3.3 Master Response on Groundwater Pumping Impacts

3.3.1 Introduction

Overview and Summary of Issues Addressed

This master response addresses the issues commenters raise regarding the potential impacts from pumping groundwater in the Fenner Watershed at the Fenner Gap. Commenters express concerns regarding the potential impacts to the basin, including pumping groundwater at a volume beyond the long-term natural recharge rate, modeling beyond 100 years, salt production operations, brine migration, land subsidence, and the carbonate aquifer unit. Commenters request additional discussion on whether limiting pumping to the average natural recharge rate would reduce potential impacts.

This master response is organized by the following subtopics:

3.3.2 Groundwater Pumping Impacts

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Responses

Analysis of Potential Impacts to the Groundwater Basin

Potential impacts associated with the proposed groundwater-level drawdown are described and evaluated in the Draft EIR Vol. 1, Section 4.9.3 Hydrology and Water Quality, and Section 4.6.5 Geology and Soils, pp. 4.6-27 to 4.6-32 and pp. 4.6-35 to 4.6-38. The Draft EIR concludes that the pumping would have no impact on biological resources such as bighorn sheep, no aesthetic or other impacts to National Parks, no impacts to springs, and no impacts to air quality, with the exception of construction emissions of NO_{X}. It further concludes that any potentially significant impacts to the basin itself would be less than significant or less than significant with mitigation. Specifically, any effects the Project may have on water quality due to the migration of brine toward the wellfield, lower groundwater levels in neighboring wells and in saline water wells used by the salt production operations, or minor levels of land subsidence would be mitigated by implementation of Mitigation Measures **AQ-5, GEO-1, HYDRO-2, HYDRO-3**, and **MIN-1**. These mitigation measures are updated to provide clarifying detail on their implementation methods and are included in the Final EIR Vol. 6, Chapter 5 Draft EIR Text Changes. These mitigation measures are also reflected in the Updated Groundwater Management, Monitoring and Mitigation Plan (Updated GMMMP), included in the Final EIR Vol. 7, Appendix B1 Updated GMMMP.

The Draft EIR evaluates and compares potential impacts of the Project, including analysis of potential impacts to the other water users in the basin, under three distinct recharge scenarios: 32,000 acre-feet per year (AFY), 16,000 AFY, and 5,000 AFY. The Draft EIR's findings of significance were the same across all three recharge scenarios, as well as for both potential wellfield configurations, that with the implementation of Mitigation Measures, impacts would be less than significant. **GEO-1** requires extensive monitoring using twenty land survey benchmarks, three extensometers and InSAR satellite data. If the data shows that the Project is causing a trend in subsidence that would result in a decline in the ground surface elevation of more than 0.3 feet within 10 years or would be of a magnitude within ten years that impacts existing infrastructure (the magnitude for railroad tracks is more than 1 inch of subsidence over 62 feet) then corrective actions are required. This measure provides “early warning” action criteria to ensure that potential effects of land subsidence are investigated early and avoided. As noted above a network of extensometers would be installed to monitor subsidence in the area of the wellfield and near the Dry Lakes. Subsidence from Project impacts is predicted to be limited and to occur slowly, at a rate of fractions of an inch per year. If subsidence occurs at greater rates, corrective measures would be implemented to either arrest the rate of subsidence or mitigate subsidence effects to surface resources. Subsidence potential exists when groundwater levels drop, removing groundwater from the tiny pore spaces in the geologic formations that then become susceptible to compression as the water is removed. With cessation of pumping, groundwater elevations will be stabilized because the pore spaces will be refilled with water, no new material will be exposed to compression, and subsidence will be arrested.

Mitigation Measure **HYDRO-2** would implement corrective measures to address water quality by including early warning action criteria and establishing a limit to the migration of the saline-freshwater interface through implementation of corrective measures. Five well clusters between the Project wellfield and the Dry Lakes on the freshwater side of the saline-freshwater interface would monitor the migration of the saline-freshwater interface and trigger corrective action to avoid impacts to beneficial uses of the aquifer. The interface is designated as the line where the concentration of Total Dissolved Solids (TDS) is 1,000 mg/l, based on the Upper Limit secondary Maximum Contaminant Level (MCL). If the TDS concentration reaches 600 mg/l at any of the monitoring cluster wells, responsive measures will be triggered. Migration of the saline-freshwater interface will be limited to 6,000 feet. **HYDRO-3** would provide water supplies to third parties or take other corrective measures if third-party wells were adversely impacted by the Project. **MIN-1** would use “cluster type” wells on the margins of the Dry Lakes to monitor changes in groundwater or brine levels near the salt production operations. Project-induced changes in brine chemistry or reduced production yields would require the implementation of corrective actions to maintain or restore beneficial use of the groundwater/brine water by the salt production operations. In addition to recommending the implementation of these mitigation measures, the EIR notes that the mitigation measures are also reflected as project design features in the Updated GMMMP. **Master Response 3.8** GMMMP provides additional discussion of how the GMMMP would be implemented to ensure that the groundwater basin is managed effectively to minimize impacts.

The Draft EIR also analyzed potential impacts to springs and air quality from drawdown and confirmed no impacts to springs would occur because there is no physical connection between the mountain springs and the groundwater aquifer in the Project area. Similarly, no impacts to air quality from dry lake dust emissions would occur because of the erosion resistant characteristics of the Dry Lake surface soils and the fact that groundwater drawdown will not change those erosion-resistant characteristics. Notwithstanding the findings in the Draft EIR, Mitigation Measure **AQ-5** is included to monitor changes in Dry Lake dust generation through the installation of nephelometers as well as soil sampling. If changes in particulate matter or soil composition occur as a result of the Project, action criteria would trigger corrective measures to mitigate any potential adverse changes to air quality, including modifications to Project operations.

In addition to the imposition of mitigation measures in the EIR by SMWD, the County of San Bernardino (County), as a responsible agency, will review and consider the Project pursuant to its Groundwater Management Ordinance. As part of the regulatory process, the County has requested additional conditions beyond those required for CEQA compliance. Accordingly, the Updated GMMMP includes a groundwater "floor" (maximum 80 feet of drawdown in the wellfield area) that will provide the County the opportunity to evaluate effects of Project drawdown and require the modification or suspension of Project operations to protect critical resources. The "floor" is within the model-predicted drawdown under the Project Scenario (based on 32,000 AFY of recharge) (see Draft EIR Vol. 1, Section 4.9.3 Hydrology and Water Quality, Figure 4.9-12). This feature is not required by CEQA but is included as a management feature to reinforce implementation of the GMMMP and protection of critical resources. Similarly, the Updated GMMMP also includes a management feature for springs by providing for monitoring, action criteria and corrective measures to avoid any unanticipated Project effects on spring flows. For more information on these topics, please see **Master Responses 3.4** Springs, **3.5** Dry Lakes and Dust, and **3.8** GMMMP.

Limiting Pumping to the Average Natural Recharge Rate

Several commenters have asserted that limiting the Project's pumping of groundwater to the average natural recharge rate of the basin would reduce or avoid potential Project impacts.

Impacts associated with groundwater extraction identified in Section 4.9.3 of the Draft EIR include drawdown, saline water migration, and subsidence potential. Each of these impacts would be less than significant with mitigation under the proposed Project. Limiting pumping to the natural recharge rate would result in shallower drawdown and less potential for subsidence and saline migration. However, under a limited pumping scenario, no impacts would be avoided, nor would any significant and unavoidable impacts (construction NO_X emissions and secondary growth effects) be substantially lessened or reduced to a less than significant level. Drawdown in and of itself is not an adverse impact. Revising the Project to limit pumping to the average natural recharge rate would not alter the environmental impact conclusions of the Draft EIR because the mitigation measures recommended for the Project as currently proposed would ensure that impacts to the basin are mitigated regardless of the amount of groundwater level decline. Further, as to the potential for land subsidence and saline migration, more limited pumping would not alter the conclusions of the Draft EIR, as the mitigation measures identified in the Draft EIR to address those potential impacts would still be needed and equally effective under a limited pumping scenario.

Further, as detailed in the Draft EIR and supporting studies, limiting pumping to the natural recharge rate through the Fenner Gap would not effectively reduce evaporation. Therefore, the amount of water leaving the groundwater basin annually would include the Project extraction as well as the evaporation. This is described in the Draft EIR on page 4.9-72, Table 4.9-11 and shown in Figures 4.9-11a and 4.9-11b. Reversing the gradient below the Fenner Gap requires a lower cone of depression in the wellfield area. If only the natural recharge rate is withdrawn, the existing stored groundwater in the system would continue to flow downgradient to the Dry Lakes, become saline, and then be lost to evaporation. Therefore, pumping at the natural recharge rate would not avoid any impacts or satisfy the fundamental purpose of the Project, which is the conservation of substantial quantities of groundwater for beneficial use that are presently lost to evaporation by natural processes.

Currently, groundwater flows from the surrounding valleys to Bristol and Cadiz Dry Lakes where it becomes saline and is ultimately lost to evaporation. As described in the Draft EIR Vol. 1, Chapter 3 Project Description, p. 3-5, in the absence of the Project, it is estimated that approximately 3.2 million acre-feet (MAF) of the fresh groundwater presently held in storage would become saline and/or evaporate over the next 100 years (32,000 AF x 100 years). The Project proposes to draw down groundwater levels of this fresh water that is otherwise destined to be lost to evaporation.

As described in the Draft EIR Vol. 1, Section 4.9.3 Hydrology and Water Quality, pp. 4.9-71 to 4.9-73, the Project proposes to pump an average of 50,000 AFY of groundwater for 50 years. Over the life of the Project, up to 2.5 MAF of groundwater may be withdrawn representing a fraction of the existing stored groundwater. There is an estimated 17 to 34 MAF of fresh groundwater in storage in the Bristol and Fenner Watersheds. Therefore, *not accounting* for annual average recharge of the groundwater, proposed Project pumping would account for approximately 7 to 15 percent of the stored groundwater. Factoring in the estimated annual natural recharge (32,000 AF), Project pumping is estimated to amount to between 3 and 6 percent of the available stored groundwater (Draft EIR Vol. 1, Section 4.9 Hydrology and Water Quality, p. 4.9-71, Table 4.9-10). Up to 80 percent of the Project pumping would retrieve water that would otherwise be lost to evaporation.

Pumping in excess of the average natural recharge is an important hydrologic tool that is necessary to recover the freshwater before it evaporates. Proposed Project pumping would occur from the wellfield located in the Fenner Gap area at the downgradient end of the Fenner Watershed (Draft EIR Vol. 1, Chapter 3 Project Description, Figures 3-1 and 3-2). This location allows for the recovery of groundwater that is flowing downgradient from the mountains through the Fenner Gap, as well as groundwater that has already flowed past the Gap and is now flowing downgradient from the Gap towards the Dry Lakes. The pumping rate is based on the strategic drawdown of groundwater levels needed to recover both the groundwater flowing towards the wellfield and the groundwater that has already moved past the wellfield towards the Dry Lakes (Draft EIR Vol. 1, Section 4.9.3 Hydrology and Water Quality, p. 4.9-5). As a secondary benefit, the drawdown would facilitate storage capacity that could be utilized for the Phase 2, Imported Water Storage Component of the Project, if later approved and implemented.

As described in the Draft EIR Vol. 4, Appendix H1 Cadiz Groundwater Modeling and Impact Analysis, Sub-Appendix A, based on the INFIL3.0 model, the long-term average annual recharge supplying the Fenner and northern Bristol valley area is estimated to average approximately 32,000 AFY. In addition to this amount, the Project would pump an average of 18,000 AFY of existing stored groundwater to strategically create and maintain a groundwater trough that would ensure that groundwater flowing from the Fenner Valley would be drawn to the wellfield (before it reaches the Dry Lakes) so that the Project could recover the long-term sustainable yield of the aquifers. As noted above, this is integral to the Project objective to maximize beneficial use of groundwater in the Bristol, Cadiz, and Fenner Valleys by conserving and using fresh groundwater that would otherwise be lost to evaporation. This pumping in excess of long-term recharge is necessary to recover the fresh groundwater south and west of the wellfield before it flows to the Dry Lakes and evaporates.

The volume of groundwater to be pumped is an amount that would result in greater savings of fresh groundwater than if the exact amount of recharge (32,000 AFY) were extracted. This volume is based on the results of the three-dimensional, density-dependant groundwater flow and transport model that simulates groundwater flow in the Project area (including the Fenner and Orange Blossom Wash Watersheds, as well as the northern portions of the Cadiz and Bristol Watersheds). Various groundwater-level response model scenarios were prepared to estimate the rate of groundwater that would need to be pumped in order to draw groundwater away from its path to the Dry Lakes. The variables include three different recharge rates and two different wellfield arrangements. The two configurations were used to help develop and analyze operational scenarios which took into account both transmissivity and recharge. The model parameters and results were peer reviewed by the Groundwater Stewardship Committee (GSC) (see the GSC Final Report in the Final EIR Vol. 7, Appendix B1 Updated GMMMP, Sub-Appendix A Groundwater Stewardship Committee April 2012 Summary of Findings and Recommendations).

The results indicated that an average annual pumping rate of 50,000 AFY would be an efficient pumping volume to reverse the groundwater flow south of the Fenner Gap, thus creating an effective groundwater hydraulic control mechanism that alters the gradient so that the flow of groundwater changes direction from flowing toward the Dry Lakes to flowing toward the wellfield and allows for the conservation of fresh groundwater (Draft EIR Vol. 1, Section 4.9.3 Hydrology and Water Quality, p. 4.9-5). Draft EIR Table 4.9-11, p. 4.9-72 tabulates the volumes of groundwater that would be recovered under the three scenarios. Draft EIR Figures 4.9-11a and 4.9-11b illustrate this concept. Based on the Project scenario modeling results, within 67 years after pumping ceases, the groundwater storage levels are anticipated to fully recover to pre-Project conditions.

Supplemental groundwater modeling also showed that pumping at higher rates during the initial period of Project operations would save even larger amounts of water for beneficial use and would allow for hydraulic control earlier in the life of the Project (Draft EIR Vol. 1, Section 4.9.3 Hydrology and Water Quality, pp. 4.9-72 to 4.9-73 and Draft EIR Vol. 4, Appendix H2 Supplemental Assessment of Pumping Required, pp. 7-11). Pumping at a rate of 75,000 AFY during the first 25 years and 25,000 AFY during the second 25 years would reduce evaporative losses by approximately an additional 130,000 AF over the 50-year term of the Project (Draft EIR Vol.4, Appendix H2 Supplemental Assessment of Pumping Required). This analysis shows that pumping above natural recharge rates increases the conservation of water that would otherwise evaporate, resulting in reduced overall losses from the groundwater basin compared to a natural recharge only scenario. Pumping at higher rates early in the Project captures more water in transit to the Dry Lakes and reduces evaporative losses.

Long Term Impacts (Modeling beyond 100 Years)

Commenters have expressed concern regarding the long-term impacts of the groundwater drawdown proposed by the Project, whether the recovery of the basin has been realistically evaluated and if impacts would continue beyond the modeling period of 100 years.

The Project would extract groundwater across a limited area and for a limited period of time. This is the customary and routine effect from groundwater pumping. As noted above, the Project purposely and strategically lowers the water level to change the direction of flow of underground water to intercept natural recharge and prevent groundwater already in storage from continuing towards the saline brine zone and ultimately evaporating at the Dry Lakes. Groundwater withdrawn as part of the Project will be replaced by precipitation and natural recharge. Once the Project term concludes and pumping stops, over time, water levels eventually will return to their current levels (Draft EIR Vol. 1, Section 4.9.3 Hydrology and Water Quality, p. 4.9-72). Accordingly, there would be no significant adverse long term effect to the basin as a result of the drawdown because the water table would fully recover after pumping stops. The 100 year modeling period covers the period during which any potential adverse effects of pumping would be the greatest. After 100 years, as discussed below, any continuing effects would be reduced and diminishing.

The Draft EIR Vol. 4, Appendix H1 Cadiz Groundwater Modeling and Impact Analysis, Figures 64 to 71 reflect the results of the modeling conducted to examine potential impacts to the basin. The figures show that after the 50 years of pumping, the anticipated cones of depression decrease dramatically and, by year 100, groundwater levels have nearly recovered to pre-Project levels. Once the extraction of groundwater ceases at Project Year 50, groundwater levels would begin to rise in response to the uninterrupted flow of groundwater from the upgradient areas, filling in the cone of depression (Draft EIR Vol. 4, Appendix H1 Cadiz Groundwater Modeling and Impact Analysis, Table 2). The water table would return to the pre-pumping levels with most of the recovery occurring near the wellfield within the first few years, as shown by the steeper hydrograph curves in Figures 70 and 71. The figures illustrate conditions through Year 100 because, with no additional pumping, groundwater levels would be nearly back to pre-Project levels after 100 years. Even under the worst case sensitivity scenario (5,000 AFY of recharge) groundwater levels would be recovering at Year 100 and any potential effects would be steadily diminishing. The modeling does quantify the anticipated number of years after the cessation of pumping when the groundwater levels are expected to fully recover to pre-Project levels. Full recovery for the Project Scenario is expected to occur 67 years after pumping stops, which is 17 years beyond the 100 year modeling period or Year 117 (Draft EIR Vol. 1, Section 4.9.3 Hydrology and Water Quality, p. 4.9-71).

Salt Production Operations

Commenters have expressed concern regarding the impacts of the groundwater drawdown on the salt production operations, particularly to their ability to initially access saline water by excavating trenches and to use saline wells to pump more saline water into those trenches.

The Draft EIR Vol. 1, Section 4.9.3 Hydrology and Water Quality, pp. 4.9-63 to 4.9-71 acknowledges that the drawdown of groundwater would potentially result in physical impacts that could affect the economics of salt production operations in two ways.

The first step in salt production at the Dry Lakes is to excavate trenches to access shallow saline water. The water then evaporates, concentrating salts. The first potential impact of the Project is that the drawdown of groundwater could interfere with or eliminate trenching as the initial step in accessing the saline water if the groundwater flowing from the areas to the west, south, and east is insufficient to maintain shallow water levels. Instead, salt production operations could be required to fill the trenches with saline water pumped from nearby saline wells, resulting in an added cost to the operations.

The second potential impact of the Project, although not predicted by the aquifer model, is that the drawdown of groundwater could result in the water levels falling to below the pump intakes in the saline production wells. This lowering of the water levels could in turn require that either the pumps be lowered in the affected well or that the well be replaced with a deeper well, both resulting in an added cost to the operations.

Pursuant to CEQA Guidelines, “economic or social effects of a project shall not be treated as significant effects on the environment.”[1] Neither the potential reduction in shallow saline water for the trenching process nor the lowering of water levels in saline production wells will result in significant impacts on the environment. Instead they are physical effects that may increase costs for salt production at the Dry Lakes, an economic impact for which CEQA does not require mitigation.

However, to address the neighboring salt production companies’ concerns and pursuant to the County’s Groundwater Management Ordinance, the Updated GMMMP would require that monitoring measures be implemented to track water levels to identify whether water levels are approaching the well pump intakes (Final EIR Vol. 7, Appendix B1 Updated GMMMP, Sections 5.3, 5.4, 5.5, 5.9 and 5.10), and that corrective measures be taken in the event that the salt production operations are impacted by either of the potential impacts described above (Final EIR Vol. 7, Appendix B1 Updated GMMMP, Sections 6.2 and 6.5). These measures specifically require the Project proponent to bear all additional costs to the salt production operations that are attributable to the Project. Therefore, the salt production operations would be able to continue operations with no added costs to the operators.

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1 CEQA Guideline § 15131.

Brine Migration and Third Party Wells

Commenters have expressed concern regarding the impacts of the migration of the saline-freshwater interface such that freshwater wells might become saline.

For purposes of the Proposed Project, Brine migration is the movement of salty/high total dissolved solids (TDS) in the groundwater from beneath the Dry Lakes towards the fresh groundwater located beneath the wellfield. This has the potential to impact the quality of groundwater at the edges of the Dry Lakes by increasing the concentration of TDS above potable or agricultural use standards. The saline/fresh water interface (the location where the saline water meets the fresh water) is defined as the area where the measured TDS concentration exceeds 1,000 milligrams per liter (mg/l), the Upper Limit Secondary Maximum Contaminant Level (MCL), or secondary drinking water standards.

Few if any existing groundwater wells could be affected by any migration of saline water toward the wellfield. The land in these areas is undeveloped open space on the edges of the playa, presenting few opportunities for future development of any kind. Historical and current groundwater use is described in the Draft EIR (Vol. 1 Section 4.9.1 Hydrology and Water Quality, pp. 4.9-24 to 4.9-28). Based on a review of state records concerning significant groundwater users in the area, the largest groundwater users in the region are Cadiz Inc. (agricultural operations) and Tetra Technologies (salt production operation using both saline and fresh water). Other smaller volume users include National Chloride Company and Salt Products Company (salt production operations at Cadiz and Danby Dry Lakes), the Burlington Northern Santa Fe Railroad (BNSF), and the few residents in and around the communities of Amboy, Chambless, Essex, and Goffs (however, no public records were located reporting annual use by any residents of these communities). According to a report prepared in 1964 by Southern California Edison, historical pumping in the Fenner and Cadiz Valleys from 1910 to 1964 averaged approximately 265 AFY. In a 1984 U.S. Geological Survey (USGS) Water Resources Investigation Report, groundwater pumping in the Fenner Valley between 1954 and 1981 averaged approximately 7 to 8 AFY. Neither of these reports took into account Cadiz Inc. agricultural operations. Since 1986, Cadiz Inc. agricultural use made up the majority of groundwater use, decreasing from about 5,400 AFY in 1986 to currently about 1,900 AFY. Tetra Technologies reported an average use of approximately 500 AFY with a high of 574 AFY in 1996. While not reported, National Chloride Company's use is expected to be less than Tetra Technologies due to the smaller size of their operation and the fact that California laws require that all groundwater use over 25 AFY be reported (no reports for National Chloride were found). The individual residences' use would be minimal as domestic per person use ranges from 100 to 255 gallons a day[2] or up to approximately 1 AFY (1 AFY equals approximately 326,000 gallons per year). BNSF may occasionally use groundwater from their wells for railroad operations but the volume of water required would be no more than what is needed for the ARZC (10- 100 AFY). Accordingly, annual water use in this area in 2010 from all sources other than Cadiz Inc. was less than 2,000 AFY. This represents approximately 6 percent of the predicted average annual natural recharge and 0.01 to 0.02 percent of the stored groundwater.

2 Department of Water Resources, *20X2020 Water Conservation Plan*, February 2010, p. x to xi.

As shown on Figures 4.9-7, 4.9-8, and 4.9-9 (Draft EIR Vol. 1, Section 4.9.3 Hydrology and Water Quality, pp. 4.9-50, 4.9-51, and 4.9-52 respectively), the saline-fresh water interface is expected to migrate towards the Cadiz Inc. agricultural operations under all three of the modeled recharge scenarios and both wellfield configurations. However, the model-predicted aquifer response indicates that the interface will not reach the Project pumping wells under any scenario, with the closest approach of over two miles away. In addition, apart from salt mining wells that utilize non-potable water, there are no known freshwater wells used by third parties for potable uses in the area between the saline water beneath the Dry Lakes and the Cadiz Inc. agricultural operations.

The potential saline-freshwater interface migration distance under the 32,000 AFY recharge scenario is greater than with the 16,000 and 5,000 AFY recharge scenarios. Although it may seem counter-intuitive, because lower transmissivity values in the deeper underlying soil formations, which are due to the additional consolidation from the overlying sediments, were assumed,the recharge rate estimates are lower (Draft EIR Vol. 1, Section 4.9.3 Hydrology and Water Quality, p. 4.9-49). These tighter soils slow flow rates in the deeper aquifer materials and therefore also slow migration of the saline interface line (where the saline water meets freshwater). In other words, more water is pulled from around the wellfield and less is pulled back from the Dry Lakes. Similarly, the smaller 16,000 AFY and 5,000 AFY recharge scenarios require lower tranmissivity (hydraulic conductivity) values to calibrate the model. The smaller hydraulic conductivity values would result in smaller cones of influence and seepage velocities. As a result, the interface migration under the 16,000 AFY and 5,000 AFY recharge scenarios is less than the interface migration under the 32,000 AFY recharge scenario.

As set forth in the Draft EIR, the Project would result in less than significant impacts with mitigation related to brine migration. Further as described in the Updated GMMMP (Final EIR Vol. 7, Appendix B1 Updated GMMMP, Sections 5.2 through 5.5), measures (including "cluster wells") will be implemented to monitor the freshwater-saline water interface migration and provide an "early warning" to avoid any potential adverse effects to the beneficial use of the freshwater aquifer by limiting migration to 6,000 feet. As described in the Updated GMMMP, Section 6.4 and Figure 5-2, the "cluster wells" would be located between the Dry Lakes and the wellfield on the freshwater side of the interface. If TDS concentrations reach 600 mg/l and migration is expected to reach the 6,000 foot limit within 10 years, then extraction/injection wells will be implemented to prevent migration beyond 6,000 feet or else Project pumping shall be modified or curtailed. See Mitigation Measures **HYDRO-2** and the Updated GMMMP and **Master Response 3.8** GMMMP.

Drawdown could also potentially impact third-party wells not used for salt production operations, although none are known to exist in the area that is expected to be affected by the saline-freshwater migration. See Draft EIR Vol. 1, Section 4.9.1 Hydrology and Water Quality, Figure 4.9-5. While the modeling does not predict that water levels would drop sufficiently to impact such wells, nonetheless, the Updated GMMMP and Mitigation Measure **HYDRO-3** included in Chapter 5 of this Final EIR provide for monitoring and for any third-party well owner within the affected area to submit a written documented complaint to trigger review and enforcement of mitigation measures necessary to restore the beneficial use. Should such a third party be identified, the Updated GMMMP provides that Project operators will mitigate Project impacts.

Land Subsidence

Commenters have expressed concern regarding the impacts of land subsidence caused by groundwater drawdown on infrastructure such as the existing railroad tracks.

The potential for land subsidence is influenced by the magnitude of groundwater-level decline and the thickness of the clay layers in the portion of the aquifer that becomes unsaturated as a result of the pumping. As explained in the Draft EIR Vol. 1, Section 4.6.3 Geology and Soils, pp. 4.6-29 and Draft EIR Vol. 4, Appendix H1 Cadiz Groundwater Modeling and Impact Analysis, Section 8.6, the model predicts that subsidence, if any, would occur gradually and be dispersed laterally over a large area from the Fenner Gap to the Dry Lakes with less than significant effects. The maximum potential subsidence would be expected to occur on the western portions of the Cadiz Inc. agricultural operations and the Dry Lakes. As described in the Draft EIR Vol. 4, Appendix H1, Section 8.6, the maximum potential land subsidence under all three scenarios ranges from 0.9 to 2.7 feet, and the actual amount of subsidence could be much less.

Reduction in subsurface thickness could occur at the depths where groundwater is withdrawn, well over 100 feet below the ground surface. The land subsidence could also result in some permanent loss of aquifer storage, however, the relatively small amounts of potential land subsidence (tenths to single inches, if any) relative to the overall aquifer thickness (on the order of hundreds to thousands of feet) means that the loss in storage from subsidence would be a fraction of the available storage and would be less than significant. In addition, the maximum potential model-predicted subsidence rate would be two orders of magnitude below the maximum tolerance level for railroad lines (Draft EIR Vol. 1, Section 4.6.3 Geology and Soils, p. 4.6-37). Therefore, subsidence is considered a less than significant impact. The maximum tolerance rate identified as the significance threshold is derived from Federal Railroad Administration Track Safety Standards.[3] These federal standards are established to ensure safe rail transportation and also serve to protect other developments including pipelines and buildings. The model predicts that any subsidence that may occur would be small changes in the slope over a broad area of land and would not result in severe or sudden concentrated drops in the land surface that can damage surface structures.

Mitigation Measure **GEO-1** provides "early warning" action criteria to ensure that potential effects of land subsidence are investigated early and avoided. A network of extensometers, land survey benchmarks would be installed to monitor subsidence in the area of the wellfield and near the Dry Lakes and satellite data would be reviewed. Subsidence resulting from the Project is predicted to occur slowly, at a rate of fractions of an inch per year, if at all. If subsidence occurs at greater rates, corrective measures would be implemented to either arrest the rate of subsidence or mitigate subsidence effects to surface resources. Subsidence potential exists when groundwater levels drop, removing groundwater from tiny pore spaces in the geologic formations that become susceptible to compression as water is removed. With cessation of pumping, groundwater

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3 Code of Federal Regulations 49 Chapter 5, Section 213.

elevations would be stabilized, the pore spaces would refill with water, no new material would be exposed to compression, and subsidence would be arrested. Mitigation Measure **GEO-1** and the GMMMP include measures, such as the installation of extensometers, to monitor land subsidence trends and include corrective measures to be implemented in the unlikely event that the land subsidence response is outside of the "early warning" action criteria. The monitoring measures are described in the Updated GMMMP (Final EIR Vol. 7 Appendix B1 Updated GMMMP, Sections 5.6 and 5.7). The corrective measures to be implemented should subsidence exceed action criteria are presented in the Updated GMMMP (Final EIR Vol. 7, Appendix B1 Updated GMMMP, Section 6.3). Even though no significant impact is predicted, the Updated GMMMP and Mitigation Measure **GEO-1** provide for monitoring, action criteria, and corrective measures that would address any potential impacts before they occur.

Carbonate Unit

Commenters have expressed concern that pumping from the carbonate unit in the Fenner Gap might result in decreases in water levels within the carbonate unit elsewhere, such as the outcrops of the carbonate unit in the mountains where the springs are located.

As discussed in the Draft EIR Vol. 1, Section 4.9.1 Hydrology and Water Quality, pp. 4.9-22 to 4.9-24, the pumping wells will extract groundwater from both the alluvial and carbonate aquifer units at the Fenner Gap. These units are in hydraulic continuity.

The site-specific geologic structural evaluation of the Fenner Gap reveals that the subsurface bedrock units are extensively faulted, tilted, and folded (Draft EIR Vol. 4, Appendix H1 Cadiz Groundwater Modeling and Impact Analysis, Sub-Appendix B Geologic Structural Evaluation of the Fenner Gap Region). This has resulted in the extensive joint and fracture system that increases secondary porosity[4] for groundwater flow paths. This also means that individual geologic units tend to be broken into smaller pieces and are not extensive for long distances. Because of this, exposures of carbonate units in the higher elevations of the surrounding mountain ranges are not directly connected to the carbonate units in the subsurface beneath the Fenner Gap (Draft EIR Vol. 1, Section 4.9.3 Hydrology and Water Quality, pp. 4.9-59). Consequently, it is not possible for pumping of the carbonate unit in the Fenner Gap to have any impact on carbonate unit exposures at the surface in the mountains or anywhere else. The lack of hydraulic connection between groundwater in the aquifer system in the valleys and the springs in the mountains is discussed further in the **Master Response 3.4** Springs.

[4] A subsequent or separate porosity system in a rock, often enhancing overall porosity of a rock. This can be a result of chemical leeching of minerals or the generation of a fracture system or both.