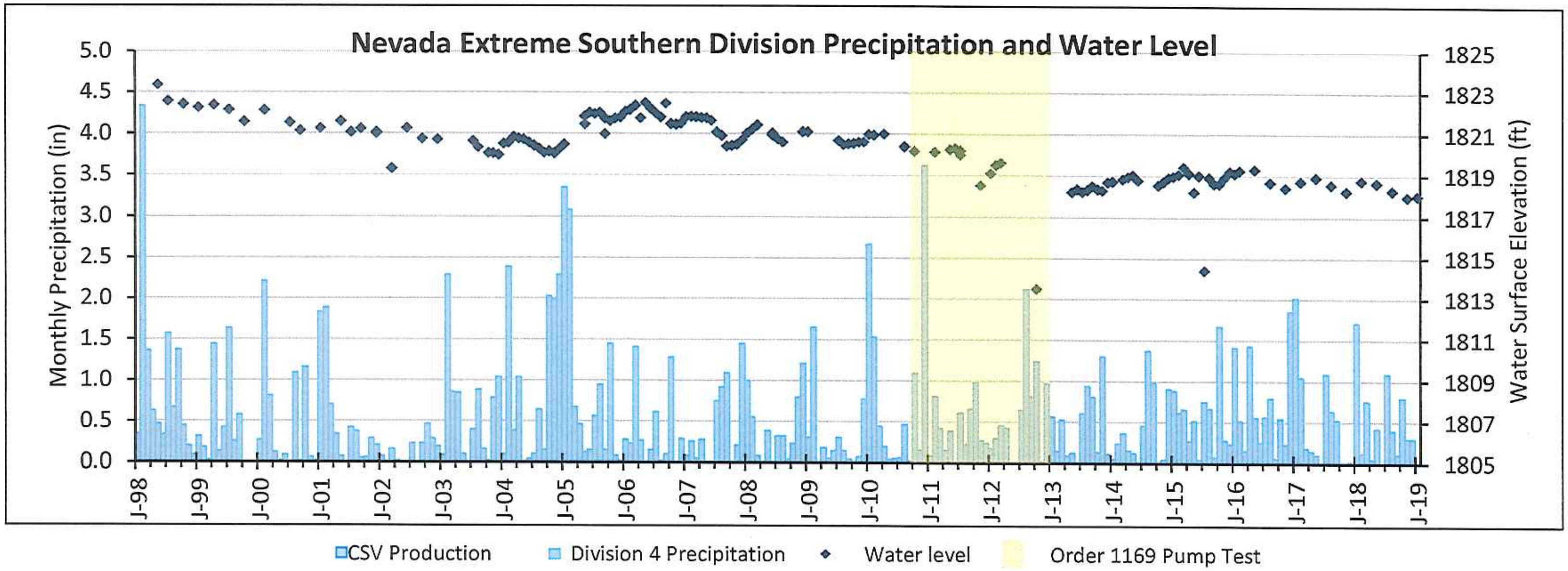


Well Information
Basin: 210
Well Depth: 628 ft
Screen Interval: Unknown
Hits Fault (Y/N): N
LSD Elevation: 2176 ft
Location: 36.7951, -114.8919

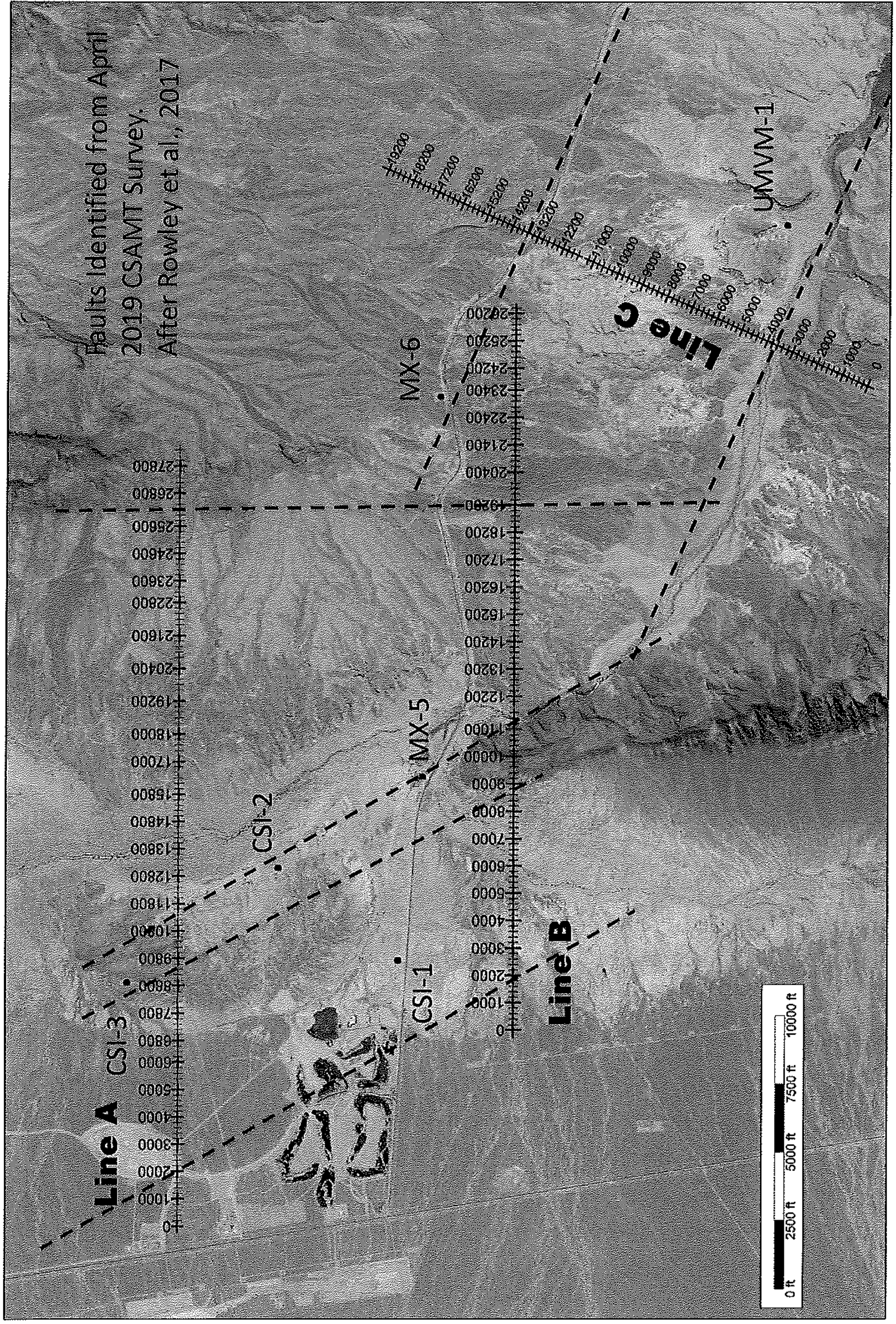
Basin 210 - Coyote Spring Valley

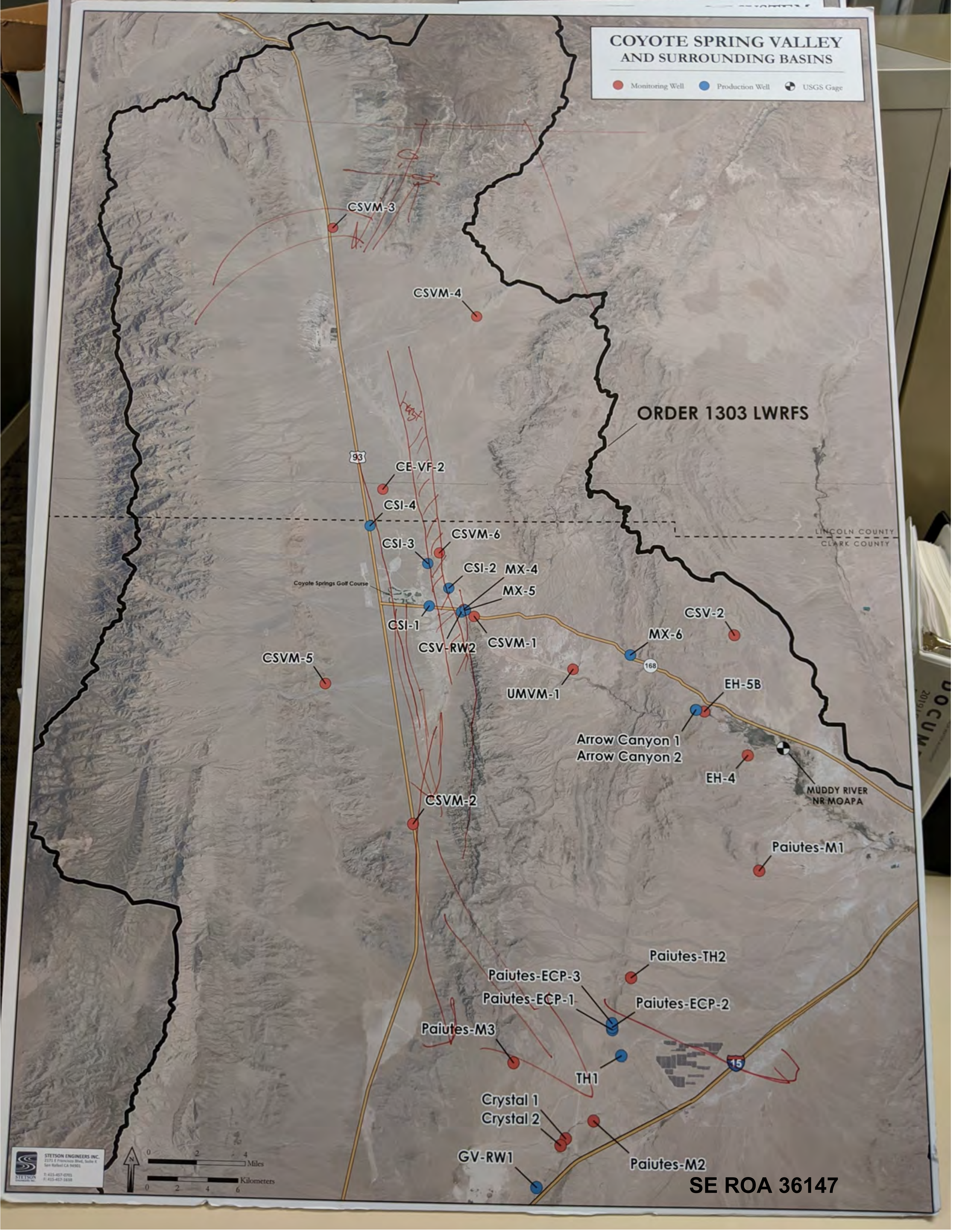
MX-5





5B


Faults Identified from April
2019 CSAMT Survey.
After Rowley et al., 2017
Line A
Line B
Line C
CSI-1
CSI-2
CSI-3
MX-5
MX-6
UMVM-1
0 ft
2500 ft
5000 ft
7500 ft
10000 ft


COYOTE SPRING VALLEY
AND SURROUNDING BASINS
● Monitoring Well
● Production Well
USGS Gage
CSVM-3
CSVM-4
ORDER 1303 LWRFS
93
CE-VF-2
CSI-4
CSVM-6
CSI-3
CSI-2
MX-4
MX-5
Coyote Springs Golf Course
CSI-1
CSV-RW2
CSVM-1
CSV-2
MX-6
168
CSVM-5
UMVM-1
EH-5B
Arrow Canyon 1
Arrow Canyon 2
EH-4
MUDDY RIVER
NR MOAPA
LINCOLN COUNTY
CLARK COUNTY
CSVM-2
Paiutes-M1
Paiutes-TH2
Paiutes-ECP-3
Paiutes-ECP-1
Paiutes-ECP-2
Paiutes-M3
15
TH1
Crystal 1
Crystal 2
Paiutes-M2
GV-RW1
STETSON ENGINEERS INC.
2171 E Francisco Blvd, Suite K
San Rafael CA 94901
T: 415-457-0701
F: 415-457-1638
STETSON
N
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2
4
Miles
Kilometers
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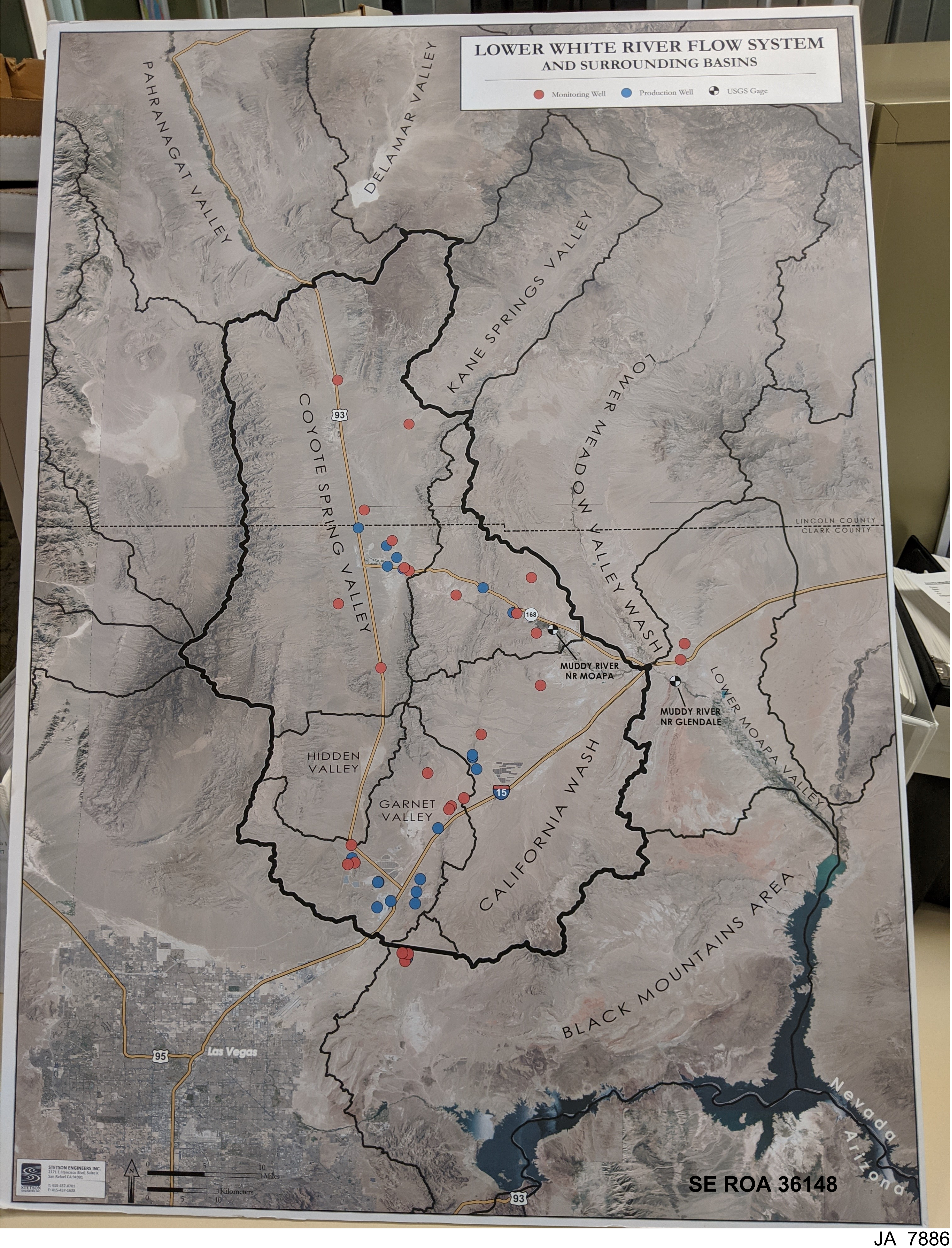

LOWER WHITE RIVER FLOW SYSTEM
AND SURROUNDING BASINS
● Monitoring Well
● Production Well
USGS Gage
PAHRANAGAT VALLEY
DELAMAR VALLEY
KANE SPRINGS VALLEY
LOWER MEADOW VALLEY WASH
COYOTE SPRING VALLEY
93
168
LINCOLN COUNTY
CLARK COUNTY
MUDDY RIVER NR MOAPA
MUDDY RIVER NR GLENDALE
LOWER MOAPA VALLEY
HIDDEN VALLEY
GARNET VALLEY
15
CALIFORNIA WASH
BLACK MOUNTAINS AREA
95
Las Vegas
Nevada
Arizona
93
STETSON ENGINEERS INC.
2171 E Francisco Blvd, Suite K
San Rafael CA 94901
T: 415-457-0701
F: 415-457-1638
STETSON ENGINEERS INC.
N
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10
Miles
Kilometers
0
5
10

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2019 SEP -6 PM 3:39

McDONALD CARANO
100 WEST LIBERTY STREET, TENTH FLOOR • RENO, NEVADA 89501
PHONE 775.788.2000 • FAX 775.788.2020

IN THE OFFICE OF THE STATE ENGINEER

OF THE STATE OF NEVADA

IN THE MATTER OF THE
ADMINSTRATION AND MANAGEMENT
OF THE LOWER WHITE RIVER FLOW
SYSTEM WITHIN COYOTE SPRING
VALLEY HYDROGRAPHIC BASIN (210),
A PORTION OF BLACK MOUNTAINS
AREA HYDROGRAPHIC BASIN (215),
GARNET VALLEY HYDROGRAPHIC
BASIN (216),
HIDDEN VALLEY HYDROGRAPHIC
BASIN (217), CALIFORNIA WASH
HYDROGRAPHOC BASIN (218), AND
MUDDY RIVER SPRINGS AREA (aka
UPPER MOAPA VALLEY
HYDROGRAPHOC BASIN (219).
/

Regarding Interim Order 1303
Hearing to Commence on
September 23, 2019

JOINT DISCLOSURE STATEMENT OF GEORGIA PACIFIC CORPORATION AND REPUBLIC ENVIRONMENTAL TECHNOLOGIES, INC.

Georgia Pacific Corporation ("Georgia Pacific") and Republic Environmental Technologies, Inc. ("Republic") (collectively the "Parties"), hereby jointly submit the following information in response to the State Engineer's Notice of Hearing in the above referenced matter, dated August 23, 2019.

The Parties' Exhibit list is attached as Exhibit A.

Jonathan Bell, PG, RG, CEM, Associate Geologist in the firm of Broadbent Associates, Inc. will present expert testimony on behalf of the Parties. Mr. Bell's CV is attached as Exhibit GP-REP 03. Mr. Bell has not previously been admitted as an expert before the State Engineer.

The following is a summary of Mr. Bell's testimony as it relates to the questions posed in Order 1303.

///

///

1. Geographic Boundary of the hydrologically connected groundwater and surface-water system comprising the Lower White River Flow System:

Although it appears the carbonate aquifer within the LWRFS is connected to some degree, the nature of carbonate aquifer hydrogeology is heterogeneous, therefore making estimating flow volumes and flow direction challenging. Data collected to date indicate that pumping from the Garnet Valley and Upper Black Mountain Basins has minimal impact on the Muddy River Spring flow or the Muddy River, both with respect to timing and degree, and consideration should be given to removing these basins from the proposed unit. Treating all of the LWRFS as a single, heterogenous basin (both alluvium and carbonate) and correcting any imbalance in groundwater diversions by priority date is not supported by the current science.

2. Information obtained from the State Engineer's Order 1169 aquifer test and subsequent to the aquifer test and Muddy River headwater spring flow as it relates to aquifer recovery since the completion of the aquifer test:

The Order 1169 aquifer testing involved pumping from Well MX-5 and the Coyote Springs Valley Pumping Center (CSVPC) approximately 20 miles from the northern boundary of the Garnet Valley/Black Mountain Pumping Center (GVBMPC). Garnet Valley is south of MX-5 and the Black Mountain Area is generally southeast of pumping well MX-5 and CSVPC. During Order 1169 testing, groundwater production continued at average annual production rates.

The additional pumping activities conducted during Order 1169 aquifer testing resulted in decreased groundwater elevations throughout the LWRFS including the GVBMPC. Water level declines observed during order 1169 testing were not instantaneous, but more gradual than observed in the CSVPC. Based on the gradual water level decline it is difficult to determine how much of the decline is associated with pumping and or seasonal flux along with the on-going pumping in the GVBMPC.

3. **The long-term annual quantity of ground water that may be pumped from the Lower White River Flow System, including the relationships between the location of pumping on discharge to the Muddy River Springs and the capture of Muddy River Flow:**

Broadbent did not attempt to determine the long-term annual quantity of water that can be sustainably pumped from the LWRFS. There is considerable variation in pumping effects based on location of pumping in a heterogeneous unit, and that variation should be accounted for in establishing long-term annual groundwater supply reflective of the opportunities to produce sustainably within individual basins. It remains unclear to what degree observed water level declines are associated with additional pumping, regional climate, seasonality, or other causes. In addition, inflows to these basins are not sufficiently defined to determine sustainable yield from Garnet Valley as it relates to the broader LWRFS Pumping from the basins upgradient and in the general vicinity of the MRSA have a profound effect on the Muddy River, whereas pumping from Garnet and Black Mountain basins have an overall reduced influence).

4. **The effects of movement of water rights between alluvial wells and carbonate wells on deliveries of senior decreed rights to the Muddy River:**

Reduced pumping in the alluvial aquifer near the Muddy River would aid in maintaining water flow and delivery of surface water rights on the Muddy River. Annual Muddy River flow measurements collected since the early 1990's and correlated to annual pumping in the Muddy River Springs Area ("MRSA") indicate the Muddy River has connection with the flow in the Muddy River. Accordingly, water rights could be moved within the LWRFS to lessen the impact to the Muddy River and associated springs. However, while beneficial to the MRSA and Muddy River flows, moving water rights from the alluvial aquifer near the Muddy River to Garnet Valley basin could negatively affect water availability in Garnet Valley and should be considered in more detail.

///

The Parties incorporate the documents and records of the Nevada State Engineer set forth in Exhibit A attached to the August 23, 2019 Notice of Hearing.

DATED: September 6, 2019.

McDONALD CARANO LLP

Sylvia Harrison (#4106)
Sarah Ferguson (#41515)

McDONALD CARANO LLP
100 West Liberty Street, 10th Floor
Reno, Nevada 89501
(775) 788-2000
sharrison@mcdonaldcarano.com
sferguson@mcdonaldcarano.com

Attorneys for Georgia Pacific Corporation and Republic Environmental Technologies, Inc.

CERTIFICATE OF SERVICE

Pursuant to NRCP 5(b), I hereby certify that I am an employee of McDONALD CARANO LLP, and that on September 6, 2019, I served the foregoing JOINT DISCLOSURE STATEMENT OF GEORGIA PACIFIC CORPORATION and REPUBLIC ENVIRONMENTAL TECHNOLOGIES via direct email to the addresses indicated below:

8milelister@gmail.com;
ablack@mcdonaldcarano.com
admin.mbop@moapabandofpaiutes.org
alaskajulie12@gmail.com;
andrew.burns@snwa.com;
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Exhibit GP-REP 01

Exhibit GP-REP 01

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July 2, 2019

Project No. 17-01-196

Mr. Tim Wilson
State Engineer
Division of Water Resources
901 South Stewart Street, Suite 2002
Carson City, Nevada 89701

Attn: Mr. Tim Wilson, P.E.

Re: Response to Nevada State Engineer Interim Order 1303

Dear Mr. Wilson:

This letter serves as a response to the Nevada State Engineer Interim Order #1303 on behalf of Dry Lake Water, LLC, Georgia Pacific Corporation, and Republic Environmental Technologies. This letter discusses the Lower White River Flow System (LWRFS) specifically groundwater production the Garnet Valley Basin (216) and the upper Black Mountain Basin (215). Comments are based on the Aquifer Testing activities and reports associated with Nevada State Engineer Order 1169 and 1169A.

Please do not hesitate to contact us if you should have any questions or require additional information.

Sincerely,
BROADBENT & ASSOCIATES, INC.

Jonathan Bell, PG
Associate Geologist

Reviewed and Approved by:

Lonnie C. Roy, P.E.
Principal Engineer

cc: Ms. Dainae Prejean, Georgia Pacific, 11401 US Highway 91, North Las Vegas, NV 89165
Mr. Golden Welch, Dry Lakes Water, LLC, 2470 St. Rose Parkway, Suite 107, Henderson NV 89074
Mr. David Vossmer, Republic Services, 13550 North US Highway 93, Las Vegas, NV 89165

1.0 INTRODUCTION

On March 8, 2002, Order 1169 was issued by the Nevada State Engineer (NSE) to hold in abeyance all pending groundwater applications for the carbonate-rock aquifer in Basins 210 (Coyote Spring Valley), 215 (Black Mountains Area), 216 (Garnet Valley), 217 (Hidden Valley), 218 (California Wash), 219 (Upper Moapa Valley - Muddy River Springs), and 220 (Lower Moapa Valley) until the completion of a pumping test to stress the aquifer (Office, 2002). The NSE designated the multi-basin area to be known as the Lower White River Flow System (LWRFS). Figure 1 depicts the various basins that make up the proposed LWRFS. Based on data and observations made during the Order 1169 carbonate aquifer testing, the NSE issued Order 1303 on January 11, 2019. Order 1303 designated all water rights within the LWRFS as a joint administrative unit. The order also notified stakeholdes in the LWRFS to file reports regarding future water rights.

2.0 ORDER 1169 TESTING

Order 1169 initially called for a 5-year hydrologic study to include the pumping of 8,050 acre-feet per year (afy) for two consecutive years. This represents half of the existing water rights in the Coyote Spring Valley (16,100 afy). After several meetings, the NSE determined that the objectives of Order No. 1169 could still be met by pumping less than 8,050 afy (NDWR, 2010). To that end, Southern Nevada Water Authority (SNWA) well MX-5, and Coyote Springs Investment (CSI) wells CSI-1, CSI-2, CSI-3, and CSI-4 were selected to pump from the carbonate-rock aquifer for the duration of the test.

SNWA began pumping from well MX-5 on November 15, 2010 to initiate the carbonate-rock aquifer test. Pumping from MX-5 continued for the duration of the test, except during intermittent periods of shutdowns due to facility maintenance and operational issues (SNWA, 2013). Production from the four CSI wells (CSI-1 through CSI-4) was intermittent and fluctuated seasonally. During the test, water production in the Muddy River Springs area and the Garnet Valley/Black Mountain Areas continued. Figure 2 depicts the three primary pumping areas. The aquifer test ended on December 31, 2012.

A total of 79 wells from both the alluvial and carbonate-rock aquifers, and 10 surface-water gaging stations were monitored for the duration of the carbonate-rock aquifer test. Combined pumping from MX-5 and the CSI wells (CSI-1 through CSI-4) totaled 5,331 afy and 5,102 afy during 2011 and 2012, respectively (SNWA, 2013).

Spring flow in the Muddy River Spring Area was reduced during the Order 1169 test pumping. The springs located closest to the headwater of the Muddy River indicated decreased flow in the Pederson gage from 0.22 cubic feet per second (cfs) to 0.08 cfs and in the Pederson east gage from 0.12 cfs to 0.08 cfs. Baldwin and Jones springs decreased approximately 4% (NSE,2019). Additionally, Pederson spring has not recovered to pre-testing flows (NSE,2019).

Groundwater levels within pumping well MX-5 dropped approximately seven feet during the carbonate-rock aquifer test. As would be expected, groundwater levels in observation wells located in close proximity to MX-5 also declined during pumping (between 2.5 and 3 feet) and recovered quickly when the pump was shut off. Groundwater level behavior varied in wells located further away from MX-5 within the Coyote Spring Basin. Some wells did not respond to pumping due to inferred flow barriers (i.e., CSVM-

3 and CSVM-5), faulty transducers (i.e., CSVM-4), or damaged well casing (i.e., CE-VF-2), while others mimicked MX-5 pumping levels with groundwater elevations declining approximately 2.5 feet during the test (SNWA, 2013). Groundwater levels measured in wells located beyond the Coyote Springs Basin to the east and to the south did not indicate the instantaneous responses to pumping in MX-5 that were observed in closer wells, however, groundwater levels did decline approximately 2 feet during the duration of the carbonate-rock aquifer test (SNWA, 2013).

3.0 GARNET VALLEY/BLACK MOUNTAIN PUMPING AREA

As depicted in Figure 1, the northern boundary of the Garnet Valley/Black Mountain Pumping Center (GVBMPC) is located approximately 20 miles away from pumping well MX-5 and the Coyote Springs Valley Pumping Center (CSVPC). Garnet Valley is south of MX-5 and the Black Mountain Area is generally southeast of pumping well MX-5 and CSVPC. GVBMPC is one of the three primary production areas in the LWRSF averaging 1,358 acf in Garnet Valley and 1,591 acf in Black Mountain from 2001 through 2017 (NSE,2019). During Order 1169 testing, groundwater production continued at average annual production rates.

Additional pumping activites conducted during Order 1169 aquifer testing resulted in decreased groundwater elevations throughout the LWRFS including the GVBMPC. In the GVBMPC, water level decreases in the carbonate aquifer ranged from 1 to 1.6 feet during the test pumping (NSE, 2019). Water level decline during pumping indicates a degree of hydraulic connection in the LWRFS carbonate aquifer. Water level declines observed during order 1169 testing were not instantanious, but more gradual than observed in the CSVPC (SNWA, 2013). Based on the gradual water level decline it is dificult to determine how much of the decline is associated with pumping and or seasonal flux along with the on-going pumping in the GVBMPC.

4.0 DISCUSSION

Some of the basins that have been included in the proposed LWRFS (i.e., Hidden Valley, Garnet Valley, Black Mountains Area, and portions of the California Wash) have a suggested carbonate-rock aquifer connectivity based on observed water level declines (approximately 2 feet) of similar magnitude to those observed in the Coyote Springs Valley during the pump test (SNWA, 2013). Hydrographs from Coyote Springs Valley, California Wash, and Garnet Valley (Apex area) show similar seasonal groundwater trends occurring in the decade preceding the carbonate-rock aquifer test with no discernible signal delay or diminishing amplitude with distance from the pumping centers suggesting that regional climatic conditions may be a driving force in water level fluctuation (Mifflin, 2013 – see Figure 10). Seasonal groundwater variations were also observed in most of the wells monitored during the aquifer test. It is possible that the observed groundwater declines (approximately 2 feet) in the distal parts of the proposed LWRFS are the result of regionally dry climatic conditions, coupled with known seasonality patterns, rather than from the effects of pumping and aquifer connectivity.

In addition, Mifflin & Associates, Inc. (Mifflin) suggest the presence of multiple potential flow barriers in the carbonate-rock aquifer between the Moapa Indian Reservation (California Wash and Garnet Valley) and Lake Mead (Mifflin, 2013) based on findings from water-level models and 7-day aquifer tests near ECP-1 on the Moapa Band of Paiutes Reservation (Figure 1). The presence of flow barriers to the west and north of MX-5 are highlighted in the SNWA study report (SNWA, 2013), however, groundwater response to pumping in those areas is not mirrored in the southern portion of the proposed LWRFS. It is possible that heterogeneity within the carbonate rock aquifer was not observed in the southern LWRFS because of the distance between the observation wells and the pumping center and the shortage of observation points (i.e., no carbonate aquifer wells in Hidden Valley, two carbonate aquifer wells in Black Mountains area, etc.).

5.0 CONCLUSIONS

The Order 1169 aquifer testing provided evidence that stresses imposed on the carbonate-rock aquifer in the Coyote Springs Valley (i.e., MX-5 and CSI-1 through CSI-4) may have an effect on groundwater levels in the southern portion of the LWRFS (i.e., Hidden Valley, Garnet Valley, California Wash, and portions of the Black Mountains Area). It remains unclear to what degree observed water level declines were associated with additional pumping, regional climate, seasonality, or other causes. Based on the documents provided in the NSE Order 1169 and Order 1303 filed reports, Broadbent has the following opinions as they relate to the Garnet Valley Basin and Upper Black Mountain Basin:

- Based on the location of GVBMPC relative to the Muddy Springs Area we believe the pumping from the Garnet Valley and Upper Black Mountain Basins has minimal impact on the Muddy River Spring flow or the Muddy River.
- Although it appears the carbonate aquifer within the LWRFS is connected to some degree, the nature of carbonate aquifer hydrogeology is heterogeneous, therefore making estimating flow volumes and flow direction challenging.
- Although the measured decline in water levels during testing seem to indicate hydrualic connection in the carbonate aquifer other potential drivers such as seasonal flux, climate or changes to groundwater production in the GVBMPC may be adding to the water level decreases observed during the Order 1169 testing.
- We belive that treating all of the LWRFS as a single, heterogenous basin (both alluvium and carbonate) and correcting any imbalance in groundwater diversions by priority date is not supported by the current science.

PROFESSIONAL ENGINEER - STATE OF NEVADA
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6.0 REFERENCES

Mifflin & Associates, Inc. (Mifflin). 2013. Summary of Order 1169 Testing Impacts, per Order 1169A. June 28.

Nevada Division of Water Resources (NDWR). 2010. Applications 54055-54059, 63272-63276, 63867-63876, 54076; Order No. 1169. July 10.

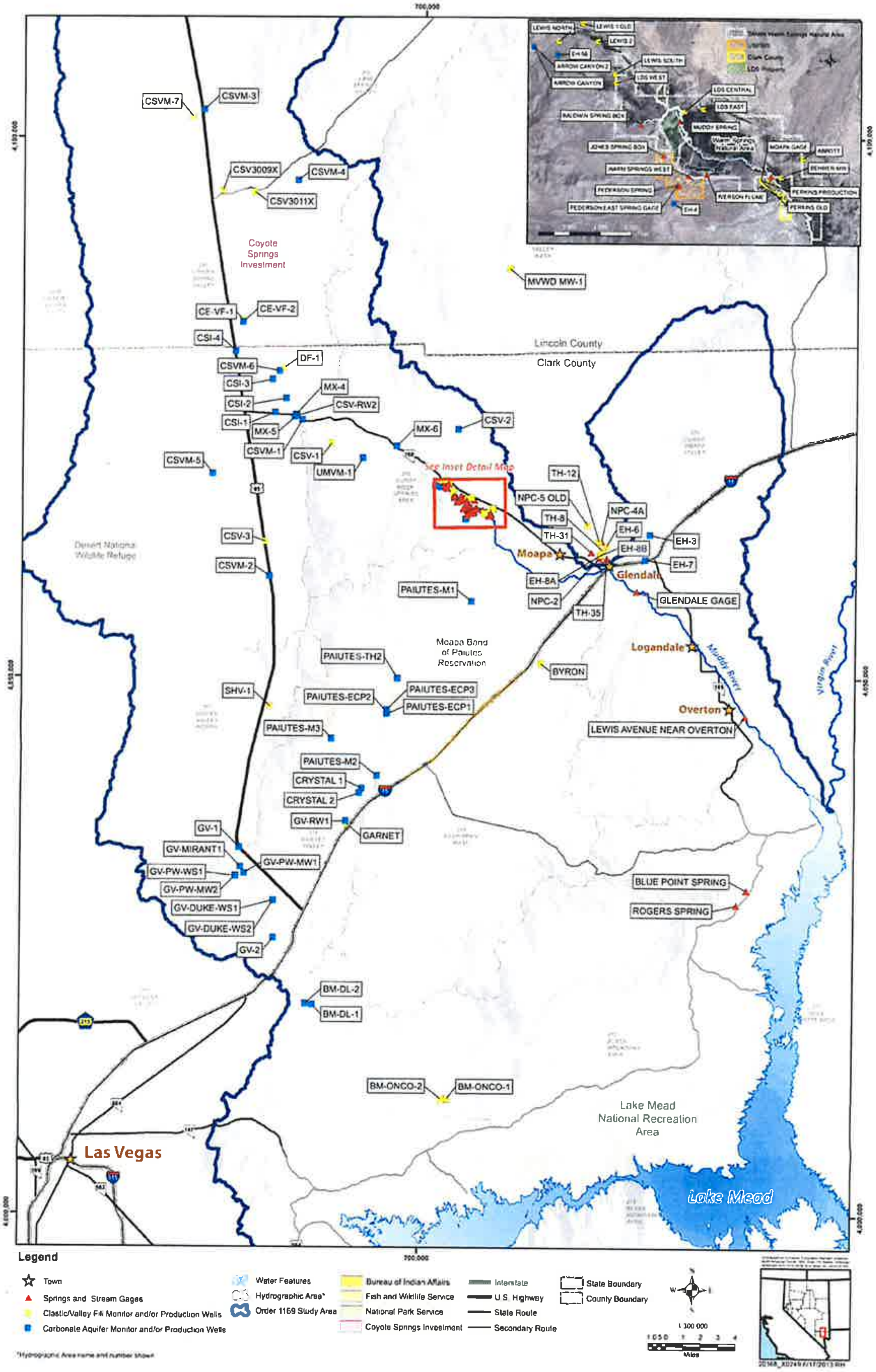
Office of the State Engineer of the State of Nevada (NSE), 2019, Order 1303.

Office of the State Engineer of the State of Nevada (NSE), 2002, Order 1169.

Southern Nevada Water Authority (SNWA). 2013. Nevada State Engineer Order 1169 and 1169A Study Report. June 27.

U.S. Fish and Wildlife Service, Bureau of Land Management, and National Park Service. 2013. Test Impacts and Availability of Water Pursuant to Applications Pending Under Order 1169 Presentation to the Office of the State Engineer. June 28.

FIGURES



Source: Southern Nevada Water Authority, 2013, Nevada State Engineer Order 1169 and 1169A Study Report: Southern Nevada Water Authority, Las Vegas, Nevada, Doc. No. WMP-ED-0001, Figure 3.

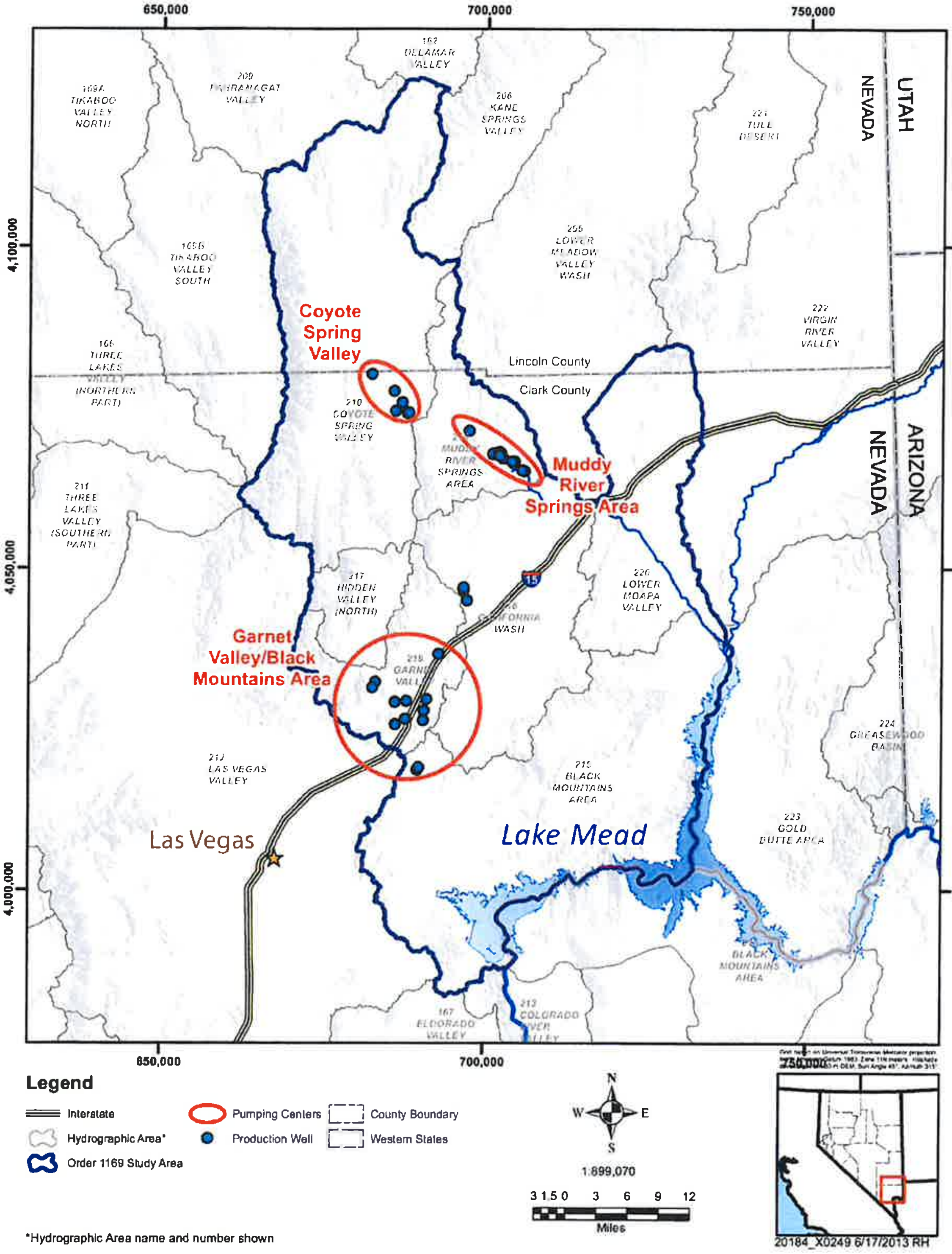
BROADBENT

Prepared by: RH Reviewed by: JB Date: 07/02/2019

Location of Order 1169 Monitoring Sites

Apex Industrial Park Water Rights
Apex, Nevada
Project No. 17-01-179

Figure
1



Source: Southern Nevada Water Authority, 2013, Nevada State Engineer Order 1169 and 1169A Study Report: Southern Nevada Water Authority, Las Vegas, Nevada, Doc. No, WMP-ED-0001, Figure 14.

Prepared by: RH Reviewed by: JB Date: 07/02/2019

Map of Three Principal Groundwater Pumping Centers

Apex Industrial Park Water Rights
Apex, Nevada
Project No. 17-01-179

Figure

2

Exhibit GP-REP 02

Exhibit GP-REP 02

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August 16, 2019

Project No. 17-01-196-001

Mr. Tim Wilson
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Carson City, Nevada 89701

Attn: Mr. Tim Wilson, P.E.

Re: Rebuttal to Reports Submitted for State Engineer Order #1303

Dear Mr. Wilson

This letter serves as a response to the Nevada State Engineer Interim Order #1303 for rebuttal to the submitted 1303 reports. This response is on behalf of Dry Lake Water, LLC, Georgia Pacific Gypsum LLC, and Republic Environmental Technologies. This letter discusses the Lower White River Flow System (LWRFS), specifically groundwater availability and production within the Garnet Valley Basin (216) and the upper Black Mountain Basin (215). Rebuttals and comments are based on reports submitted to the Nevada State Engineer as part of Order #1303 (NSE.2019). Please do not hesitate to contact us if you should have any questions or require additional information.

Sincerely,
BROADBENT & ASSOCIATES, INC.

Jonathan Bell, PG
Associate Geologist

cc: Ms. Dainae Prejean, Georgia Pacific, 11401 US Highway 91, North Las Vegas, NV 89165
Mr. Golden Welch, Dry Lakes Water, LLC, 2470 St. Rose Parkway, Suite 107, Henderson NV 89074
Mr. David Vossmer, Republic Services, 13550 North US Highway 93, Las Vegas, NV 89165

INTRODUCTION

The March 8, 2002 Order #1169 was issued by the Nevada State Engineer (NSE) to hold in abeyance all pending groundwater applications for the carbonate-rock aquifer in Basins 210 (Coyote Spring Valley), 215 (Black Mountains Area), 216 (Garnet Valley), 217 (Hidden Valley), 218 (California Wash), 219 (Upper Moapa Valley - Muddy River Springs), and 220 (Lower Moapa Valley) until the completion of a pumping test to stress the aquifer (Office, 2002).. Based on data observations made during Order #1169 carbonate aquifer testing, the NSE issued Order #1303 on January 11, 2019, which designated the multi-basin area to be known as the Lower White River Flow System (LWRFS) and notified stakeholders in the LWRFS to file reports on specific topics by July 3, 2019. Specifically, Order #1303 asked for reports addressing (a) the geographic boundary of the hydrologically connected groundwater and surface water systems comprising the LWRFS; (b) the information obtained from Order 1169 aquifer test and subsequent to the aquifer test and Muddy River headwater spring flow as it relates to aquifer recovery since the completion of the aquifer test; (c) the long-term annual quantity of groundwater that may be pumped from the LWRFS, including the relationships between the location of pumping on discharge to the Muddy River Springs, and the capture of Muddy River flows; (d) the effects of movement of water rights between alluvial wells and carbonate wells on deliveries of senior decreed rights to the Muddy River; and (e) other matters believed to be relevant to the NSE's analysis. Additionally, Order #1303, as amended, indicated rebuttal reports to the July 3, 2019 LWRFS reports were to be submitted to the NSE by August 16, 2019. This letter documents certain information in reports filed by others and our response in rebuttal.

On August 8, 2019, the NSE held a prehearing conference and stated on the record that the scope of any order resulting from this hearing would be limited to defining a geographic boundary for the joint management unit and the long-term annual quantity of groundwater that may be pumped from the joint management unit. While Order 1303 and the related technical submissions address the relationships (or lack of information supporting relationships) between the location of pumping on the discharge to the Muddy Springs, and the capture of Muddy River flow and the effects of movement of water rights between alluvial wells and carbonate wells, the presiding officer stated that groundwater management decisions and policy considerations would not be addressed in this proceeding. This position ignores the fundamental policy questions that must be driven by the evidence: whether a joint management unit comprised of hydrographic basins defined by current topography and bearing little relationship to flow paths within the carbonate aquifer is appropriate at all, and whether the sustainability of the water resource can be effectively managed across the entire proposed administrative unit on the basis of priority dates.

For example, given that the relationship of pumping at various locations to the Muddy River Springs and Muddy River flows varies and is not well established, the blunt application of curtailments based on priority date across the entire defined geography should not be considered to be a mandated groundwater management strategy as the result of this proceeding. Based on the notice and stated nature of the hearing, it is our understanding that NSE's goal is to define a joint management unit based on a clearer understanding of the interplay between surface waters, alluvial basin fill aquifers and the carbonate aquifer in order to develop a sustainable groundwater management plan for the flow system. We strongly recommend future opportunities for a robust discussion by stakeholders of evidence-based policies, and whether different legal tools must be considered or developed to achieve sustainable management of this resource.

REBUTTAL ITEMS

Discussed below are rebuttals to items discussed from reports submitted under the Order #1303 (NSE.2019). Bold text represents the report title and italicized text represents item in question.

Technical Memorandum, Groundwater Management and Muddy River Springs, Report in Response to Nevada State Engineer Order 1303. (Center for Biological Diversity 2019)

Conclusion (Page 26)

"The Order 1169 pump test made apparent that there is a broad highly transmissive carbonate aquifer underlying CSV, MRSA, Garnet Valley, Hidden Valley and California Wash. The aquifer is interconnected so much among basins that it is necessary to manage groundwater through all basins as if they were part of a whole basin. The primary conclusion of this analysis is that the NSE not allow any pumping of the carbonate aquifer if the continued decrease in spring flow in MRSA is to be avoided. This conclusion results from the direct correlation of carbonate pumping and carbonate water level and spring discharge decline. Because the spring flow is directly responsible for Muddy River flows, preventing any additional carbonate pumpage is also necessary for protecting downstream water rights."

Response:
The degree of hydrologic connection in the LWRFS is still unclear and we disagree that all pumping from the LWRFS has caused the declines in the entire system. The Order 1169 pump test provided some evidence of hydrologic connection between the basins based on a general decrease in water levels throughout the LWRFS. Although pump test results seem to provide an indication of interconnectivity, the science is still unclear as to what degree other components, such as regional short- and long-term climatic conditions and recharge from barrier basins, affect the LWRFS (Mifflin, 2019). The inclusion of climatic signals as part of the overall hydrology of the LWRFS has generally not been evaluated (Mifflin, 2019). For example, hydrographs from Coyote Springs Valley, California Wash, and Garnet Valley show similar seasonal groundwater trends occurring in the decade preceding the carbonate-rock aquifer test with no discernible signal delay or diminishing amplitude with distance from the pumping centers. This suggests that regional climatic conditions may be a driving force in water level fluctuation (Mifflin, 2013 – see Figure 10).

Due to the heterogenous nature of carbonate aquifers, pumping groundwater from the carbonate aquifer in downgradient Garnet valley does not have the same 1:1 effect as pumping in the Coyote Springs area or in the alluvial deposits next to the Muddy River (Mifflin, 2019). Individual basins may be separately influenced by the adjacent boundary basins, recharge zones, fault boundaries, along with inflow from adjacent basins. And, as noted above, climatic effects have been generally overlooked.

It is our opinion that the record establishes variation in pumping effects based on location of pumping in a heterogeneous unit, and that variation should be accounted for in establishing long-term annual groundwater supply reflective of the opportunities to produce sustainably within individual basins.

Technical Memorandum, Garnet Valley Groundwater Pumping Review for APEX Industrial Complex, City of North Las Vegas, Clark County, Nevada (CNLV, 2019)

Summary and Recommendations (Page 52)

"Leasing senior groundwater rights located in the LWRFS has merit in a couple regards. Senior groundwater rights in Muddy River Springs Area have historically been pumped from alluvium, which appears to capture flows of the Muddy River, thus potentially interfering with senior decreed water rights. Transferring of senior groundwater rights out of this environment and to a distal and down-gradient portion of the LWRFS will help alleviate this potential water right conflict. For the City of North Las Vegas, securing senior groundwater rights will help assure that pumping from the Playa and Kapex wells is not likely to be subject to curtailment, should actions be necessary to regulate groundwater rights of the LWRFS by priority date. A lease of senior water rights and transfer of these water rights to the Playa and Kapex wells can help bridge the time required to complete the Colorado River pipeline throughout APEX. SNWA has ample water rights in Garnet Valley, however, they are junior rights and potentially subject to LWRFS curtailment, should regulation by priority date occur."

Response:
Reduced pumping in the alluvial aquifer near the Muddy River would aid in maintaining water flow and delivery of surface water rights on the Muddy River. Annual Muddy River flow measurements collected since the early 1990's and correlated to annual pumping in the MRSA, clearly indicate the Muddy River has a direct connection with the flow in the Muddy River (Vidler, -see Figure 5-1). Water rights could be moved within the LWRFS to lessen the impact to the Muddy River and associated springs. Additional pumping in Garnet valley will have little to no short term or long-term effect on the Muddy River and associated spring flow, as demonstrated by the higher than average pumping that occurred in 2016-2017 (CNLV, 2019b). The regional and hydrogeologic location of pumping dictates how pumping affects the MRSA and Muddy River flows (Vidler, 2019). While beneficial to the MRSA and Muddy River flows, we are concerned that moving water rights from the alluvial aquifer near the Muddy River to Garnet Valley basin could negatively affect water availability in Garnet Valley if not considered in more detail.

Movement of water production from the alluvium to the carbonate should be considered on a case-by-case basis given the potential for localized impacts in the basin to which pumping is moved.

Assessment of Lower White River Flow System Water Resource Conditions and Aquifer Response. (Southern Nevada Water Authority)

6.1.1 Implications of Continued Pumping (Page 6-32)

" In the long-term, it is expected that any groundwater production from the carbonate system within the LWRFS will ultimately capture discharge to the MRSA (e.g., spring discharge, subsurface inflow to the alluvial reservoir and, consequently, Muddy River streamflow) because of the high aquifer diffusivity and hydraulic connectivity throughout the flow system and because the MRSA constitutes the majority, if not all, of the discharge from the flow system The results of the Order 1169 aquifer test indicate that for the areas directly upgradient of the MRSA (i.e., Arrow Canyon and Coyote Spring Valley), water-level responses to pumping stresses occur very quickly."
"changing the spatial distribution of pumping within the LWRFS will change the distribution of drawdown and the timing of impacts, but not the long-term outcome."

Response:
For the reasons discussed above, we do not believe pumping from the carbonate aquifer in Coyote Springs, where the pump test occurred, provides a sound scientific basis to conclude that the same short-term or long-term effect on the Muddy River or associated Springs results from pumping from down gradient basins in Garnet Valley or Black Mountain basins. In addition to not addressing regional climatic conditions that may be a driving force in water level fluctuation (Broadbent, 2019 Mifflin, 2013*)*, inflows to these basins are not sufficiently defined to determine sustainable yield from Garnet Valley as it relates to the broader LWRFS. Modeling reported in the July 2, 2019 CNLV report (CNLV,2019b) suggests 450 acre/feet per year of groundwater inflow to the Garnet Valley from the Coyote Springs Valley through Hidden Valley. Additionally, the CNLV model indicates the potential 700-acre feet of annual groundwater inflow to Garnet Valley from the south in the Las Vegas basin (212) (CNLV, 2019b). What degree groundwater inflow from Las Vegas Valley occurs is something that should be further studied. Pumping from the basins upgradient and in the general vicinity of the MRSA have a profound effect on the Muddy River, whereas pumping from Garnet and Black Mountain basins have an overall reduced influence (CNLV,2019b). A sound understanding of the science, including *the degree* of regional connection in the carbonate aquifer along with sources of groundwater recharge must be understood for the management of water rights. The omission of basin 212 from the proposed administrative unit where there is evidence there may be significant contribution to the LWRFS underscores the arbitrary nature of the unit boundary designation. The administration of water rights in the LWRFS, based on priorities in relation to other rights without distinction or refinement of effects based on location of pumping of senior water rights could be unnecessary for the protection of the MRSA or Muddy River flows.

***Prediction of the Effects of Changing the Spatial Distribution of Pumping in the Lower White River Flow System*. (NPS. 2019)**

Section 4.4.3 Rogers and Blue Point Springs Comparison (page 20)

"Simulated discharge from the Rogers and Blue Point Springs are shown in Figure 4-18. Discharge from the springs is highest at the beginning of the simulations, about 2.25 cfs. Discharge from the springs is reduced by the smallest amount in Simulation 1, down to 2.1 cfs. Simulation 2 and 3, in which greater amounts of pumping were moved from the northern to southern basins, simulated a slightly lower discharge of about 2.0 cfs after 500 years"

Response:
Multiple model simulations were utilized to evaluate anticipated flow on the Rogers and Blue Point Springs. The simulations included pumping volume from Order #1169 pumping test (14,535 acre feet-feet/year) as the base volume and ultimately moved the pumping areas throughout the LWRFS. Pumping run times for each area were evaluated over 100, 200, and 500-year periods. Based on the model simulations, the maximum estimated reduction in spring flow over a 500-year period was estimated 0.25 cubic feet per second (cfs). This variation seems within annual climatic variations and modeling error. Additionally, we do not believe this minimal reduction warrants including the entire Black Mountain Basin into the LWRFS because it does not demonstrate a degree of connection that suggests an ability to meaningfully affect a joint management strategy.

Section 5.2.1.1 Black Mountain Area (Page 22)

"Drawdown has the potential to extend into the Black Mountain basin further than just the northwestern corner." "Given that other lines of hydrogeologic evidence also strongly support a pathway for groundwater flow to Rogers and Blue Point Springs in this area (see Section 1.1), we would recommend including all of the Black Mountains Area basin within the final boundary of the LWRFS."

Response:
We disagree that the hydrogeology supports a pathway for groundwater flow to the entire Black Mountain basin (215), and that the entire Black Mountain basin should be included in the designated LWRFS. The current portion of upper Black Mountain was designated based on the hydrogeology and the assumed extension of the carbonate aquifer into this region. Our position is based on the assumption that the carbonate aquifer in Black Mountain basin is limited to the eastern portion of the basin and moving east toward Lake Mead the hydrogeology varies Basin (CNLVb, 2019b-see Figure 5).

REFERENCES

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IN THE OFFICE OF THE STATE ENGINEER

OF THE STATE OF NEVADA

IN THE MATTER OF THE
ADMINSTRATION AND MANAGEMENT
OF THE LOWER WHITE RIVER FLOW
SYSTEM WITHIN COYOTE SPRING
VALLEY HYDROGRAPHIC BASIN (210),
A PORTION OF BLACK MOUNTAINS
AREA HYDROGRAPHIC BASIN (215),
GARNET VALLEY HYDROGRAPHIC
BASIN (216),
HIDDEN VALLEY HYDROGRAPHIC
BASIN (217), CALIFORNIA WASH
HYDROGRAPHOC BASIN (218), AND
MUDDY RIVER SPRINGS AREA (aka
UPPER MOAPA VALLEY
HYDROGRAPHOC BASIN (219).
/

Regarding Interim Order 1303
Hearing Held on September 23, 2019

GEORGIA PACIFIC CORPORATION AND REPUBLIC ENVIRONMENTAL TECHNOLOGIES, INC. ERRATA TO RESPONSE AND REBUTTAL

Georgia Pacific Corporation ("Georgia Pacific") and Republic Environmental Technologies, Inc. ("Republic") (collectively the "Parties"), hereby jointly submit this *Errata* to correct errors contained within their *Response to State Engineer Order # 1303* filed on July 2, 2019 ("Response") and the *Rebuttal to Reports Submitted for State Engineer Order # 1303* filed on August 16, 2019 ("Rebuttal").

Page 3 of the Response uses the word heterogenous when the correct word is homogenous. A corrected page 3 is attached hereto, the deleted text is in red font and inserted text is in blue font.

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Page 6 of the Rebuttal incorrectly refers to the eastern portion of the basin when it should be western. Additionally, the last word of the last sentence, basin, has been deleted. A corrected page 6 is attached hereto, the deleted text is shown in red and any inserted text is in blue.

DATED: October 8, 2019.

McDONALD CARANO LLP

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CERTIFICATE OF SERVICE

Pursuant to NRCP 5(b), I hereby certify that I am an employee of McDONALD CARANO LLP, and that on October 8, 2019, I served the foregoing ERRATA via direct email to the addresses indicated below:

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An employee of McDonald Carano LLP

July 2, 2019 Response to State Engineer Order # 1303

Corrected Page 3

response to pumping in those areas is not mirrored in the southern portion of the proposed LWRFS. It is possible that heterogeneity within the carbonate rock aquifer was not observed in the southern LWRFS because of the distance between the observation wells and the pumping center and the shortage of observation points (i.e., no carbonate aquifer wells in Hidden Valley, two carbonate aquifer wells in Black Mountains area, etc.).

5.0 CONCLUSIONS

The Order 1169 aquifer testing provided evidence that stresses imposed on the carbonate-rock aquifer in the Coyote Springs Valley (i.e., MX-5 and CSI-1 through CSI-4) may have an effect on groundwater levels in the southern portion of the LWRFS (i.e., Hidden Valley, Garnet Valley, California Wash, and portions of the Black Mountains Area). It remains unclear to what degree observed water level declines were associated with additional pumping, regional climate, seasonality, or other causes. Based on the documents provided in the NSE Order 1169 and Order 1303 filed reports, Broadbent has the following opinions as they relate to the Garnet Valley Basin and Upper Black Mountain Basin:

- Based on the location of GVBMPC relative to the Muddy Springs Area we believe the pumping from the Garnet Valley and Upper Black Mountain Basins has minimal impact on the Muddy River Spring flow or the Muddy River.
- Although it appears the carbonate aquifer within the LWRFS is connected to some degree, the nature of carbonate aquifer hydrogeology is heterogeneous, therefore making estimating flow volumes and flow direction challenging.
- Although the measured decline in water levels during testing seem to indicate hydrualic connection in the carbonate aquifer other potential drivers such as seasonal flux, climate or changes to groundwater production in the GVBMPC may be adding to the water level decreases observed during the Order 1169 testing.
- We believe that treating all of the LWRFS as a single, ~~heterogenous~~ homogenous basin (both alluvium and carbonate) and correcting any imbalance in groundwater diversions by priority date is not supported by the current science.

August 16, 2019 Rebuttal to Responses to State Engineer Order # 1303

Corrected Page 6

Prediction of the Effects of Changing the Spatial Distribution of Pumping in the Lower White River Flow System. **(NPS. 2019)**

Section 4.4.3 Rogers and Blue Point Springs Comparison (page 20)

"Simulated discharge from the Rogers and Blue Point Springs are shown in Figure 4-18. Discharge from the springs is highest at the beginning of the simulations, about 2.25 cfs. Discharge from the springs is reduced by the smallest amount in Simulation 1, down to 2.1 cfs. Simulation 2 and 3, in which greater amounts of pumping were moved from the northern to southern basins, simulated a slightly lower discharge of about 2.0 cfs after 500 years"

Response:
Multiple model simulations were utilized to evaluate anticipated flow on the Rogers and Blue Point Springs. The simulations included pumping volume from Order #1169 pumping test (14,535 acre feet-feet/year) as the base volume and ultimately moved the pumping areas throughout the LWRFS. Pumping run times for each area were evaluated over 100, 200, and 500-year periods. Based on the model simulations, the maximum estimated reduction in spring flow over a 500-year period was estimated 0.25 cubic feet per second (cfs). This variation seems within annual climatic variations and modeling error. Additionally, we do not believe this minimal reduction warrants including the entire Black Mountain Basin into the LWRFS because it does not demonstrate a degree of connection that suggests an ability to meaningfully affect a joint management strategy.

Section 5.2.1.1 Black Mountain Area (Page 22)

"Drawdown has the potential to extend into the Black Mountain basin further than just the northwestern corner." "Given that other lines of hydrogeologic evidence also strongly support a pathway for groundwater flow to Rogers and Blue Point Springs in this area (see Section 1.1), we would recommend including all of the Black Mountains Area basin within the final boundary of the LWRFS."

Response:
We disagree that the hydrogeology supports a pathway for groundwater flow to the entire Black Mountain basin (215), and that the entire Black Mountain basin should be included in the designated LWRFS. The current portion of upper Black Mountain was designated based on the hydrogeology and the assumed extension of the carbonate aquifer into this region. Our position is based on the assumption that the carbonate aquifer in Black Mountain basin is limited to the ~~eastern~~ western portion of the basin and moving east toward Lake Mead the hydrogeology varies ~~Basin~~ (CNLVb, 2019b-see Figure 5).