Appendix B1

Groundwater Management, Monitoring, and Mitigation Plan – UPDATED

ESA

Groundwater Management, Monitoring, and Mitigation Plan

For

The Cadiz Valley Groundwater Conservation, Recovery and Storage Project[1]

July 2012

[1] This Management Plan shall not become final or effective until approved by the Santa Margarita Water District and the County of San Bernardino Board of Supervisors after a noticed public meeting by the respective agencies.

TABLE OF CONTENTS

Page

TABLE OF CONTENTS
(continued)

Page

TABLE OF CONTENTS
(continued)

Page

TABLE OF CONTENTS
(continued)

Page

TABLE OF CONTENTS
(continued)

Page

FIGURES

Tables

Groundwater Management, Monitoring, and Mitigation Plan For the Cadiz Valley Groundwater Conservation, Recovery, and Storage Project

EXECUTIVE SUMMARY

The fundamental purpose of the Cadiz Valley Groundwater Conservation, Recovery, and Storage Project (Project) is to conserve and recover substantial quantities of groundwater that in the absence of the Project would otherwise evaporate. The Project is a 50-year groundwater recovery, conservation and conjunctive use storage project located within the collective Fenner, Orange Blossom Wash, Bristol and Cadiz Watersheds in the Eastern Mojave Desert. It will provide reliable water supply to the Santa Margarita Water District (SMWD) and other participating water agencies. Phase I of the Project provides for the initial extraction of groundwater in amounts not to exceed an annual average of up to 50,000 acre-feet per year (afy)[2] from a wellfield in the area within and south/southwest of the Fenner Gap. Phase II of the Project, if proposed and implemented, would use available aquifer capacity to operate a one million acre-feet groundwater storage bank to facilitate the storage and recovery of imported water over the Project's 50-year term. Phase II is not proposed at this time and will be subject to subsequent environmental and regulatory review. The full term of the Project's operation, including Phase I and Phase II, shall be limited to 50 years.

This Groundwater Management, Monitoring, and Mitigation Plan (Management Plan) will govern the operation and management of the Project by Fenner Valley Mutual Water Company (FVMWC) through a joint powers agreement initally between FVMWC and SMWD. The Management Plan is prepared to comply with the County of San Bernardino's (County) Desert Groundwater Management Ordinance (Ordinance) as an excluded Project under the exclusion provisions set forth in Article 5, Section 33.06552 of the County Code. As part of its compliance with the exclusion provisions of the Ordinance, SMWD, FVMWC, Cadiz Inc. (Cadiz), and the County approved a May 2012 Memorandum of Understanding (MOU).

The Management Plan requires monitoring of aquifer health and safe yield, groundwater levels and rates of decline, groundwater quality, subsidence, surface vegetation, air quality, third-party wells and springs, and corrective measures to address potential significant adverse impacts to critical resources[3] and Undesirable

[2] Actual total pumping would vary depending on Project participant supply needs. The maximum extraction rate in any given year would be limited to 75,000 afy with the long-term average of up to 50,000 afy as measured over a rolling 10-year period.

[3] SMWD has prepared an Environmental Impact Report (EIR) that evaluates the potential for the Project to result in significant impacts to the environment pursuant to Public Resources Code section 21000 et

Results[4] attributable to the Project. The Management Plan sets forth the plan of action to optimally manage groundwater resources and monitor and mitigate physical effects of the Project, and it ensures that Project operations will be conducted without significant adverse impacts to critical resources and Undesirable Results attributable to the Project.

During operations, the initial extraction of an annual average of up to 50,000 afy is designed to capture annual native recharge plus groundwater in storage that is migrating toward the Bristol and Cadiz Dry Lakes. Additional extractions above annual native recharge are planned for the purpose of strategically lowering groundwater levels in the vicinity of the Project wellfield to realize two essential Project benefits that are not available under existing conditions. First, the lowering of groundwater levels will cause existing groundwater gradients to reverse so that the Project will retrieve substantial quantities of potable groundwater located to the south and east of the wellfield that would otherwise flow into the saline groundwater underlying the Dry Lakes and evaporate. Lowered groundwater levels at the end of pumping will further slow the loss of groundwater to evaporation at the Dry Lakes until these lowered groundwater levels recover as a result of natural recharge and restore the hydraulic gradient such that losses to evaporation return to pre-Project levels. Second, the managed lowering of groundwater levels will also establish dewatered space within the aquifer to facilitate the storage and recovery of imported water during the potential Phase II of the Project.

The Management Plan is designed to avoid significant adverse impacts and Undesirable Results to the critical resources within the region, including the following:

- Groundwater aquifers tapped by the Project;
- Local springs within the Fenner Watershed;
- Brine resources of Bristol and Cadiz Dry Lakes;

---

seq. While certain of the mitigation measures recommended in the EIR mirror the corrective measures contained in the Management Plan, the use of the phrase "significant adverse impacts to critical resources" is specific to the Management Plan and is not a reference to a determination by SMWD of a significant impact to the environment pursuant to CEQA

[4] "Undesirable Results" means any of the following: (i) the progressive decline in groundwater levels and freshwater storage below the "floor" established in this Management Plan; (ii) the progressive decline in groundwater levels and freshwater storage at a rate greater than the established rate in this Management Plan where the decline signifies a threat of other physical impacts enumerated including (a) land subsidence, (b) the progressive migration of hyper-saline water from beneath the Cadiz or Bristol Dry Lakes toward the Project well sites; (c) increases in air quality particulate matter; (vi) loss of surface vegetation; or (d) decreases in spring flows.

- Air quality in the Mojave Desert region; and
- Adjacent areas, including the Colorado River and its tributary sources of water.

By definition, the Project intends to implement a managed drawdown in water levels to achieve specific conservation objectives. This Management Plan is designed to prevent significant adverse impacts to critical resources and Undesirable Results traditionally associated with groundwater pumping by collecting data and determining if observed changes in groundwater levels, groundwater quality, and land subsidence are consistent with changes projected in groundwater modeling as described in this Management Plan and references cited herein. If there are deviations from the groundwater modeling projections, those deviations will prompt further investigation and assessment under this Management Plan, and if necessary, implementation of corrective measures so as to avoid potential adverse impacts to critical resources and Undesirable Results. The Project approval is limited to a defined period of operations (50 years).[5]

The Management Plan incorporates a comprehensive network of monitoring features and data collection facilities, which include:

- Local springs;
- Observation wells at various locations, several of which will be clustered wells with depth-discrete screened intervals;
- Project production wells;
- Land survey benchmarks;
- Downhole flowmeter surveys;
- Gamma-ray and dual induction electric logs;
- Nephelometers for dust monitoring; and

[5] The option agreements for the Project participants contemplate that the Project participants may elect to extend the term of the Project beyond the 50-year term. If such an election were made, new purchase agreements would be required and full environmental review would be developed prior to consideration and potential approval of an extended term, which would include the development of a new management plan. The new plan would be subject to discretionary review by the County under its Desert Groundwater Management Ordinance and pursuant to any surviving provisions of the MOU.

- Weather stations.

The Management Plan establishes a process for scientific review of the observations and data obtained from monitoring features and facilities, and sets forth action criteria, and if appropriate, corrective measures to be taken if an action criterion is or may be triggered. The Management Plan has taken a conservative approach in its action criteria and potential corrective measures in the following areas:

- Local springs;
- Third-party wells;
- Land subsidence;
- Induced flow of lower-quality water from Bristol and Cadiz Dry Lakes;
- Brine resources underlying Bristol and Cadiz Dry Lakes;
- Air quality; and
- Adjacent groundwater basins, including the Colorado River and its tributary sources of water.

This Management Plan includes measures that are also required by the California Environmental Quality Act (CEQA) as mitigation for potential Project impacts, as well as additional Project design features to monitor and verify Project operations and predicted effects and confirm protection of critical resources. These additional Project design features are not required under CEQA but, for the avoidance of doubt and to satisfy the County's Ordinance, they have been included to provide a comprehensive monitoring program for the groundwater basin and all critical resources within the watershed.

The Project will be carried out as a public-private partnership between SMWD and Cadiz. While the lands and water rights to be used for the Project are owned by Cadiz, SMWD will be responsible for management and control of Project operations and will act as the approving authority for the design and construction of the Project. The Project will be operated by FVMWC (all the memberships of which will be owned by SMWD and the other Project participants) under the management and supervision of SMWD through a Joint Powers Authority (JPA) formed initially between FVMWC and SMWD. Through the JPA, FVMWC and SMWD will lease to own all Project facilities and control and operate the Project during its entire duration. As a mutual water company, FVMWC will be controlled by the Project participants, with SMWD being the lead participant, during both the Project development and operations periods. While SMWD and FVMWC will carry out the Project through the JPA, this Management Plan sets forth how the County will participate in the Project to ensure that groundwater resources within the County's jurisdiction are appropriately managed.

As set forth in the MOU, compliance with this Management Plan shall be overseen and enforced by the County. SMWD is the Project's Lead Agency with responsibility for mitigation of Project impacts pursuant to the Project's EIR and Public Resources Code section 21081.6. SMWD shall enforce, as a condition of Project approval, the implementation of all adopted mitigation measures, including those measures which correspond to provisions of the Management Plan. In recognition of the County's regulatory role in enforcing the Desert Groundwater Management Ordinance, SMWD shall share with the County enforcement responsibilities with regard to those impact areas and mitigations in the EIR's Mitigation Monitoring and Reporting Program (MMRP) that fall within the County's jurisdiction pursuant to the MOU and Ordinance. SMWD will, pursuant to CEQA Guideline section 15097(a), delegate the reporting and monitoring responsibilities for those mitigation measures to the County. SMWD shall be responsible for reviewing and considering the County's on-going determination of compliance with those mitigation measures, which are also provisions of this Management Plan, in assessing compliance with the MMRP and with conditions of Project approval. A Technical Review Panel (TRP) will be created to assist in evaluating monitoring protocols and methods of data collection and processing, water quality, the rate of decline in the groundwater elevations, monitoring the level of the water table in the Cadiz well-field in relation to an established safe floor, and the Project's potential to cause Undesirable Results, as defined in the MOU. The TRP may make recommendations to the County or the County may request recommendations from the TRP that require additional monitoring, mitigation, and modification to Project operations as set forth in Chapter 8.

The Management Plan requires that all technical data be made available to the public in the form of annual reports reviewed and maintained by the County, and it also calls for periodic water resources model refinements and incremental five-year projections of the physical impacts of Project operations to be set forth in periodic reports, together with any recommendations for Project improvements.

CHAPTER 1
INTRODUCTION AND BACKGROUND

1.1 The Cadiz Valley Water Conservation, Recovery, and Storage Project

This Groundwater Management, Monitoring and Mitigation Plan (Management Plan) is an integral part of the oversight of the Cadiz Valley Groundwater Conservation, Recovery, and Storage Project (Project). The Project is a water conservation supply and potential conjunctive use storage project undertaken by SMWD, in collaboration with Cadiz, that would make optimal use of the groundwater resources within the collective Fenner, Orange Blossom Wash, Bristol, and Cadiz Watersheds in the Eastern Mojave Desert, without displacing other beneficial uses (see Figure 1-1). The Project will develop a new water supply from the surplus waters of the Watersheds and enable the use of groundwater storage for future banking with participating water agencies as described herein.

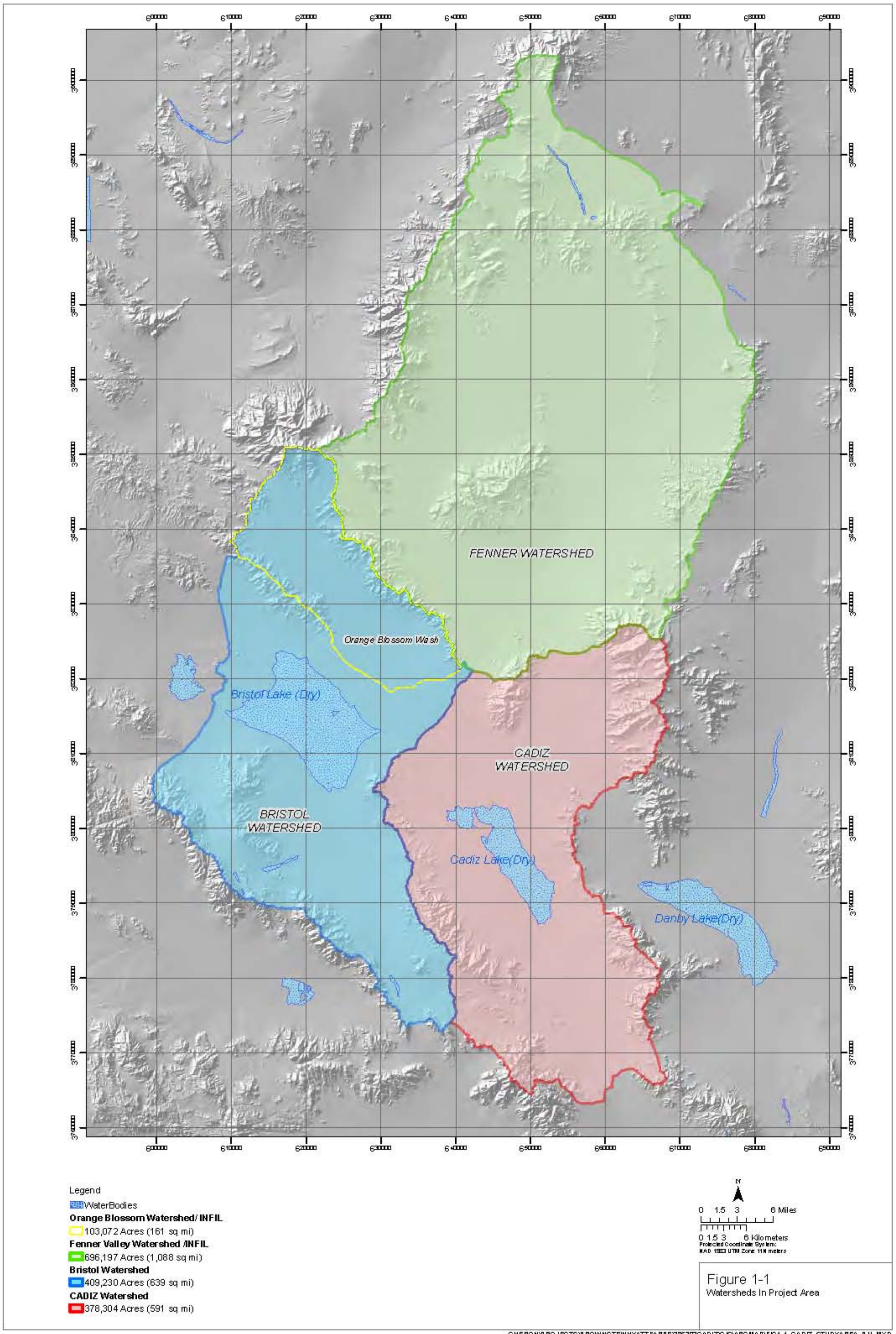


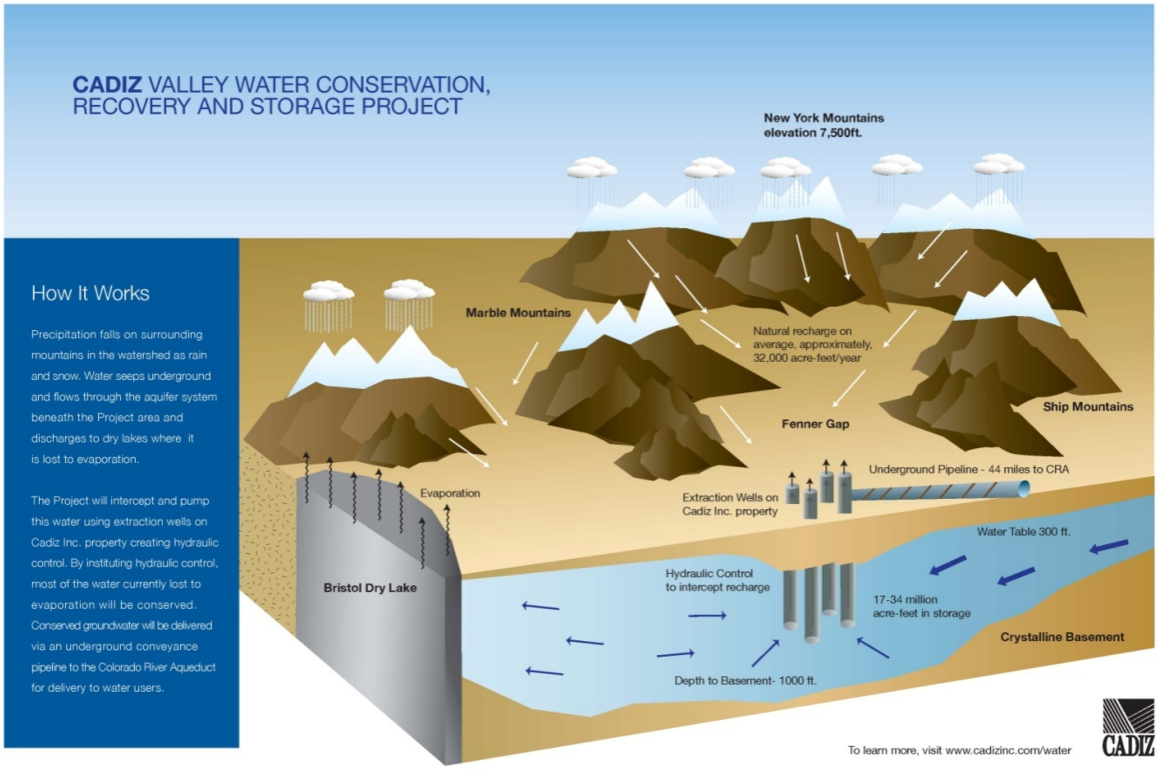
Figure 1-1
Watersheds In Project Area

The first phase of the Project, which is referred to herein as the "Conservation Component," would extract and convey groundwater at an initial average rate of up to 50,000 acre-feet per year (afy) from a wellfield in the area within and south/southwest of Fenner Gap via pipeline to the Colorado River Aqueduct (CRA). The 50,000 afy of extraction will make use of the long-term average annual natural recharge from the Fenner and Orange Blossom Wash Watersheds. Groundwater extraction will strategically lower groundwater levels within the immediate vicinity of the Project wellfield to intercept natural recharge and retrieve groundwater already held in storage beneath and downgradient of the wellfield before it can evaporate from the Dry Lakes, as discussed below.

The potential second phase of the Project, the Imported Water Storage Project, would involve managing the groundwater basin conjunctively by importing water during times of surplus, storing it in the basin, and recovering the stored water to meet drought, emergency, or other demands. The dewatered storage created by extracting more than the annual natural recharge in Phase I would create storage space facilitating a conjunctive use project to store surplus imported surface water when available to be recovered when needed. Imported water for storage would be conveyed to the Fenner Gap area by pipeline from the CRA and, potentially, an interconnection of the California Aqueduct to the Project through a converted natural gas pipeline. The water would be recharged into the groundwater basin via spreading basins constructed within or just north of the Fenner Gap.

Under the Imported Water Storage Component of the Project, up to 1 million acre-feet of dewatered capacity would be managed and made available for groundwater banking.

A conceptual model of the Project is shown in Figure 1-2.



Proposed monitoring in this Management Plan only addresses Phase I of the Cadiz Valley Groundwater Conservation, Recovery, and Storage Project. The potential storage and recovery of up to one million acre-feet of imported water was previously analyzed in 2000-2002 by the United States Bureau of Land Management in connection with its grant of a right-of-way for a project then proposed by the Metropolitan Water District of Southern California. This Management Plan will be updated and revised prior to any implementation of Phase II in order to integrate additional monitoring and mitigation requirements that may result from additional CEQA analysis and review associated with the proposed conjunctive use operations taking into account variables such as the identity of Phase II Project participants, the source of supply, volumes, and timing of deliveries.

1.2 Overview of the Management Plan

This Management Plan governs water extraction for the Project and is designed to ensure that Project operations and future irrigation under the Cadiz agricultural development will be conducted without significant adverse impacts to critical resources. While Cadiz may continue production of groundwater to irrigate agriculture within the Project area, such agricultural irrigation will be commensurately phased out as Project production increases in order to ensure that the initial average annual extraction rate of 50,000 afy is not exceeded. Under no circumstance shall combined

Project production and the Cadiz agricultural operations exceed the average rate of 50,000 afy.

This Management Plan is designed to prevent significant adverse impacts to critical resources and Undesirable Results by collecting data and determining if observed changes in groundwater levels, groundwater quality, and land subsidence are consistent with changes projected in groundwater modeling, as described in this Management Plan and references cited herein. Critical resources identified in this Management Plan are as follows:

- The basin aquifers tapped by the Project;
- Springs within the Fenner Watershed, including springs of the Mojave National Preserve and BLM-managed lands;
- Brine resources of Bristol and Cadiz Dry Lakes;
- Air quality in the Mojave Desert region;
- Project area vegetation; and
- Adjacent groundwater basins, including the Colorado River and its tributary sources of water.[6]

This Management Plan establishes a comprehensive network of monitoring and data collection facilities combined with procedures for comprehensive scientific review of all actions and decisions. The Management Plan includes action criteria prior to the occurrence of adverse impacts on critical resources resulting from Project operations. Implementation of specific corrective actions are meant to ensure that the adverse effects to critical resources are avoided or reduced to below specific objective standards designed to safeguard the critical resources. For example, third-party well owners can participate in a monitoring program that will trigger corrective action (e.g., provision of replacement water) if static groundwater levels in their wells drop due to Project operations. Third-party well owners not participating in the monitoring program can trigger corrective action by providing a written complaint to FVMWC. See Chapter 6 for full details of the action criteria and corrective measures. For several critical

[6] As explained in Chapter 2 of this Management Plan, technical analysis to date concludes that there is no hydrogeologic connection between groundwater that would be extracted by the Project, and groundwater supplies to the northeast within watersheds that are tributary to the Colorado River. Nonetheless, this Management Plan proposes the monitoring of groundwater levels in the adjacent Piute Watershed, which is tributary to the Colorado River.

resources, including local springs, air quality, and the groundwater resources of neighboring basins, the Management Plan provides for monitoring of such critical resources even though technical research and available scientific data demonstrate that the Project is not anticipated to impact these critical resources. The monitoring is being undertaken to comport with the County's Ordinance and the recommendations of the Groundwater Stewardship Committee, a multi-disciplinary panel of earth science and water professionals assembled by Cadiz and SMWD to provide advice and comment on the Project (see Appendix A Groundwater Stewardship Committee, Current Summary of Findings and Recommendations, Cadiz Valley Groundwater Conservation, Recovery, and Storage Project).

This Management Plan mandates specific action criteria (triggering levels) for impacts to critical resources and specified responses if an action criterion is reached. It establishes a defined process for scientific and objective review of groundwater management and a decision-making process to protect critical resources. Refinements to this Management Plan may occur during the life of the Project as more data and understanding becomes available. Such refinements will be developed in consultation with the TRP and subject to County and SMWD review and approval. Management Plan reports will be of public record. This Management Plan is intended to comply with the County's Guidelines for Preparation of a Groundwater Monitoring Plan and its Desert Groundwater Ordinance, which provides, in part, that installation of groundwater extraction wells may be excluded from the Ordinance's permitting provisions if the Project is subject to an enforceable agreement with the County and will be managed consistent with a County-approved groundwater management plan (San Bernardino County Code §33.06552).

The Project will be comprised of three time periods: a pre-operational period, an operational period of 50 years, and a post-operational/closure period that will span a minimum of 10 years, subject to review and a potential extension by the TRP, FVMWC, SMWD, and the County. The pre-operational phase will commence upon start of construction and will last a minimum of 12 months. Cadiz will complete and deliver all needed permits for monitoring facilities prior to the pre-operational phase. Cadiz will construct all facilities that are agreed to in this Management Plan and for which permits have been received.

This Management Plan and the MOU are not subject to extension by the parties. At the end of the Project's operational life, however, Cadiz, FVMWC, and SMWD may seek a new authorization from the County for the extraction and conveyance of groundwater from the aquifer. Any new authorization will be subject to County review and approval and further environmental review, as well as new agreement(s) and a new groundwater management plan. The quantity of recoverable groundwater that might be available at that time would have to be re-evaluated based on operational and other data on the rates of recharge, safe yield of the aquifer, and appropriate groundwater levels.

1.3 The Project Area

The Project area is located in the eastern Mojave Desert of San Bernardino County, California approximately 200 miles east of Los Angeles, 60 miles southwest of Needles, and 40 miles northeast of Twentynine Palms. The Project wellfield is located within and south/southwest of the Fenner Gap which is centered between the Marble and Ship Mountains east of Cadiz.

The Project area can be divided into four areas for discussion purposes. The first and largest is the area encompassed by the totality of Bristol, Cadiz, and Fenner Watersheds as shown in Figure 1-3 and referred to herein as the "larger watershed area." Orange Blossom Wash is within the Bristol Watershed. The second area is the region beyond the larger watershed area which includes adjacent areas that are tributary to the Colorado River, such as the Piute Watershed. This second area is referred to herein as "adjacent regions." All precipitation within the larger watershed area that infiltrates to the groundwater table or runs off as surface flow, ultimately discharges to Bristol or Cadiz Dry Lakes. Groundwater flow from the Fenner Watershed converges and flows through Fenner Gap ultimately making its way to Bristol and Cadiz Dry Lakes. Similarly, groundwater flow in the Orange Blossom Wash area moves downgradient to Bristol Dry Lake. The third area is the freshwater zone located between the Fenner Gap and Bristol Dry Lake, as mapped by Shafer (1964), and is referred to herein as the northern Bristol/Cadiz Sub Basin (Figure 1-3). The fourth area is the area of the proposed wellfield, which is in the vicinity of the Fenner Gap and referred to herein as the wellfield area (Figure 1-3).

The total area of the Bristol (which includes Orange Blossom Wash), Cadiz, and Fenner Watersheds is approximately 2,320 square miles. The Bristol Watershed is approximately 640 square miles, the Cadiz Watershed is 590 square miles, and the Fenner Watershed is approximately 1,090 square miles.

These Watersheds are considered to be a single closed drainage system because all surface and groundwater drains to central lowland areas of the Bristol and Cadiz Dry Lakes. The Bristol, Cadiz, and Fenner Watersheds are separated from the surrounding watersheds within the adjacent regions by topographic divides (generally mountain ranges).

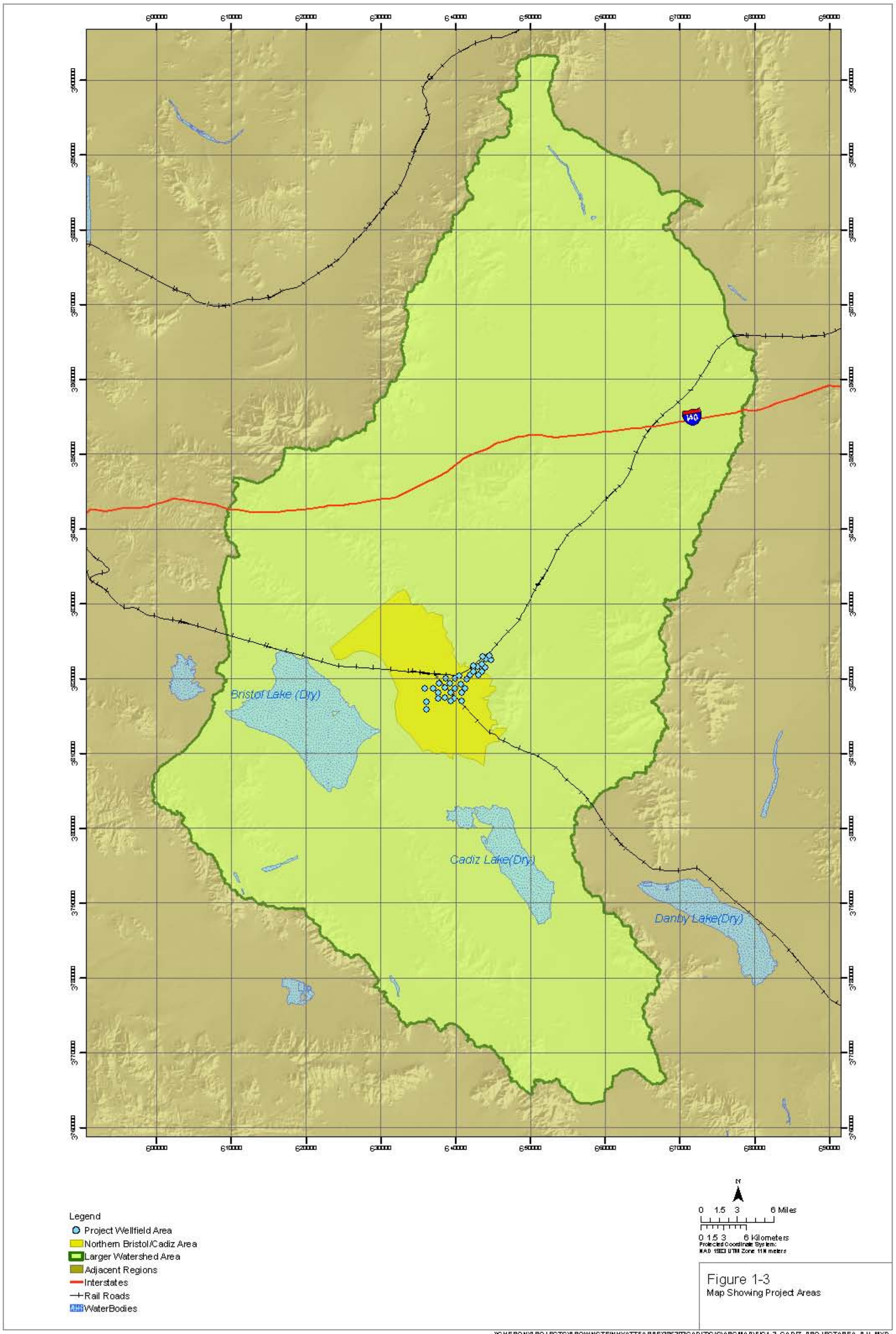
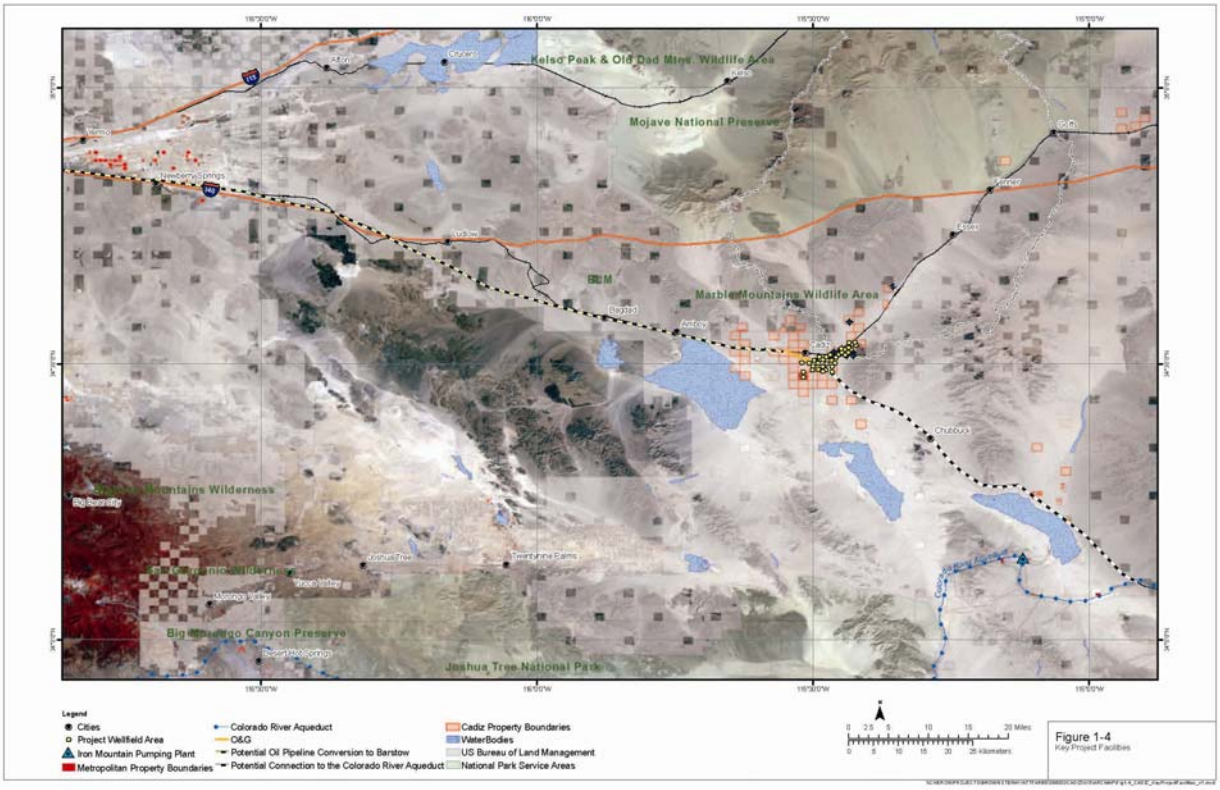


Figure 1-3
Map Showing Project Areas

A map of key current and future Project facilities is shown in Figure 1-4.



1.4 The Parties

The Project and the Management Plan are the joint efforts of SMWD, Cadiz, FVMWC, and the County in accordance with the County's Guidelines for Preparation of a Groundwater Monitoring Plan.

1.4.1 *Santa Margarita Water District*

SMWD was initially formed in 1964 by landowners seeking a reliable water supply, and it has grown into the second largest retail water agency in Orange County. It supplies clean, affordable, reliable water and wastewater services to over 155,000 residents and businesses in Mission Viejo, Rancho Santa Margarita, and the unincorporated areas of Coto de Caza, Las Flores, Ladera Ranch, and Talega. When implemented, the Project will diversify SMWD's water portfolio and help drought-proof the District to ensure its water demands are met regardless of variability in State Water Project supplies. As part of a public-private partnership with Cadiz Inc., SMWD will be the public agency carrying out the Project and will also be the public agency with the greatest responsibility for supervising the Project. Specifically, SMWD will carry out and supervise the Project through its participation in a Joint Powers Authority with FVMWC and through its role as a shareholder in FVMWC. SMWD will be responsible for management and control of Project operations and will act as the approving authority for the design and construction of the Project. SMWD (through the JPA), FVMWC, and SMWD will lease-to-own all Project facilities and control and operate the Project during its entire duration. Accordingly, SMWD is the agency most responsible for carrying out the Project.

As the Lead Agency for the Project's California Environmental Quality Act (CEQA, Cal. Pub. Res. Code §§ 21000 *et seq*.) review process, SMWD is responsible for evaluating the Project's alternatives, environmental impacts, and potential mitigation measures. A draft of the Management Plan was included as an appendix to the EIR for the Project, and its provisions were evaluated in the EIR. Prior to approval of the Management Plan, SMWD as the lead agency and the County as a responsible agency will be required to determine whether the Project, including the Management Plan, were adequately evaluated in the EIR and to make any required findings under CEQA.

SMWD shall enforce the implementation of all adopted mitigation measures, including those measures which correspond to provisions of the Management Plan, as conditions of Project approval. SMWD will, pursuant to CEQA Guideline section 15097(a), delegate to the County the reporting and monitoring responsibilities for those mitigation measures and conditions of approval that are subject to County jurisdiction under its Ordinance and the MOU. SMWD shall review and consider the County's on-going determination of compliance with those mitigation measures which are also provisions of the Management Plan in assessing compliance with the Mitigation Monitoring and Reporting Program and with the conditions of Project approval.

1.4.2 *Cadiz Inc.*

Founded in 1983, Cadiz Inc. (Cadiz) is a renewable resources company based in Los Angeles. Using integrated satellite imagery and geological, geophysical, and geochemical survey methods, the company has identified and acquired 34,000 acres of land in Cadiz Valley situated over a large, naturally recharging basin. Cadiz's goal is for this basin to provide a high-quality, reliable water supply to Southern Californians, as well as much-needed underground storage for surplus water, all without causing material adverse impacts to the local environment.

1.4.3 *County of San Bernardino*

The proposed Project lies within the unincorporated desert area of eastern San Bernardino County, where groundwater production is regulated under the County's Desert Groundwater Management Ordinance (Ordinance) (San Bernardino Code §§ 33.06551 *et seq*.). A project may qualify for exclusion from the Ordinance's permitting procedures where the operator has developed a groundwater management, monitoring and mitigation plan approved by the County that is consistent with guidelines developed by the County[7] and the County and the operator have executed a memorandum of understanding that complies with the provisions of the Ordinance (San Bernardino Code §33.06552(b)(1)). This Management Plan and the MOU amongst FVMWC, SMWD, the County, and Cadiz together are designed to serve as the Project's compliance with the County Groundwater Management Ordinance and ensure the Project is operated to avoid significant adverse impacts to critical resources and Undesirable Results. Because approval of the Management Plan is necessary to qualify the Project for exclusion from the Ordinance and is a discretionary action, Santa Bernardino County's decision is subject to CEQA and the County is acting as a responsible agency.

1.4.4 *Fenner Valley Mutual Water Company*

FVMWC is a California mutual water company formed for the purpose of delivering water from the Project to its members at cost under the supervision of SMWD. Outstanding membership shares are available for issuance to Project participants, including SMWD. Cadiz will not own shares in FVMWC. FVMWC intends to contract with public agencies, including SMWD, for the purpose of forming a JPA (see California Government Code, § 6525). In the formation of this JPA, SMWD will be the designated agency in the joint powers agreement pursuant to Government Code section 6509. The Project will be operated by FVMWC (all memberships of which will be owned by SMWD and other Project participants) under the management and supervision of SMWD through a joint powers agreement between FVMWC and SMWD. FVMWC will lease all Project facilities and control and operate the Project during its entire duration. As a mutual water company, FVMWC will be controlled by the Project participants, with SMWD being the lead participant, during both the Project development and operations periods. Pursuant to this Management Plan, FVMWC shall assess technical data and responsive actions, propose refinements to the Management Plan, and corrective measures regarding compliance with the provisions of the Management Plan, and prepare and submit various annual and periodic technical reports, all in consultation with SMWD and the TRP and subject to the oversight of the County, as specified further in Chapters 6, 7, 8, and 9.

---

[7] This Groundwater Management Plan has been prepared to satisfy the County's Guidelines for Preparation of a Groundwater Monitoring Plan, which were last revised in June 2000. The Groundwater Monitoring Plan includes methods and procedures to measure groundwater production, groundwater levels, water quality and potential land subsidence (see County Guidelines for Preparation of a Groundwater Monitoring Plan, § 1.1).

1.4.5 *Other Anticipated Project Participants*

In addition to the three Project parties listed above, other water service providers and additional users are expected to participate in the Project. These participants include:

- Three Valleys Municipal Water District, which serves 133 square miles in Los Angeles County, California and includes Azusa, City of Industry, Covina, Claremont, Diamond Bar, Glendora, Hacienda Heights, La Puente, La Verne, Pomona, Rowland Heights, San Dimas, Walnut, and West Covina.

- Golden State Water Company, which provides service to three water service regions across 10 California counties. Region I consists of 7 customer service areas in northern and central California and Ventura County; Region II consists of 4 customer service areas located in Los Angeles and Orange County; and Region III consists of 10 customer service areas in eastern Los Angeles County and in Orange, San Bernardino, and Imperial Counties.

- Suburban Water Systems, which serves an area covering approximately 42 square miles, including all or portions of Glendora, Covina, West Covina, La Puente, Hacienda Heights, City of Industry, Whittier, La Mirada, La Habra, Buena Park, and unincorporated portions of California's Los Angeles and Orange Counties.

- Jurupa Community Services District (JCSD), which provides potable water, sewer, and street lighting services to over 101,000 people located throughout 48 square miles in the Jurupa area of Riverside County. JCSD serves unincorporated areas of Riverside County as well as the communities of Jurupa Valley and Eastvale.

- California Water Service Company (Cal Water) distributes and sells water to 1.7 million Californians through 435,000 connections. Its 24 separate water systems serve 63 communities from Chico in Northern California to the Palos Verdes Peninsula in Southern California.

- The Arizona and California Railroad Company (ARCZ) owns and operates a railway line in a right-of-way that runs between the Cadiz property and the Colorado River. Its parent company is RailAmerica.

1.5 Project Description

The Project will include two phases:

1.5.1 *Phase I*

Phase I will provide for initial extraction and delivery to the CRA of up to an annual average of 50,000 afy for delivery to Project participants in compliance with this Management Plan to avoid adverse impacts to critical resources and Undesirable Results. Extraction in any given year may range from 25,000 to 75,000 afy to accommodate carryover, but shall not exceed more than an average of 50,000 afy measured over a 10-year period, inclusive of agricultural production by Cadiz. Project participants can carry over their annual allocations by storing their water in the basin for later extraction and delivery during drought or emergency conditions within the 50-year operation period.

The Project involves construction and operation of the facilities shown on Figures 1-3 and 1-4 and as described below:

- A wellfield of up to approximately 34 extraction wells and appurtenant facilities;
- An approximately 43-mile long conveyance pipeline and appurtenant facilities from the CRA to the wellfield, including power, generally parallel to the conveyance;
- Instrumentation and control systems to monitor all Project operations; and
- Observation wells, cluster wells, land survey benchmarks, extensometers, weather stations, and other appurtenant facilities necessary for this Management Plan.

The conveyance and power distribution facilities, observation wells, land survey benchmarks, and other monitoring features, along with all Project facilities, will be located on land owned by Cadiz or on easements obtained from other landowners.

1.5.2 *Phase II*

Phase II, subject to approval of appropriate environmental documentation, would provide conjunctive-use storage, up to a total of one million acre-feet of storage at any given time, in compliance with an updated version of the Management Plan. The

County's and SMWD's approval of the MOU and this Management Plan does not include approval of Phase II. There are no agencies currently committed to participate in Phase II. Phase II requires potential future approvals by agencies not yet identified under terms not yet negotiated. Because of this, Phase II is still in the conceptual stage and is analyzed in the Environmental Impact Report programmatically. Subsequent CEQA review and updates to this Management Plan will be required prior to implementation of Phase II.

1.6 Project Objectives

The Project objectives are as follows:

- Maximize beneficial use of groundwater in the Bristol, Cadiz, and Fenner Valleys by conserving and using water that would otherwise be lost to brine and evaporation;

- Improve water supply reliability for SMWD and other Southern California water providers by developing a source of water that is not significantly affected by drought;

- Reduce dependence on imported water by utilizing a source of water that is not dependent upon surface water resources from the Colorado River or the Sacramento-San Joaquin Delta;

- Enhance dry-year water supply reliability within SMWD and other Southern California water provider Project participants;

- Enhance water supply opportunities and delivery flexibility for SMWD and other participating water providers through the provision of carry-over storage and, for Phase II, imported water storage;

- Support operational water needs of the ARZC in the Project area;

- Create additional water storage capacity in Southern California to enhance water supply reliability;

- Locate and design the Project in a manner that minimizes significant environmental effects and provides for sustainable operations.

1.7 Existing Groundwater Management

Cadiz owns 34,000 acres of largely contiguous land in the Cadiz and Fenner Valleys of eastern San Bernardino County, where it has farmed successfully for more than 15 years, as shown in Figure 1-3. Approximately 1,600 acres of this land has been cultivated for citrus and stone fruit orchards, vineyards, and specialty row crops.

In 1993, San Bernardino County certified a Final Environmental Impact Report (FEIR), and granted various land use approvals for expansion of agricultural operations up to 9,600 acres on this property. As a component of this approval, the County identified specific groundwater monitoring activities to be undertaken by Cadiz. To comply with these monitoring requirements, the Cadiz Valley Agricultural Development Ground Water Monitoring Plan (GWMP) was developed in cooperation with San Bernardino County to monitor all potential environmental impacts that could result from the agricultural irrigation. The GWMP governs water use, storage, and extraction for the agricultural operations and ensures that Project operations and future irrigation under the Cadiz Valley agricultural development will be conducted without adverse impacts to critical resources. While Cadiz may continue production of groundwater to irrigate agriculture within the Project area, such agricultural irrigation will be commensurately phased out as production by the Project increases to ensure that the initial average extraction rate of 50,000 afy is not exceeded. In addition, FVMWC shall ensure proper closure of any agricultural wells that will be taken out of production or use with the new Project. Regardless of any phasing, the average annual extraction over the 50 years of Project operations will be no greater than 50,000 afy from all Cadiz and Project pumping.

1.8 Purpose and Scope of Management Plan

The Management Plan is prepared to comply with the County Desert Groundwater Management Ordinance and the MOU by and between SMWD, FVMWC, Cadiz, and the County. The Management Plan requires monitoring of aquifer health and safe yield, groundwater levels, groundwater quality, subsidence, surface vegetation, air quality, third-party wells, and springs and to address, through corrective measures, potential significant adverse impacts to critical resources and Undesirable Results attributable to the Project. The Management Plan sets forth the plan of action to optimally manage groundwater resources, monitor and mitigate physical effects of the Project, and ensures that Project operations will be conducted without significant adverse impacts to critical resources.

This Management Plan includes the following:

1) Description of the Project location and objectives;

2) Description of physical characteristics of the groundwater basin;

3) Identification of the critical resources and assessment of potential impacts in and surrounding the Project area due to Project groundwater extraction;

4) Description of the modeling tools that will be used to refine the monitoring network and that will be used in the future to refine impact assessments and action criteria;

5) Description of the monitoring network and identification of the locations of the features of the monitoring network;

6) Description of the monitoring, testing, and reporting procedures that will be used to collect and analyze data;

7) Description of the action criteria established to avoid potential significant adverse impacts to critical resources;

8) Description of the decision-making process to be used once the action criteria are met or when the County considers refinements to this Management Plan;

9) Description of corrective measures that may be implemented to minimize potential significant adverse impacts to critical resources;

10) Description of objectives and requirements for a Closure Plan; and

11) Description of the TRP and its responsibilities and procedures.

CHAPTER 2
DESCRIPTION AND CHARACTERISTICS OF GROUNDWATER BASINS AND PRESENT USES

2.1 Geologic Setting

As shown above in Figure 1-3, the study area includes the Fenner, Bristol, and Cadiz Watersheds. These watersheds are located in the Eastern Mojave Desert, which is a part of the Basin and Range Province of the western United States. The Basin and Range Province is characterized by a series of northwest/southeast trending mountains and valleys formed largely by faulting. One of the prominent features of the area is the Bristol Trough, a major structural depression caused by faulting. The Bristol Trough encompasses the Bristol and Cadiz Watersheds that together form a relatively low-land area that extends from just south of Ludlow, California on the northwest to a topographic and surface drainage divide between the Coxcomb and Iron mountains on the southwest. The Bristol and Cadiz Valleys are bounded on the southwest by the Bullion, Sheep Hole, Calumet, and Coxcomb mountains and on the northeast by the Bristol, Marble, Ship, Old Woman, and Iron mountains. The Cadiz and Bristol Dry Lakes are separated by a low topographic and surface drainage divide. The Fenner Watershed is located north of the Bristol Trough. This watershed encompasses approximately 1,100 square miles (mi2). It is bounded by the Granite, Providence, and New York mountains on the west and north and the Piute, Ship, and Marble mountains on the east and south. Fenner Gap occurs between the Marble and Ship mountains, where the surface drainage exits Fenner Watershed and enters the Bristol and Cadiz Watersheds. The Clipper Mountains rise from the southern portion of the watershed, just northwest of Fenner Gap (CH2M Hill, July 2010).

The Orange Blossom Wash Watershed is a subarea of the Bristol Watershed, that is located in the western portion of the Project area between the Marble and Bristol mountains. The Orange Blossom Wash Watershed is bounded on the west by the Granite Mountains and drains to the southeast into the Bristol Dry Lake. The Bristol and Cadiz Watersheds are located in the southern portion of the Project area. The proposed Project wellfield is located in the northern Bristol and Cadiz valleys, within and south/southwest of the Fenner Gap (CH2M HILL, July 2010).

The total area of the Bristol, Cadiz, and Fenner Watersheds is approximately 2,330 square miles and consists of the Fenner Watershed (1,090 square miles), Bristol Watershed (including the Orange Blossom Wash) (640 square miles), and Cadiz Watershed (590 square miles). The surface water drainage and groundwater flow from all four of the watersheds in this Project area drain into the Bristol and Cadiz Dry Lakes, where it joins the brine water underlying the Dry Lakes and evaporates (CH2M HILL, July 2010).

The alluvial sediments of the Fenner Valley are underlain by carbonate, granitic, and metamorphic rocks, forming a rock-bounded basin overlain with sands and gravels hundreds of feet thick. Groundwater ranges from approximately 270 to 400 feet bgs in the northeastern portion of the Project area to 140 feet bgs in the southwest, becoming shallower with increasing proximity to the Dry Lakes. Groundwater in storage has been estimated at between 17 and 34 million acre-feet. Of this amount, 4 to 10 million acre-feet is estimated to exist in the fresh water zone south of the Fenner Gap (CH2M HILL, July 2010).

2.2 Surface Water Resources

Native springs and localized wet areas associated with these springs are present in the mountain ranges in the Project vicinity, as shown in Figure 2-15 of CH2M Hill's July 2010 Report. The closest native springs to the Project site are located to the north, in the Granite, Clipper, and Old Woman Mountains. The nearest spring is Bonanza Spring (Spring 007N015E22DS01S), which is located in the Clipper Mountains, approximately 11 miles north of the center of Fenner Gap. These springs are located in hard rock (volcanic, granitic and metamorphic rocks) formations substantially higher in elevation than the carbonate and alluvial aquifers of the groundwater basin, such that they are not in hydraulic communication with the proposed wellfield and spreading basin areas. Therefore, pumping in the carbonate aquifer and alluvial aquifer in the Project wellfield should not affect groundwater levels in the hard rock formations that supply water to the vicinity springs. Nonetheless, this Management Plan provides for monitoring of the springs to confirm that Project operations have no impact on the spring flow from these springs consistent with recommendations of the Groundwater Stewardship Committee.

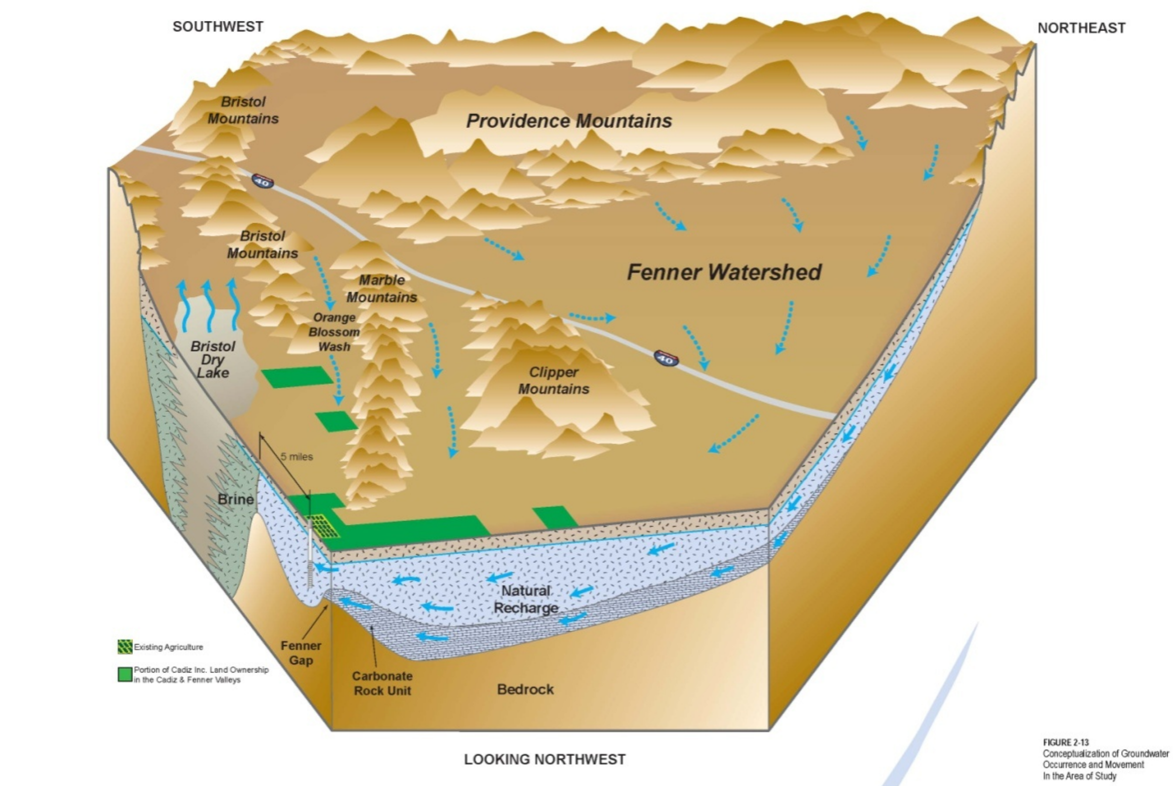
The Bristol and Cadiz Dry Lake playas are the lowest points in the Project area and are separated by a low topographic and surface drainage divide. Since the four Watersheds are part of a closed drainage system, the only natural outlet for surface water and groundwater is through evaporation at the Dry Lake surfaces.

2.3 Natural Recharge

The natural recharge in the Project area watersheds has been the subject of several studies since 1970 (see Appendix D to Geoscience, September 1, 2011)/ The most recent study, based on data obtained from field investigations in the Fenner Gap, use of INFIL3.0 watershed soil-moisture budget model released in 2008, and three-dimensional groundwater flow model simulations for the Fenner Gap, estimated the long-term average annual natural recharge of 32,000 afy (CH2M Hill, July 2010).

The primary sources of replenishment to the groundwater system within the larger watershed area include direct infiltration of precipitation (both rainfall and snowfall) in fractured bedrock exposed in mountainous terrain and infiltration of ephemeral stream flow in sand-bottomed washes, particularly in the higher elevations of the watershed. The source of much of the groundwater recharge within the larger watershed area occurs in the higher elevations, including Bristol Mountains, Granite Mountains, Providence Mountains, Marble Mountains, New York Mountains, Piute Mountains, Old Woman Mountains, Ship Mountains, Clipper Mountains, Wood Mountains, and Hackberry Mountains (CH2M Hill, July 2010).

Most of the precipitation in the Eastern Mojave Desert accumulates during the winter months from November through March. Early summer and late fall are typically periods of little rainfall. The amount of precipitation in the Bristol, Cadiz, and Fenner Watersheds vary with differences in altitude. Average annual precipitation ranges from approximately 3 inches on the Cadiz and Bristol Dry Lakes (elevations of 545 to 595 ft amsl) to over 12 inches in the Providence and New York mountains (elevations over 7,000 ft amsl). However, most of the larger watershed area receives, on the average, 4 to 6 inches of rain annually (Geoscience, September 2011). A conceptualized model of groundwater recharge in the area is shown in Figure 2-1.



2.4 Hydrogeology

Based on available geologic and geophysical data, the principal geologic deposits in the Project area that can store and transmit groundwater (i.e., aquifers) can be divided into three units: an upper alluvial aquifer, a lower alluvial aquifer, and a bedrock aquifer consisting of Tertiary fanglomerate, Paleozoic carbonates, and fractured and faulted granitic rock. In general, these three units are in hydraulic continuity with each other and the separation is primarily due to stratigraphic differences (Geoscience, September 2011).

The alluvial aquifer system consists mainly of Quaternary alluvial sediments which consist of stream-deposited sand and gravel with lesser amounts of silt. The thickness of the alluvial aquifer varies between 200 and 800 feet. To the west of Fenner Gap, the upper aquifer is separated from the lower aquifer system by discontinuous layers of silt and clay. The average thickness of the upper aquifer in Fenner Gap is approximately 500 feet. The upper aquifer is very permeable in places and can yield 3,000 gallons per minute (gpm) or more to wells with less than 20 feet of drawdown (Geoscience, September 2011).

The lower alluvial aquifer consists of older sediments, including interbedded sand, gravel, silt, and clay. The maximum thickness of the lower aquifer is unknown but may reach over 6,000 feet in the vicinity of Bristol Dry Lake. Where these materials extend below the water table, they yield water freely to wells but are generally less permeable than the upper aquifer sediments. The Cadiz agricultural wells are screened primarily in the lower alluvial aquifer and typically yield 1,000 to 2,000 gpm (Geoscience, September 2011).

Based on findings from recent drilling in the Fenner Gap area, Tertiary fanglomerate, fractured and faulted granitic rock, and Paleozoic carbonates located beneath the lower alluvial aquifer contain groundwater and are considered a third aquifer unit. Groundwater movement and storage within the carbonate bedrock aquifer primarily occurs within secondary porosity features (i.e., fracture zones associated with faulting and cracks and cavities developed within the rocks over time) (Geoscience, September 2011).

2.5 Groundwater Storage

The volume of groundwater in storage was estimated to be about 17 million to 34 million acre-feet in the alluvium of the Fenner Valley, Orange Blossom Wash, and northern Bristol/Cadiz area, where the conservation and storage Project will be sited. Four to ten million acre-feet of groundwater lie to the west and southwest of the proposed wellfield location (Geoscience Tech Memo September 20, 2011). Estimates of groundwater in storage in various zones within the general Project area are listed in Table 2-1, which also includes estimates of the following variables: volume of aquifer, determined as the volume between the groundwater table and the base of the alluvium (saturated thickness), percent of aquifer saturated thickness that is expected to be an aquifer (to exclude clay and silt intervals that do not yield water readily), and estimated specific yield. Low and high ranges are provided for each of these variables based on previous estimates (CH2M Hill, July 2010).

Table 2-1

Cadiz Study Area Groundwater Storage Calculations

Low Estimate					High Estimate				
Zones	Saturated Thickness Volume (ac-ft)	% of Saturated Thickness which is Aquifer	Specific Yield	Groundwater in Storage (ac-ft)	Zones	Saturated Thickness Volume (ac-ft)	% of Saturated Thickness which is Aquifer	Specific Yield	Groundwater in Storage (ac-ft)
Zone 1	11,251,515	75%	0.15	1,265,795	Zone 1	11,251,515	85%	0.20	1,912,758
Zone 2a	63,758,585	50%	0.10	3,187,929	Zone 2a	63,758,585	60%	0.15	5,738,273
Zone 2	93,083,800	50%	0.10	4,654,190	Zone 2	93,083,800	60%	0.15	8,377,542
Zone 3	13,052,800	20%	0.10	261,056	Zone 3	13,052,800	40%	0.15	783,168
Zone 4	489,237	50%	0.10	24,462	Zone 4	489,237	75%	0.15	55,039
Zone 5	88,466,500	50%	0.10	4,423,325	Zone 5	88,466,500	75%	0.15	9,952,481
Fenner	93,676,400	50%	0.05	2,341,910	Fenner	93,676,400	60%	0.10	5,620,584
Goffs	32,917,900	50%	0.05	822,948	Goffs	32,917,000	60%	0.10	1,975,074
				16,981,615					**34,414,919**

This storage estimate does not include water contained within the carbonate and fractured portion of the bedrock beneath the alluvial units. Recent drilling has revealed that these units also store groundwater. As such, the estimated volume of groundwater in storage is a conservative underestimate; the actual volume of groundwater in storage is larger by some unknown amount (Geoscience, September 2011). Figure 2-2 shows the storage zones used in the calculations of groundwater in storage.

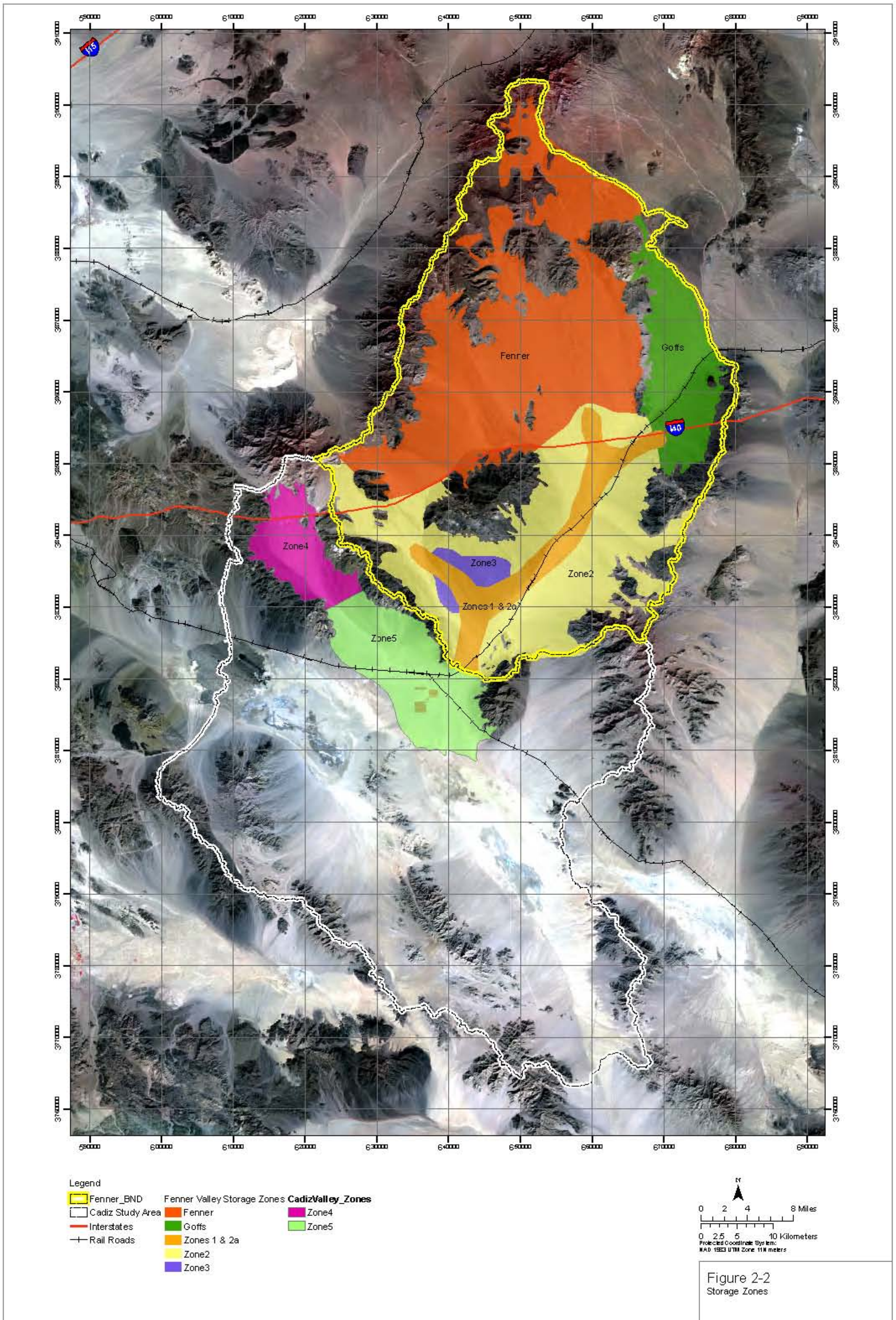


Figure 2-2
Storage Zones

2.6 Groundwater Quality

With the exception of the areas underlying and immediately adjacent to the Bristol and Cadiz Dry Lakes, the quality of the groundwater in the northern Bristol, Cadiz, and Fenner Gap area is relatively good, with total dissolved solids (TDS) concentrations typically in the range of 300 to 400 milligrams per liter (mg/L). Table 2-2 summarizes water quality data collected from an existing well on the Cadiz agricultural operations property, south/southwest of the Fenner Gap. The State of California guideline for drinking water is a maximum TDS of 1,000 mg/L. However, all groundwater having a TDS below 3,000 mg/L is considered by the State to be a potential domestic or municipal source of water supply.

TABLE 2-2: GROUNDWATER CHEMISTRY AT CADIZ ALLUVIAL AQUIFER

	CA MCL	CA SMCL	CADIZ GROUNDWATER
TDS		500-1000 mg/L	260 mg/L
Arsenic	10 µg/L		3.1 µg/L
Chloride		250-500 mg/L	34 mg/L
Total Chromium	50 µg/L		16 µg/L
Fluoride	2.0 mg/L		1.6 mg/L
Manganese		50 µg/L	Not Detected (< 20 µg/L)
Nitrate as NO3	45 mg/L		12 mg/L
Sulfate		250-500 mg/L	11 mg/L

CA MCL: California primary maximum contaminant levels for drinking water (chemicals affecting health and safety)

CA SMCL: California secondary maximum contaminant level for drinking water (chemicals affecting taste and odor)

mg/L = milligrams per liter

µg/L = micrograms per liter

Not Detected = not detected at or above the reportable detection limit

Source: 22 CCR §§ 64431, 64449

Table 2-3 shows water quality data obtained from recent hydrogeologic investigations in the Fenner Gap area. Overall, groundwater quality in the alluvial and carbonate aquifers is of very high quality, with low total dissolved solids. Chromium, and in particular hexavalent chromium, is a constituent of potential concern given the recently adopted California Public Health Goal for hexavalent chromium of 0.02 ug/l. Groundwater containing hexavalent chromium and/or chromium (III) could require treatment depending on the water quality standard developed by the State. Groundwater in the deeper section of the bedrock shows elevated concentrations of iron and manganese; however, the relative contribution of groundwater from these deeper bedrock units is expected to be small, such that the quality of groundwater in production is expected to be representative of the water quality of the alluvial and carbonate aquifers.

Table 2-3

Summary of Water Quality Results

Parameter	Regulatory Action Levels				Analytical Results[1]			
	CA Primary MCL	USEPA Primary MCL	CA Secondary MCL	USEPA Secondary MCL	TW-1 Carbonate 11/10/2009	TW-1 Alluvium 12/04/2009	TW-2 Alluvium 11/24/2009	DT-1 Bedrock 02/24/2011
Anions :								
Chloride (mg/L)			250 to 500	250	38	34	35	110
Fluoride (mg/L)	2	4		2	1.5	1.6	1.6	3.6
Nitrate as NO_3 (mg/L)	45				13	12	12	ND < 1.0
Sulfate (mg/L)			250 to 500	250	32	11	30	110
Total Anions (me/L)					4.23	3.46	4.09	-
Alkalinity :								
Total Alkalinity (mg/L)					110	100	110	130
Bicarbonate Alkalinity (mg/L)					130	130	130	160
Carbonate Alkalinity (mg/L)					ND < 3.0	ND < 3.0	ND < 3.0	ND < 3.0
Hydroxide Alkalinity (mg/L)					ND < 3.0	ND < 3.0	ND < 3.0	ND < 3.0
Cations :								
Calcium (µg/L)					24	27	26	13
Magnesium (µg/L)					5.7	5.2	5.7	5.0
Potassium (µg/L)					5.0	4.9	5.2	4.9
Sodium (µg/L)					60	48	53	170
Total Hardness (mg/L)					84	89	88	54
Total Cations (me/L)					4.4	4	4.2	-
General Parameters :								
pH				6.5 to 8.5	8.0	8.0	7.9	8.6
Langlier Index at 25 C					0.01	-0.01	-0.11	-
Total Dissolved Solids (mg/L)			500 to 1,000	500	220	260	300	530
Metals and Metalloids :								
Arsenic (µg/L)	10	10			7.5	3.1	6.5	11
Total Chromium (µg/L)	50	100			14	16	18	2.9
Hexavalent Chromium (µg/L)	[2]				16	14	14	-
Iron (µg/L)			300	300	ND < 100	ND < 100	ND < 100	11,000
Manganese (µg/L)			50	50	ND < 20	ND < 20	ND < 20	210

Notes:
(1) TW-1 and TW-2 samples were collected at the end of constant rate pumping tests.
DT-1 sample airlifted through the drill string after achieving total depth (1,500 feet).
(2) Hexavalent chromium is currently regulated under the MCL for total chromium.
CA = California
USEPA = United States Environmental Protection Agency
MCL = maximum contaminant level

At the Bristol and Cadiz Dry Lakes, surface water and shallow groundwater evaporation has concentrated dissolved salts resulting in TDS concentrations as high as 298,000 mg/L (Shafer, R. A., *Report on Investigations of Conditions which Determine the Potentials for Development in the Desert Valleys of Eastern San Bernardino County, California* (1964); Engineering Department Southern California Edison Company, Unpublished Report at 172, pp 12 plates; *cited in* Metropolitan and Cadiz Inc., *Environmental Impact Report/Environmental Impact Statement (EIR/EIS) for the Cadiz Groundwater Storage and Dry-Year Supply Program (Cadiz Project)*, pages 5-72, 5-80, and 5-81 (September 2001)). The location of the interface between the low-TDS "fresh" groundwater (i.e., TDS concentrations less than 1,000 mg/L) and high-TDS "saline" groundwater underlying the Dry Lakes has been mapped on the basis of data from observation wells in the area, and is shown in Figure 2-3.

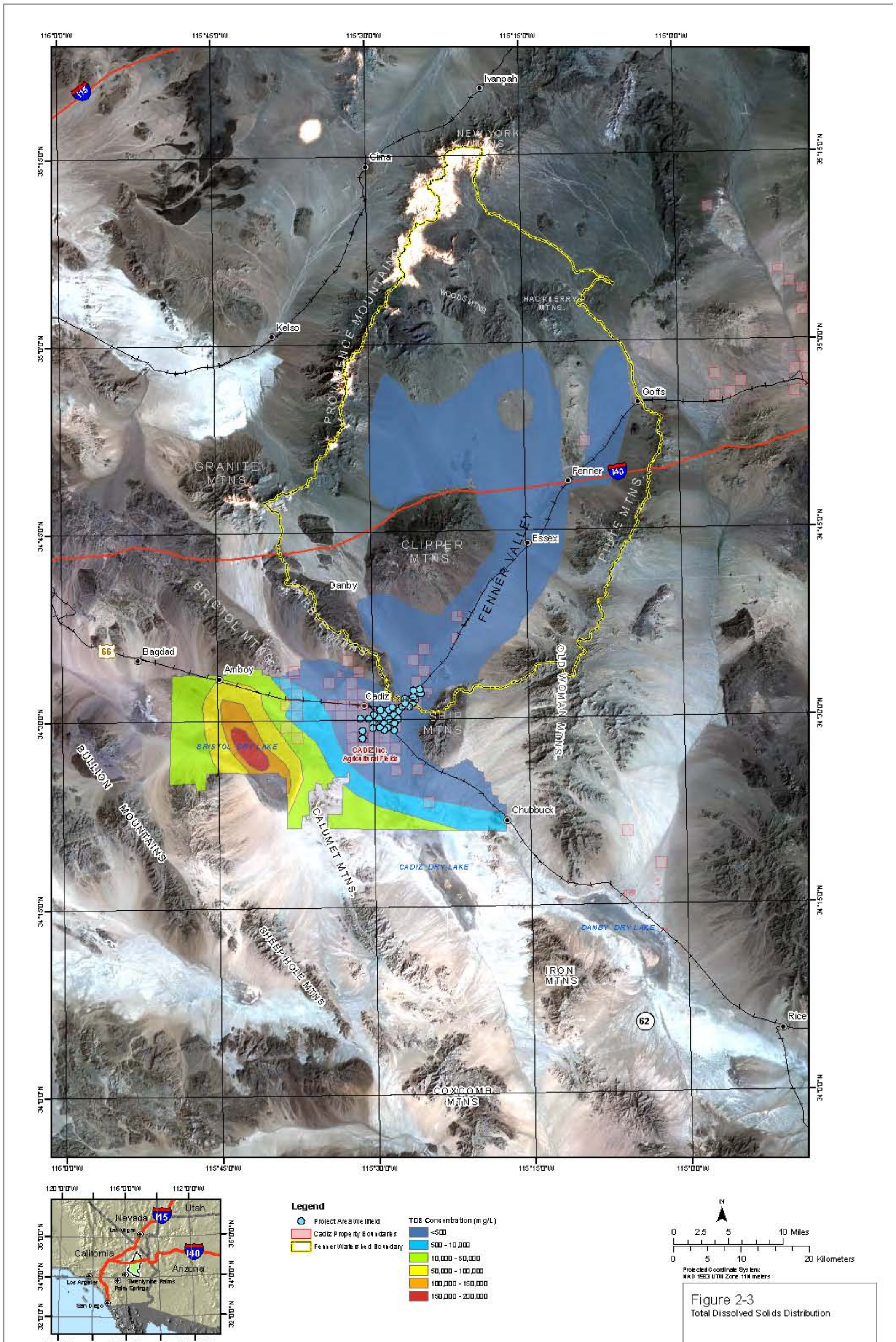


Figure 2-3
Total Dissolved Solids Distribution

2.7 Present Groundwater Production and Uses

Land use in the area consists primarily of desert conservation open space and agriculture, with limited chloride mining of the brine from the Dry Lakes and other mining, military uses, recreation, railroad, and electrical, gas, and oil utility corridors. Cadiz used, on average, 5,000 to 6,000 afy of groundwater between 1994 and 2007 for its agricultural operations. This annual usage was reduced beginning in 2007 in connection with the removal of approximately 500 acres of vineyard that had reached the end of its commercial life. Based on the current crop mix (lemons on 370 acres and grapes on 160 acres and seasonal row crops), the agricultural operations are using approximately 1800-1900 acre-feet of water per year. Another 1,070 acres are fallow and currently not irrigated.

There are also two existing salt mining operations at the Bristol and Cadiz Dry Lakes. These operations involve evaporation of the hyper-saline groundwater from the Dry Lakes to obtain remaining salts (calcium chloride and sodium chloride). One operation uses approximately 500 afy of the hyper-saline groundwater based upon recorded water extractions pursuant to California Water Code Section 4999 et seq., while it is estimated that the other operation, being approximately one-half of the size, uses approximately 250 afy for a total of 750 afy of hyper-saline groundwater.

CHAPTER 3
GROUNDWATER CONSERVATION

The Project is designed to operate consistent with California's constitutional requirement that all waters of the state not be wasted, but rather put to fullest beneficial use. By lowering water levels in the northern Bristol/Cadiz Sub-Basin, the Project will intercept natural recharge flowing through the Fenner Gap and from Orange Blossom Wash and, during Project pumping, reverse existing groundwater gradients and retrieve water stored in alluvial aquifers to the immediate southwest and southeast of the Fenner Gap back to the Project wellfield (Geoscience, September, 20 2011). Existing groundwater gradients cause water within these alluvial aquifers to flow towards the Bristol and Cadiz Dry Lakes, where it blends with brine beneath the Dry Lakes and ultimately evaporates. Thus, the Project's goal of lowering the water table will facilitate the recovery and conservation of this water before it is lost to the Dry Lakes where it evaporates.

This premise was studied and reported on in a technical memorandum issued by Project consultant Geoscience Support Services Inc. (Geoscience), titled Supplemental Assessment of Pumping Required for the Cadiz Valley Groundwater Conservation, Storage and Recovery Project, dated September 20, 2011. Geoscience used a variable density groundwater flow and transport model that it developed for the Project (see discussion of groundwater flow models in Chapter 4) to evaluate the savings of fresh groundwater as a result of the Project, water that would otherwise evaporate from the Dry Lakes absent the Project.

Table 3-1: Summary of Net Savings from Proposed Project Production (Average 50,000 afy/50 Years)

Natural Recharge	Time	Cumulative Reduction of Evaporative Losses [acre-feet]	Cumulative Depletion of Storage [acre-feet]	Fresh Groundwater Storage Impacted by Saline Migrations [acre-feet]	Cumulative Net Water Saving[8] from Project [acre-feet]
32,000 acre-ft/yr	At the End of 100 Years	2,210,000	220,000	173,000	1,871,000
	At the End of 50 years	1,360,000	1,090,000	177,000	93,0000
16,000 acre-ft/yr	At the End of 100 Years	1,544,000	870,000	215,000	459,000
	At the End of 50 Years	745,000	1,684,000	175,000	-1,114,000
5,000 acre-ft/yr	At the End of 100 Years	470,000	1,870,000	183,000	1,583,000
	At the End of 50 Years	221,000	2,155,000	126,000	-2,060,000

By lowering groundwater levels in the alluvial aquifers, the Project will also create space in the Sub-Basin to store imported water as part of the potential future water banking project use that may occur for the second phase of the Project. In sum, the

[8] Net water savings is derived from subtracting depletion of storage and amount of freshwater storage impaired by migration of saline water from the reduction of evaporative losses. The 100-year time frame assumes no Project pumping during years 51 through 100.

Project will capture natural recharge, optimize conservation by retrieving groundwater presently in storage before it can evaporate, allow for the carryover of native water in storage, and set the stage of a new water bank storage opportunity that does not presently exist. As explained below in Chapters 5 and 6, this Management Plan provides for comprehensive monitoring of potential significant adverse impacts to critical resources, together with a series of action criteria and potential corrective measures, to ensure that the Project does not cause significant adverse environmental impacts to critical resources or Undesirable Results.

CHAPTER 4
ASSESSMENTS OF POTENTIAL SIGNIFICANT ADVERSE IMPACTS TO CRITICAL RESOURCES IN OR ADJACENT TO THE PROJECT AREA

As discussed above, the objectives of this Management Plan are to ensure compliance with the County Groundwater Management Ordinance and MOU and avoid material adverse impacts to critical resources or Undesirable Results. This Management Plan addresses the following critical resources:

- The basin aquifers tapped by the Project;
- Brine resources of Bristol and Cadiz Dry Lakes;
- Springs within the Fenner Watershed including springs of the Mojave National Preserve and BLM-managed lands;
- Air quality in the Mojave Desert region;
- Project area vegetation; and
- Adjacent groundwater basins, including the Colorado River and its tributary sources of water.

This chapter takes a conservative approach in its technical analysis of the potential adverse impacts to these critical resources as a result of the Project operations.

4.1 Potential Significant Adverse Impacts to Critical Resources Related to Basin Aquifers

For the purposes of this Management Plan, the basin aquifers include aquifers of the Fenner, Bristol, and Cadiz Watersheds as described in Section 2.4. However, emphasis is placed on the aquifers in the vicinity of the northern Bristol/Cadiz Sub-Basin and Fenner Valley Watershed along with any aquifers that extend toward the Bristol and

Cadiz Dry Lakes where analysis has shown that Project operations may have an effect. Potential significant adverse impacts to critical resources within this area include:

- Decline of groundwater levels and storage that impairs identified critical resources or manifests other Undesirable Results;
- Impacts to wells owned by neighboring landowners (including wells operated in the larger Fenner Watershed area) due to Project operations;
- Land subsidence and loss of groundwater storage capacity due to groundwater withdrawal; and
- Induced flow of lower quality water from Bristol and Cadiz Dry Lakes.

Water resources models were developed and applied to assess these potential impacts. The specific models and their application are described below in Sections 4.1.1 and 4.1.2.

4.1.1 *Water Resources Modeling*

Water resources models developed during the pre-operational phase of the Project have been, and are planned to be, used to simulate the impacts of planned Project operations. These models include the INFIL3.0 soil-moisture budget model, MODFLOW-2000/MT3D groundwater flow and solute transport model, and SEAWAT-2000 model (note that selection of models may change subject to concurrence with the TRP, SMWD, and the County based on either updates to these models or availability of comparable models). The results of simulations using these models have been used to assess potential impacts during Project operations. Results of these simulations are used to identify monitoring features and conditions to be monitored and locations and frequency of monitoring during Project operations in order to verify these model projections. During Project operations, the results of monitoring will be used to evaluate whether any action criteria are triggered and to verify simulations. Evaluation of monitoring results could result in refinements to action criteria as well as identifying areas where collection of additional data may be needed to improve the monitoring network and accuracy of simulations. Any refinements to models that monitoring data indicate may be needed will be made in accordance with the decision-making process described in Chapters 6 and 8. The specific attributes of, and simulation results from, each of the models is discussed next.

4.1.1.1 INFIL3.0

INFIL3.0 is a grid-based, distributed–parameter, deterministic water-balance watershed model, released for public use by the USGS in 2008, which is used to estimate the areal and temporal net infiltration of precipitation below the root zone (USGS, 2008). This model was used to estimate potential recoverable water for the Project. The model is based on earlier versions of INFIL code that were developed by the USGS in cooperation with the Department of Energy to estimate net infiltration and groundwater recharge at the Yucca Mountain high-level nuclear-waste repository site in Nevada. Net infiltration is the downward movement of water that escapes below the root zone, is no longer affected by evapotranspiration, and is capable of percolating to and recharging groundwater. Net infiltration may originate as three sources: rainfall, snow melt, and surface water runon (runoff and streamflow). Application of INFIL3.0 to the Fenner and Orange Blossom Wash Watersheds produced long-term average annual natural recharge estimates of approximately 32,000 afy.

This model will be updated and refined during Project operations based on data obtained from the monitoring features.

4.1.1.2 MODFLOW-2000/MT3D - Groundwater Flow and Transport Model

Geoscience Support Services, Inc. (Geoscience) developed a numerical groundwater flow and solute transport simulation of a large portion of the larger watershed area, utilizing MODFLOW2000 and MT3D. This model provides the basis for developing the variable density model described in the next section. This model, along with other identified models in Section 4.1.1, will be updated and refined during Project operations based on monitoring data, and the monitoring network and action criteria refined during the Project. MODFLOW-2000 is a modular finite-difference flow model developed by the USGS to solve the groundwater flow equation.

The numerical groundwater flow and solute transport model was developed based on a conceptual model developed during the pre-operations stage incorporating the area of interest, aquifer systems, and boundary conditions. This conceptual model of hydrogeology and groundwater flow conditions in the larger watershed area will be further refined based upon a thorough analysis of the available hydrogeologic data for the modeled area, as additional information is collected from installation of the monitoring wells and extraction wells, and as monitoring data are compiled during the operations stage. The groundwater flow model will integrate quantities and distribution of recharge and discharge estimated from updates to INFIL3.0 and Project extractions. INFIL3.0 was released for public use by USGS in 2008.

4.1.1.3 Variable Density Groundwater Flow And Transport Model, Including Subsidence

A variable density flow and transport simulation utilizing SEAWAT-2000 Version 4 was also developed by Geoscience. SEAWAT-2000 Version 4 was developed by the USGS in 2008. This model simulates the transport of solute mass through a numerical solution of a mass balance equation involving fluid density, and was specifically designed to estimate the likely effects of Project operations on the projected saline/freshwater interface (northerly of the margins of the Dry Lakes). The single solute species, total dissolved solids (TDS) is transported conservatively (i.e., there is no absorption or any other losses of TDS) in the model. Sources and boundary conditions of solutes are specified as sources of salts, such as the Dry Lakes.

The model domain extends over the same area as the flow and solute transport model domain. The height and horizontal and vertical grid spacing was selected based on available data and the intended use of the model. These models include hydraulic conductivity, specific storage, effective porosity, and dispersion coefficients for each model element. Specified flux and chloride mass fraction was provided by the regional groundwater flow and solute transport model described previously.

In addition, in order to simulate subsidence potential, the variable density flow and transport model was augmented by incorporating the Subsidence and Aquifer-System Compaction (SUB) Package (Hoffmann, et. al, 2003). The SUB Package is used in conjunction with SEAWAT-2000 to simulate the elastic (recoverable) compaction and expansion and inelastic (permanent) compaction of compressible fine-grained beds (interbeds) within the aquifers. The deformation of interbeds is caused by changes in effective stress as a result of groundwater level changes. If the stress is less than the preconsolidation stress of the sediments, the deformation is elastic (i.e., recoverable). If the stress is greater than the preconsolidation stress, the deformation is inelastic (i.e., permanent).

If necessary, this model will be updated and refined during Project operations based on data obtained from the monitoring features.

4.1.2 *Application of Water Resources Models*

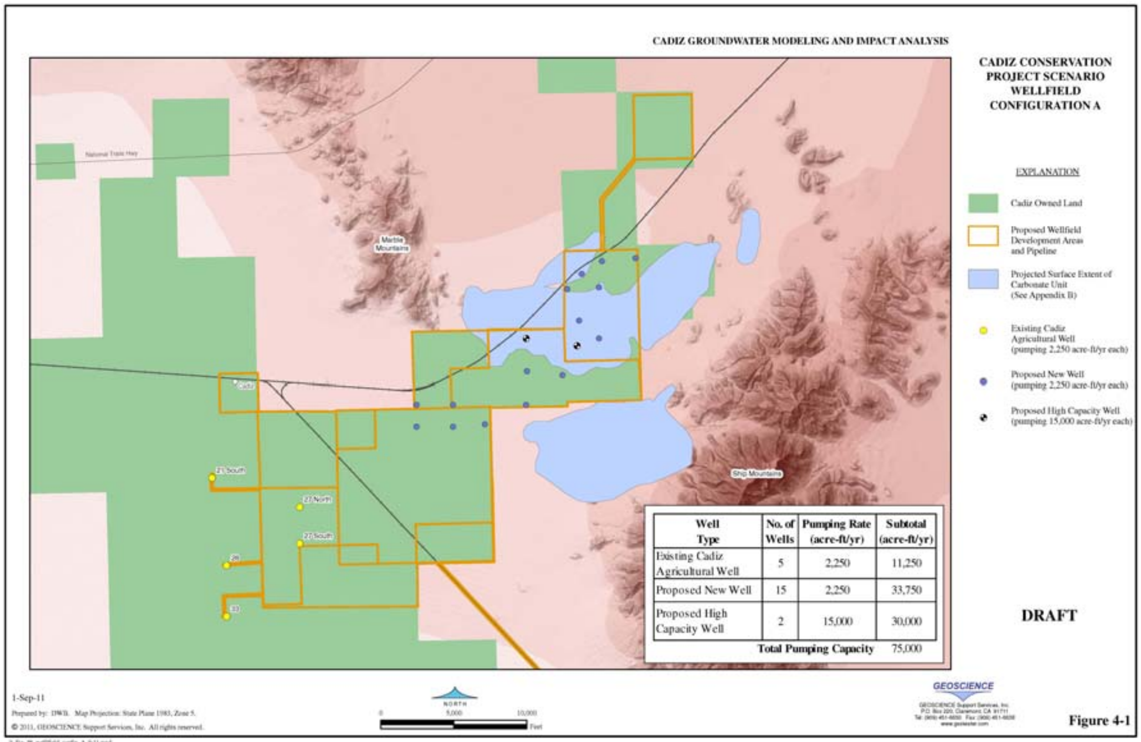
Building on prior technical investigations of area groundwater resources, geologic mapping, and recent exploratory drilling and testing, Geoscience developed a three-dimensional variable density groundwater flow and solute transport model of a portion of the total watershed area tributary to the Fenner, Bristol, and Cadiz Valleys to simulate the operation of the proposed wellfield and its effects on groundwater levels, groundwater in storage, the freshwater/saltwater interface near the Dry Lakes, and potential land subsidence. The results of Geoscience's investigation and modeling are set forth in its report titled Cadiz Groundwater Modeling and Impact Analysis, dated September 1, 2011.

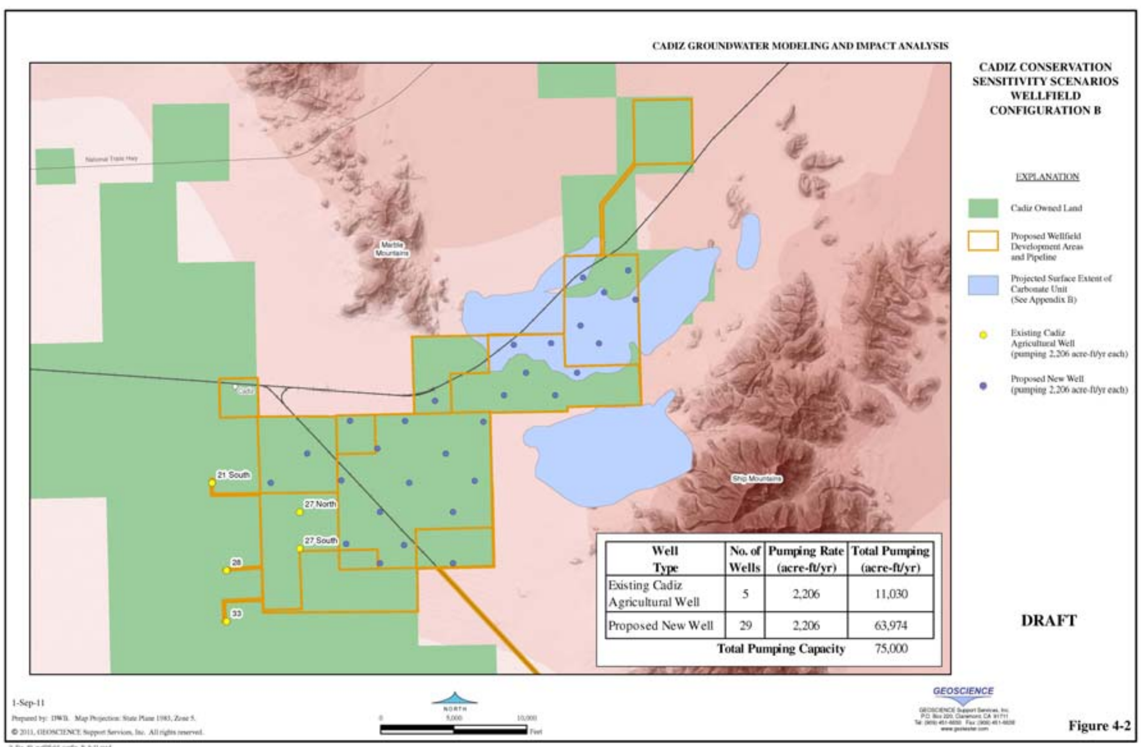
Geoscience's groundwater model consists of a six-layer variable density flow and solute transport model constructed to simulate the groundwater conditions that underlie Fenner Valley, Fenner Gap, and a portion of the Bristol and Cadiz Dry Lakes. Recent geologic mapping, interpretive geologic cross-sections, and lithologic logs from exploratory borings and water wells, along with geologic and hydrologic data available in the literature, are used to develop the six model layers. The model layers consist of the following:

- Layer 1 - Upper Alluvium
- Layer 2 - Alluvium beneath the Upper Alluvium to a depth of approximately 1,200 ft
- Layer 3 - Alluvium beneath a depth of 1,200 ft
- Layer 4 - Fanglomerate, carbonate, lower Paleozoic sequence, and weathered granitic rocks
- Layer 5 - Carbonate, lower Paleozoic sequence, and weathered granitic rocks
- Layer 6 - A Detachment Fault Zone (approximately 200 ft thick) in the Fenner Gap area and weathered granitic rocks.

(Geoscience, September 1, 2011).

Geoscience simulated two wellfield configurations as shown in Figures 4-1 and 4-2. The first simulation (Configuration A) modeled a wellfield configuration of two large-capacity wells in the carbonate units encountered in the Fenner Gap area, which results in a more tightly clustered wellfield in the Fenner Gap area. The second simulation (Configuration B) assumed a more dispersed wellfield with pumping more evenly distributed among the wells.





The groundwater model developed by Geoscience assumed horizontal groundwater flow through each model layer, with vertical leakage providing hydraulic connection between the layers. The model accounted for both natural and artificial recharge, as well as discharge via evaporation at the Dry Lakes and agricultural pumping. Geoscience applied the industry standard "history matching" technique to both steady state and transient calibration. For each calibration run, the relative error was 0.15 percent for the steady-state model and 1.7 percent for the transient model, both well below the recommended relative error of 10 percent.

Geoscience simulated three recharge scenarios, including 5,000 afy, 16,000 afy, and 32,000 afy to assess effects on groundwater levels, the movement of the freshwater/saltwater interface near the Dry Lakes, and land subsidence. The 32,000 afy recharge scenario is based on USGS INFIL3.0 modeling of the soil-moisture water budget for the Fenner and Orange Blossom Wash Watershed areas. Geoscience simulated this large range in long-term average annual recharge by reducing the projected recharge by 50 percent (16,000 afy) and then to an amount that is generally equivalent to Cadiz historical agricultural pumping (5,000 afy) in order to increase the conservatism of the analysis (identify potential worst-case impacts).

After the model was calibrated, Geoscience simulated 100-year predictive runs for each of the three ranges of recharge scenarios, including 32,000 afy, 16,000 afy, and 5,000 afy. The Project Scenario assumed 32,000 afy of natural recharge and a Project wellfield clustered around Fenner Gap (Configuration A). The 32,000 afy recharge scenario was based on USGS INFIL3.0 modeling of the soil-moisture water budget for the Fenner and Orange Blossom Wash Watersheds. The two Sensitivity Scenarios, which assumed less natural recharge and a Project wellfield spread out from the Fenner Gap (Configuration B), allowed Geoscience to evaluate the potential range of worst-case impacts on groundwater levels, migration of the saline-freshwater interface, and subsidence. Configuration A was utilized for the Project Scenario to account for higher transmissivity values allowing for use of fewer high capacity wells installed in the carbonate aquifer with less drawdown than comparable wells in the alluvial aquifer. Configuration B was used under the two Sensitivity Scenarios due to lower transmissivity values and the corresponding need for a greater number of wells spread out over the wellfield to limit drawdown. The model scenarios and assumptions used in each are summarized in Table 4-1.

TABLE 4-1: GEOSCIENCE GROUNDWATER MODEL ASSUMPTIONS

Model Scenario	Model Assumptions			
	Natural Recharge (afy)	Wellfield Configuration	Groundwater Pumping Years 1 to 50 (afy)	Groundwater Pumping Years 50 to 100 (afy)
Project Scenario	32,000	Configuration A	50,000	0
Sensitivity Scenario 1	16,000	Configuration B	50,000	0
Sensitivity Scenario 2	5,000	Configuration B	50,000	0

4.1.2.2 Project Impact Findings from Groundwater Flow Model

Based on the results of its groundwater model, Geoscience made the determinations about the impact of the Project discussed in this section below. As the Project is implemented, data will be obtained from drilling and testing of Project production and monitoring wells, and monitoring data will be obtained as a part of the monitoring plan described in Chapter 5. As data are obtained, these water resources models will be periodically updated, at minimum annually during development of the Project, to continuously assess effects on critical resources and, if necessary, to revise the monitoring program, action triggers, and mitigation responses as described in Chapter 6.

4.1.2.3 Groundwater Elevations

Table 4-2 below shows the change in groundwater elevations at the end of Year 50 under each model-calculated scenario. The lowest groundwater levels (i.e., greatest impact) would occur at the center of the Project wellfield. The pumping would create a cone of depression and groundwater would flow toward the proposed wellfield from Fenner, Bristol, and Cadiz Valleys. At the end of 100 years, groundwater levels in the wellfield approach pre-Project levels for the Project scenario (full recovery in Year 117 or 67 years after cessation of pumping) (Geoscience, September 1, 2011). For the two scenarios simulating lower recharge values, the water table would return to pre-pumping levels with most of the recovery occurring near the wellfield within the first 10 years and full recovery to pre-Project levels to occur approximately 100 to almost 400 years after pumping stops. The groundwater flow model simulations show that groundwater levels are drawn down to effect capture of water that would otherwise evaporate to the Dry Lakes, and then groundwater levels recover upon cessation of pumping after Year 50. During the 50-year span of the Project, the groundwater flow model simulations show that the Project's operation will cause a decline of groundwater levels.

TABLE 4-2: GROUNDWATER DRAWDOWN IMPACTS

Model Scenario	End of 50 Years (End of Project Pumping)		End of 100 Years (End of Model Simulation or 50 Years After Pumping Stops)	
	Drawdown at Wellfield (feet)	**Drawdown at Bristol Dry Lake (feet)**	**Drawdown at Wellfield (feet)**	**Drawdown at Bristol Dry Lake (feet)**
Project Scenario	70 – 80	10 – 30	0 – 10	10 – 20
Sensitivity Scenario 1	120 – 130	10 – 60	10 – 20	30 – 40
Sensitivity Scenario 2	260 – 270	0 – 80	50 – 60	10 – 70

Figures 4-3 through 4-8 show groundwater-level drawdown for those various recharge scenarios simulated, both at the end of 50 years of pumping and then for the 50 years following the cessation of Project pumping (for a total of simulated period of 100 years). Groundwater-level drawdown decreases northward into Fenner Valley, such that drawdown effects near Danby decrease to about 15 feet, and at Interstate 40 (and certainly at Goffs) are negligible.

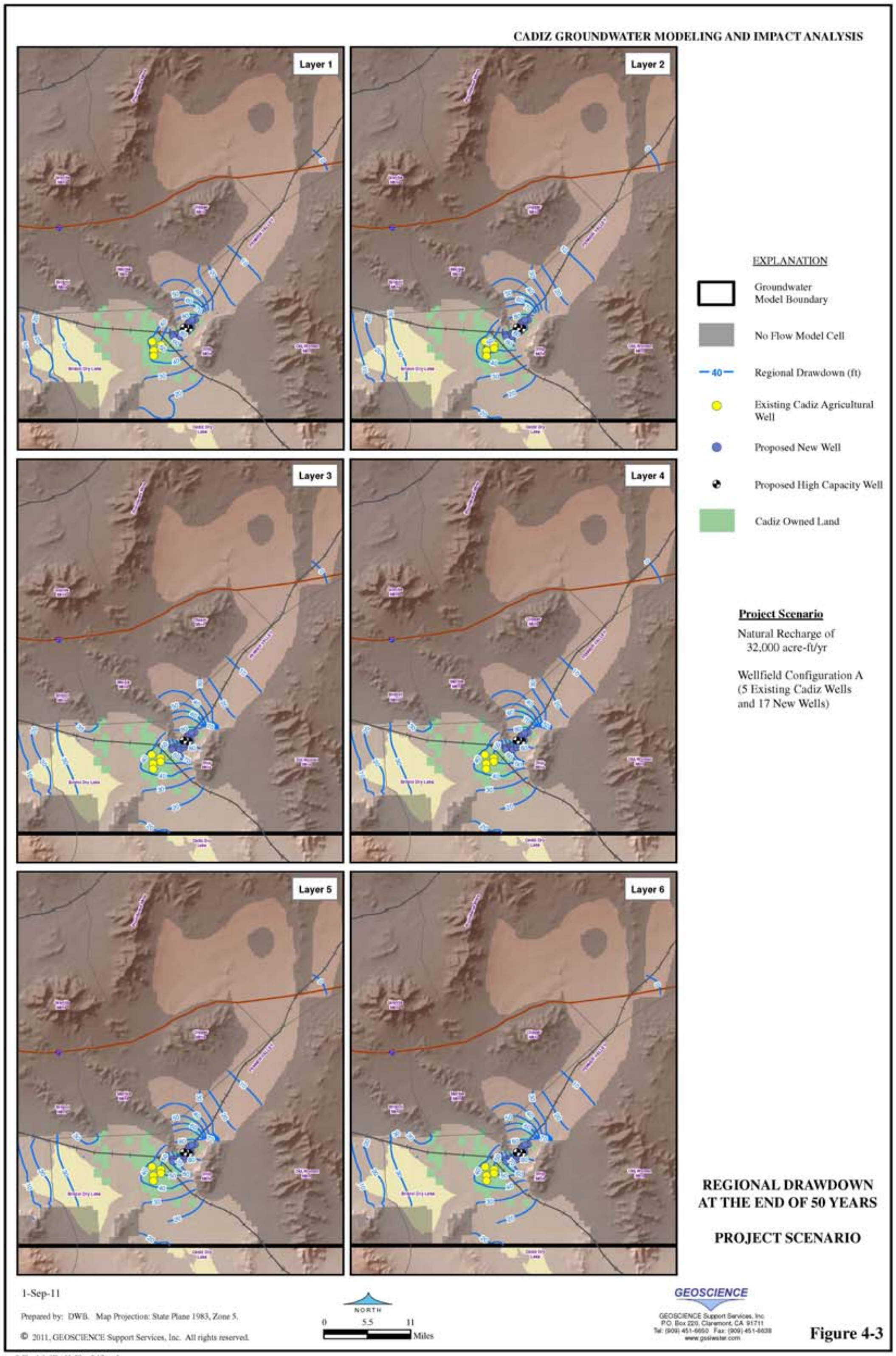
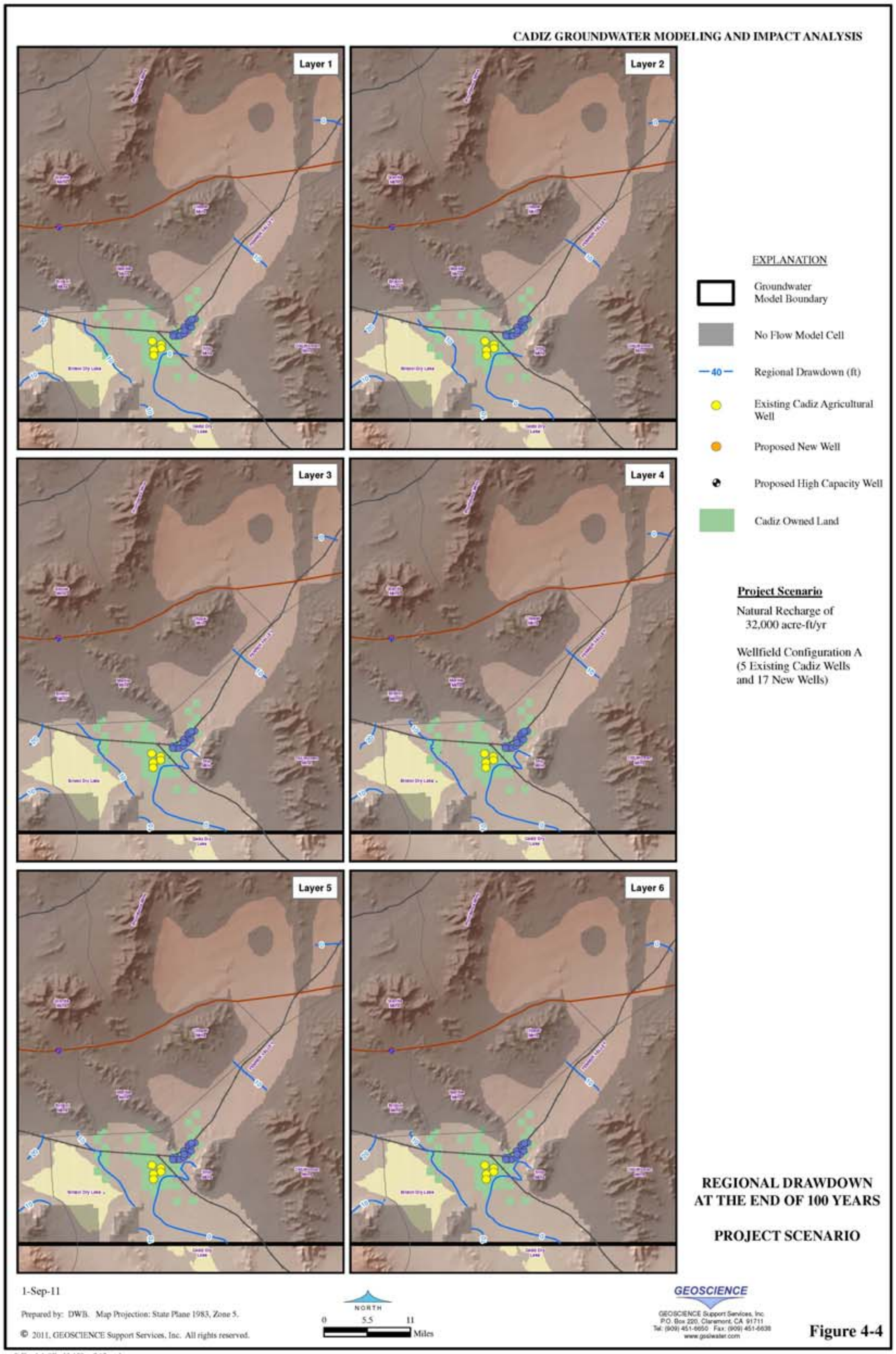
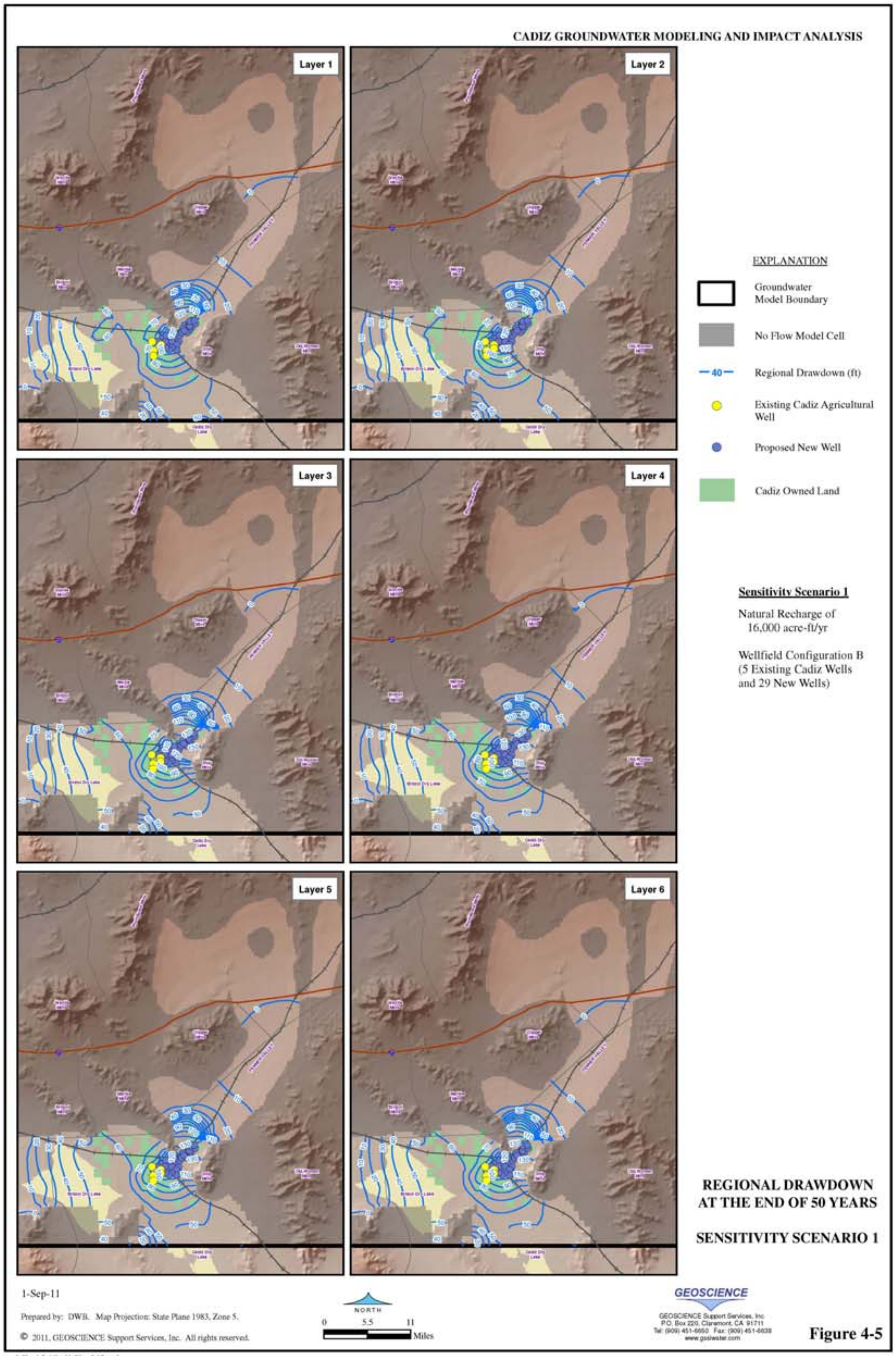
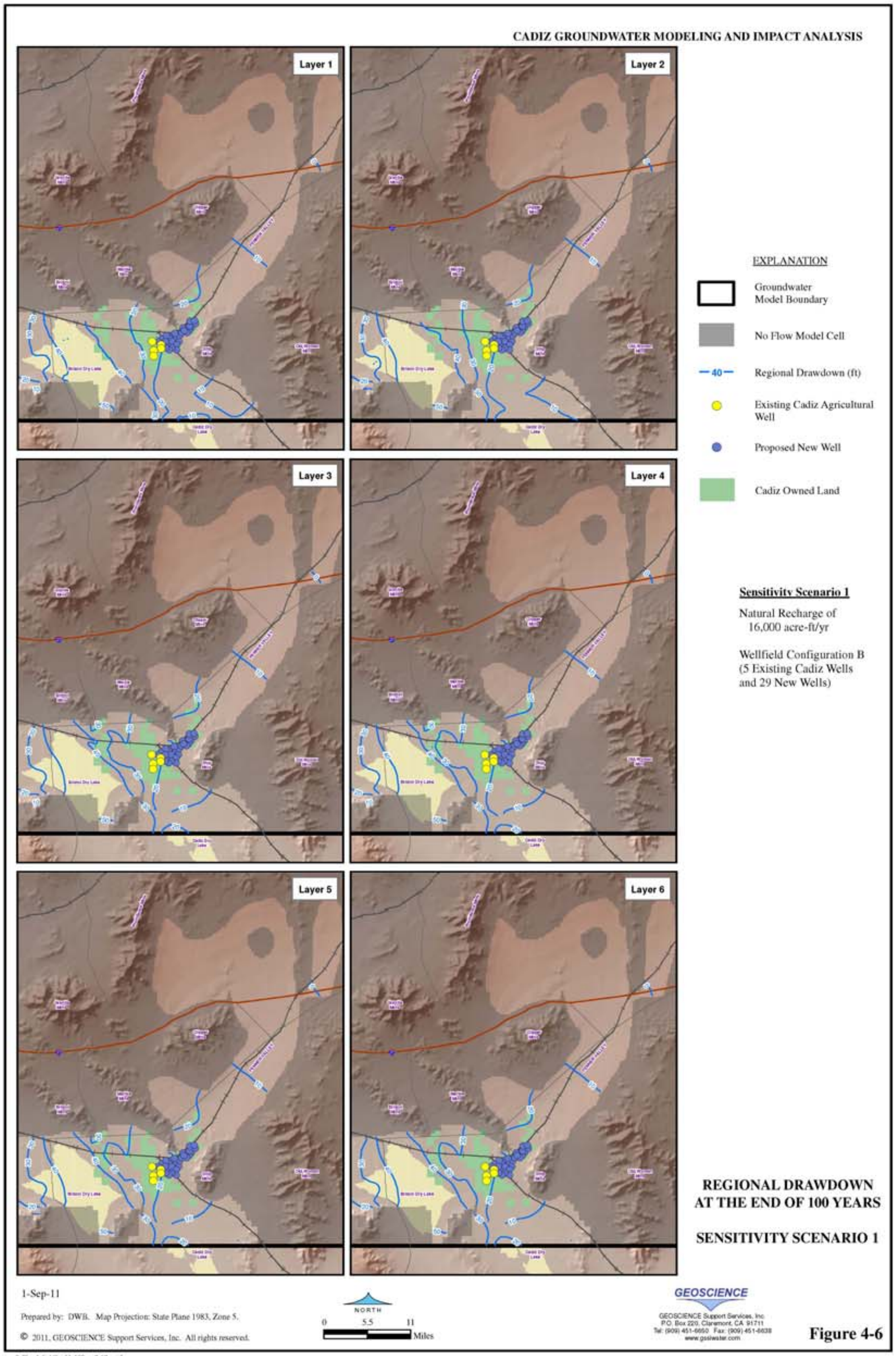


Figure 4-3

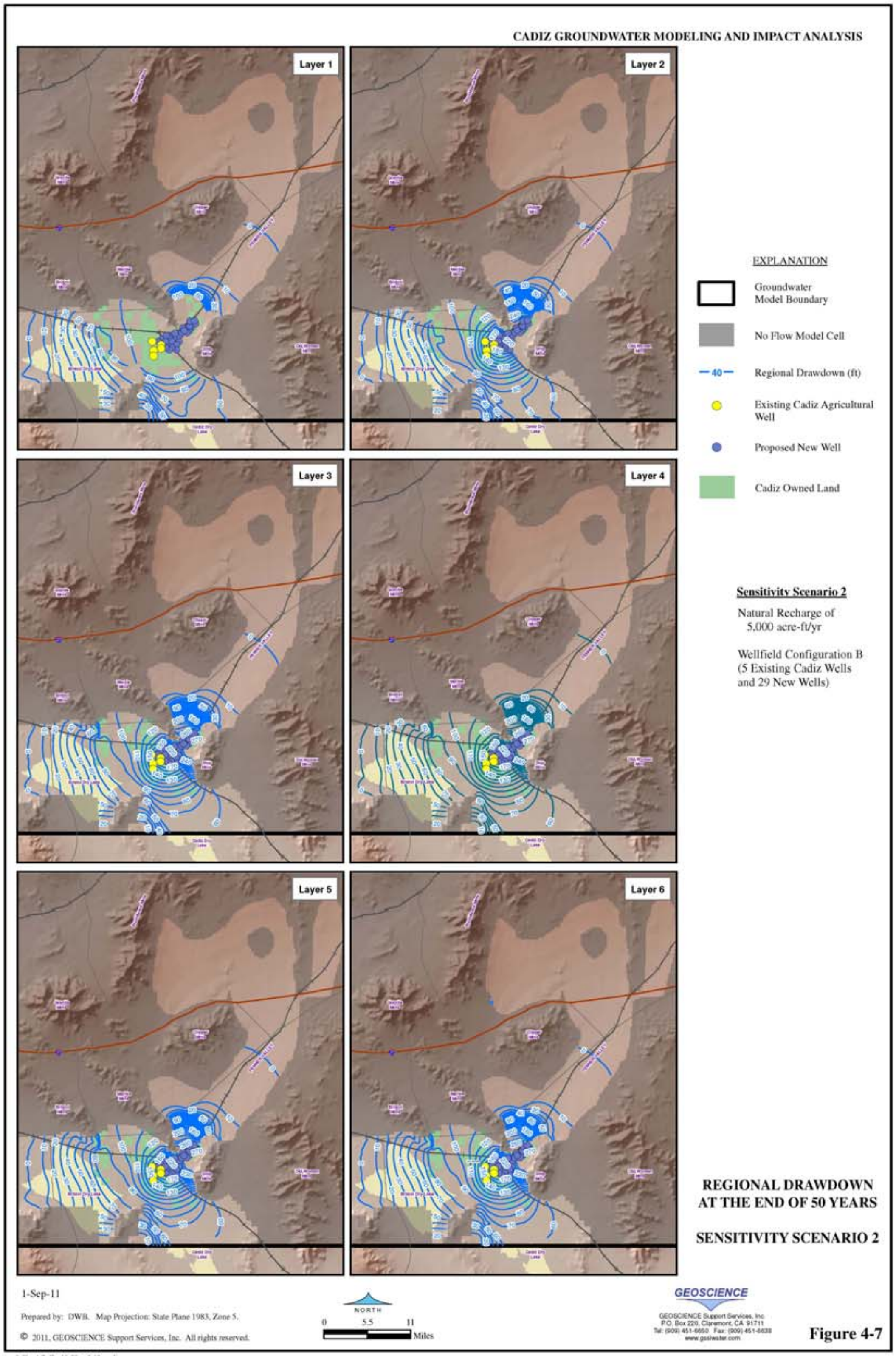
0_Fig_4-3_32k_dd_50yr_2-12.mxd


CADIZ GROUNDWATER MODELING AND IMPACT ANALYSIS
Layer 1
Layer 2
Layer 3
Layer 4
Layer 5
Layer 6
EXPLANATION
Groundwater Model Boundary
No Flow Model Cell
40
Regional Drawdown (ft)
Existing Cadiz Agricultural Well
Proposed New Well
Proposed High Capacity Well
Cadiz Owned Land
Project Scenario
Natural Recharge of 32,000 acre-ft/yr
Wellfield Configuration A (5 Existing Cadiz Wells and 17 New Wells)
REGIONAL DRAWDOWN AT THE END OF 100 YEARS
PROJECT SCENARIO
1-Sep-11
Prepared by: DWB. Map Projection: State Plane 1983, Zone 5.
© 2011, GEOSCIENCE Support Services, Inc. All rights reserved.
NORTH
0
5.5
11
Miles
GEOSCIENCE
Figure 4-4

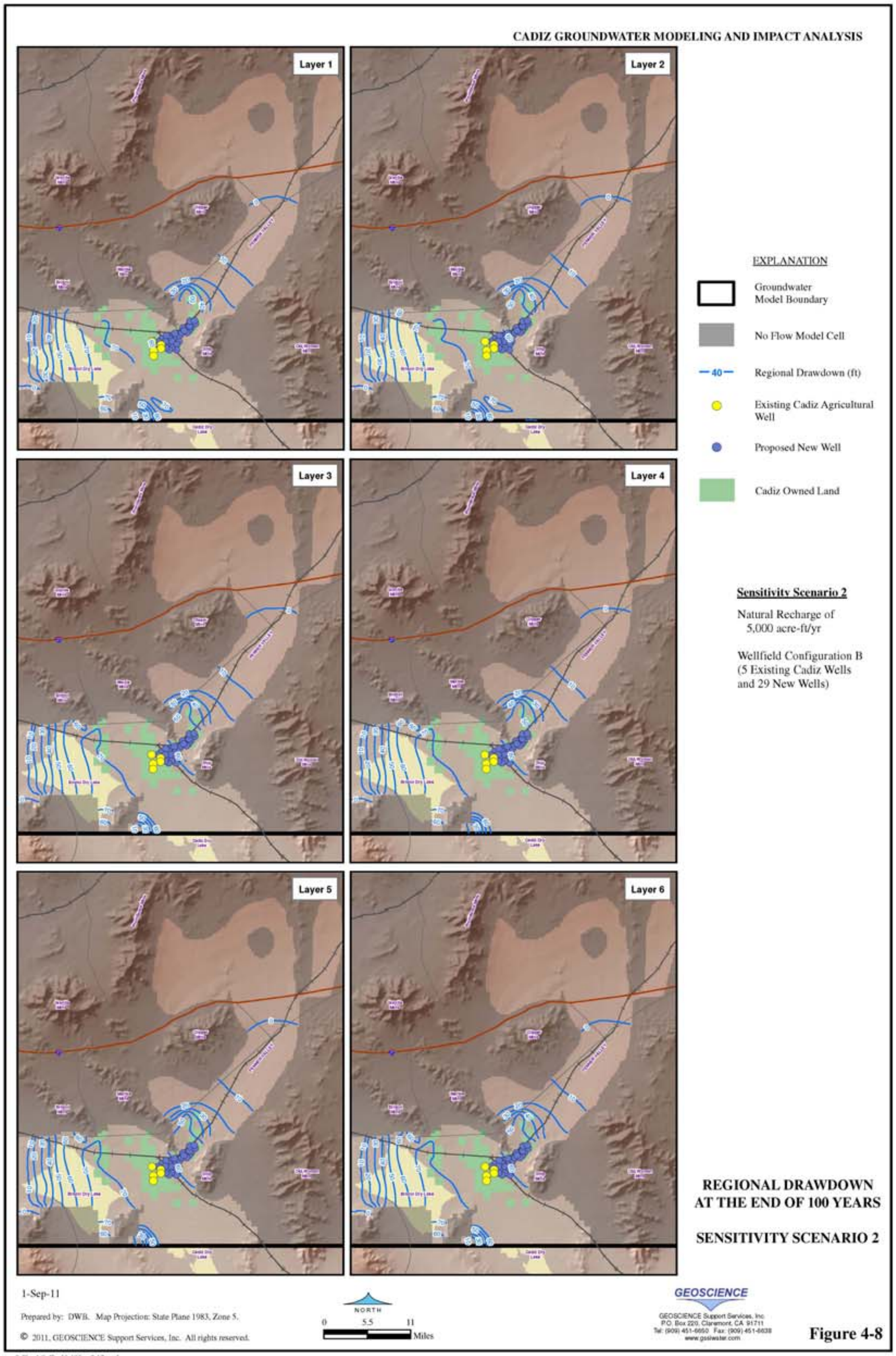

CADIZ GROUNDWATER MODELING AND IMPACT ANALYSIS
Layer 1
Layer 2
Layer 3
Layer 4
Layer 5
Layer 6
EXPLANATION
Groundwater Model Boundary
No Flow Model Cell
40
Regional Drawdown (ft)
Existing Cadiz Agricultural Well
Proposed New Well
Cadiz Owned Land
Sensitivity Scenario 1
Natural Recharge of 16,000 acre-ft/yr
Wellfield Configuration B (5 Existing Cadiz Wells and 29 New Wells)
REGIONAL DRAWDOWN AT THE END OF 50 YEARS
SENSITIVITY SCENARIO 1
1-Sep-11
Prepared by: DWB. Map Projection: State Plane 1983, Zone 5.
© 2011, GEOSCIENCE Support Services, Inc. All rights reserved.
NORTH
0 5.5 11
Miles
GEOSCIENCE
Figure 4-5



0_Fig_4-6_16k_dd_100yr_2-12.mxd



0_Fig_4-7_5k_dd_50yr_2-12.mxd


CADIZ GROUNDWATER MODELING AND IMPACT ANALYSIS
Layer 1
Layer 2
Layer 3
Layer 4
Layer 5
Layer 6
EXPLANATION
Groundwater Model Boundary
No Flow Model Cell
40
Regional Drawdown (ft)
Existing Cadiz Agricultural Well
Proposed New Well
Cadiz Owned Land
Sensitivity Scenario 2
Natural Recharge of 5,000 acre-ft/yr
Wellfield Configuration B (5 Existing Cadiz Wells and 29 New Wells)
REGIONAL DRAWDOWN AT THE END OF 100 YEARS
SENSITIVITY SCENARIO 2
1-Sep-11
Prepared by: DWB. Map Projection: State Plane 1983, Zone 5.
© 2011, GEOSCIENCE Support Services, Inc. All rights reserved.
NORTH
0
5.5
11
Miles
GEOSCIENCE
Figure 4-8
0_Fig_4-8_5k_dd_100yr_2-12.mxd

4.1.2.4 Depth to Groundwater

Table 4-3 shows the predicted depth to groundwater during the 50-year and 100-year model simulation period at selected locations including the center of the Project wellfield, the existing Cadiz Inc. wells, the edge of the Bristol Dry Lake, the center of Bristol Dry Lake, and the edge of Cadiz Dry Lake (Geoscience, September 1, 2011). Groundwater levels decline during the limited term of the Project (50 years) to satisfy the Project's intended goal of capturing groundwater that is flowing to the Dry Lakes.

Pursuant to the MOU, the parties agreed to work in good faith to (i) identify the groundwater levels that will serve as monitoring targets and a "floor" for the maximum groundwater drawdown level in the Project wellfield, and (ii) establish a Projected rate of decline in the groundwater table. The floor and rate of decline are to be designed to help assess trends and operate the Project in a manner that avoids Undesirable Results or other potential significant adverse impacts to critical resources enumerated in the MOU (including saline water migration).

TABLE 4-3: GROUNDWATER MODEL DEPTH IMPACTS

Location	Time	Depth to Groundwater (feet)			
		Existing	Project Scenario	Sensitivity Scenario 1	Sensitivity Scenario 2
Center of Wellfield	End of 50 Years	354	435	486	627
	End of 100 Years		351	371	412
Existing Cadiz Inc. Wells	End of 50 Years	156	197	241	315
	End of 100 Years		154	181	219
Edge of Bristol Dry Lake	End of 50 Years	33	68	95	118
	End of 100 Years		42	74	108
Center of Bristol Dry Lake	End of 50 Years	18	50	63	54
	End of 100 Years		33	62	79
Edge of Cadiz Dry Lake	End of 50 Years	7	21	59	72
	End of 100 Years		10	17	68

4.1.2.5 Saline-Freshwater Interface

Geoscience used the SEAWAT-2000 variable density groundwater flow and solute transport model to predict the movement of the saline-freshwater interface as a result of Project pumping. The location of the current saline-freshwater interface is defined by the location of the 1,000 mg/L total dissolved solids (TDS) concentration contour, which is based on groundwater quality data from historical data from wells in the area.

Results of the modeling indicate that the saline-freshwater interface in the Bristol Dry Lake area would move up to 10,400 feet northeast during Years 1 to 50 under the Project Scenario, up to 9,700 feet under Sensitivity Scenario 1, and up to 6,300 feet under Sensitivity Scenario 2. During years 50 to 100, after Project pumping has ceased and without any physical measures to impede migration, the saline-freshwater interface would continue to move northeast, reaching a total distance of 11,500 feet, 11,100 feet, and 9,200 feet under the Project Scenario, Sensitivity Scenario 1, and Sensitivity Scenario 2, respectively. Table 4-4 summarizes the maximum migration distance of the saline-freshwater boundary (Geoscience, September 1, 2011). As a precautionary measure to limit the migration of hyper-saline groundwater and protect the health of the aquifer under the County Ordinance, the saline-freshwater boundary shall be monitored and its migration limited to 6,000 ft northeast of the Dry Lakes through physical measures (e.g., injection or extraction wells) or pumping restrictions if physical measures prove ineffective.

TABLE 4-4: SALINE/FRESHWATER BOUNDARY MIGRATION

Model Scenario	Maximum Migration of Saline-Freshwater Boundary at Year 50	Maximum Migration of Saline-Freshwater Boundary at Year 100
Project Scenario	10,400 ft Northeast	11,500 ft Northeast
Sensitivity Scenario 1	9,700 ft Northeast	11,100 ft Northeast
Sensitivity Scenario 2	6,300 ft Northeast	9,200 ft Northeast

4.1.2.6 Groundwater in Storage

Based on its groundwater model, Geoscience determined that the cumulative annual change in groundwater storage would reach a maximum of -1,090,000 acre-feet (a negative sign represents a decline in groundwater storage) in Year 50 under the Project Scenario conditions. This change in storage reflects ongoing evaporation from the Dry Lakes of approximately 244,000 acre-feet and about 33,000 acre-feet of water contributed from interbed storage ("squeezing" of water out of fine-grained units, which results in the compaction as discussed below), thus resulting in an additional net loss of about 211,000 acre-feet of groundwater storage during the initial 50 years, in addition to pumping beyond the natural recharge rate. This decline in storage is approximately 3 percent to 6 percent of the total groundwater in storage in the entire watershed area, which is estimated to be 17 to 34 million acre-feet. Upon cessation of pumping after Year 50, groundwater in storage would begin to recover and the cumulative annual change in groundwater storage would be approximately -220,000 acre-feet in Year 100 under the Project Scenario. Evaporative losses to the Dry Lakes accelerate through time as groundwater levels recover between Years 50 and 100. Based on the rate of recovery projected for Years 51 to 100, the groundwater in storage would fully recover in Year 117 (67 years after Project pumping stopped). The contribution of water from interbed storage increases and the losses due to evaporation from the Dry Lakes decreases in the sensitivity scenarios, thereby resulting in conservation benefits. Table 4-5 summarizes the cumulative annual changes in groundwater storage as calculated from Geoscience's model simulations of the three scenarios (Geoscience, September 1, 2011). The Project's operation establishes drawdown in groundwater levels for the purposes of capturing water that would otherwise discharge to the Dry Lakes and evaporate.

TABLE 4-5: REDUCTION IN ALLUVIAL GROUNDWATER IN STORAGE

Model Scenario	Cumulative Annual Changes in Groundwater Storage at Year 50		Cumulative Annual Changes in Groundwater Storage at Year 100		Time to Full Recovery after Pumping Ceases in Year 50
	Volume (acre-feet)	% of Total Groundwater Storage	Volume (acre-feet)	% of Total Groundwater Storage	
Project Scenario	-1,090,000	3% - 6%	-220,000	1%	67 (year 117)
Sensitivity Scenario 1	-1,680,000	5% - 10%	-870,000	3% - 5%	103 (year 153)
Sensitivity Scenario 2	-2,160,000	6% - 13%	-1,870,000	6% - 11%	390 (year 440)

4.1.2.7 Potential Land Subsidence

Because the Project involves a lowering of groundwater levels as discussed above in Chapter 3, potential land subsidence is a concern that must be evaluated and monitored. In general, the potential for land subsidence corresponds to the magnitude of groundwater level decline and the thickness of the fine-grained layers in the aquifer. Based on the results of the Geoscience groundwater model, any predicted subsidence would occur gradually and be dispersed laterally over a large area from the Fenner Gap to the Bristol and Cadiz Dry Lakes. Table 4-6 summarizes the model-predicted land subsidence over time at selected locations including the center of the wellfield, existing Cadiz wells, the edge of Bristol Dry Lake, the center of Bristol Dry Lake, and the edge of Cadiz Dry Lake (Geoscience, September 1, 2011). This degree of potential land subsidence is not expected to significantly impact the alluvial aquifer's storage capacity because consolidation of the aquifer will occur in clay and silt intervals, which do not contribute to the useable storage capacity. Potential subsidence in the range projected is also unlikely to harm any surface structures (for example, subsidence is not expected to exceed thresholds established for railroad tracks by the Federal Railroad

Administration Track Safety Standards Compliance Manual, April 1, 2007). This Management Plan provides in Chapter 6 monitoring and action criteria triggers and corrective actions that may be taken in response to the triggering of those action criteria in order to prevent significant adverse impacts to critical resources or the occurrence of Undesirable Results (including progressive subsidence).

TABLE 4-6: MAXIMUM POTENTIAL LAND SUBSIDENCE

Location	Time	Maximum Potential Land Subsidence (feet)		
		Project Scenario	Sensitivity Scenario 1	Sensitivity Scenario 2
Center of Wellfield	End of 50 Years	0.2	0.4	0.7
	End of 100 Years	0.2	0.4	0.7
Existing Cadiz Wells	End of 50 Years	0.6	1.0	1.5
	End of 100 Years	0.6	1.0	1.5
Edge of Bristol Dry Lake	End of 50 Years	0.5	1.0	1.4
	End of 100 Years	0.5	1.0	1.7
Center of Bristol Dry Lake	End of 50 Years	0.9	1.7	1.2
	End of 100 Years	0.9	2.1	2.7
Edge of Cadiz Dry Lake	End of 50 Years	0.1	0.4	0.5
	End of 100 Years	0.1	0.4	0.6

4.2 Potential Significant Adverse Impacts to Critical Resources: Springs Within the Fenner Watershed

As discussed in the EIR, a potential adverse environmental impact that, depending on physical conditions, can result from the lowering of regional groundwater levels is the cessation or reduction of flow from area springs. Native springs are present in the vicinity of the Project within the Fenner Watershed, as shown in Figure 4-9 (CH2M Hill, August 2011). These springs support habitat of the desert environment, and some are located within the Mojave National Preserve and BLM-managed lands. However, for the reasons discussed below, the EIR concluded that the lowering of groundwater levels with the proposed Project would not impact the flow from Fenner Watershed springs.

The springs closest to the proposed Project extraction wellfield are located in the adjacent mountains and include: Bonanza Spring, Hummingbird Spring, and Chuckwalla Spring in the Clipper Mountains to the north; Willow Spring, Honeymoon Spring, Barrel Spring, and Fenner Spring in the Old Woman and Piute Mountains on the east; and Van Winkle Spring, Dripping Spring, Unnamed-17BS1, Unnamed-17GS1, Granite Cove Spring, Cove Spring, and BLM-1 and BLM-2 springs at the Southern End of the Providence Mountains. (*Id.*) The Bonanza Spring in the Clipper Mountains, which is the closest spring to the proposed extraction wellfield, is over 11 miles from the center of the Fenner Gap. (*Id.*) All Fenner Watershed springs, including Bonanza Spring, are located in crystalline hard rock formations substantially higher in elevation than the alluvial aquifer. (*Id.*)

CH2M HILL was retained to evaluate the potential that the lowering of groundwater levels, as proposed by the Project, could impact the flow from Fenner Watershed springs. The results of CH2M HILL's analysis are set forth in a report titled "Assessment of Effects of the Cadiz Groundwater Conservation Recovery and Storage Project Operations on Springs," dated August 3, 2011. CH2M HILL reviewed the groundwater flow modeling results reported by Geoscience (Geoscience, September 1, 2011), and developed two conceptual models of the Bonanza Spring, which was chosen as an appropriate indicator spring of all springs in the Fenner Watershed because it is the closest spring to the Project's proposed wellfield, and thus would be the most likely to experience any effect from the Project.

In the first conceptual model (Concept-1), the model assumes that there is no physical connection of the springs to a regional groundwater table. This model is based on the absence of data of a physical connection of the springs to a regional groundwater table, the elevation differences between the groundwater in the alluvial aquifer and elevation of the springs, and the distance between the saturated alluvial aquifer and springs. Under this conceptual model, the spring is fed by upstream fracture flows that are not hydraulically connected to the regional water table, and thus flow rates at the spring are independent of groundwater levels in the alluvium, and no impacts would occur to the spring as a result of Project operations.

Although there has been no data developed to date that demonstrates a direct hydraulic connection between the springs and a regional groundwater table, the second conceptual model (Concept-2) hypothetically assumed that such a connection exists to address any outstanding uncertainty. A simple numerical groundwater flow model was developed for this conceptual model to evaluate potential impacts under Concept-2, where hydraulic continuity is assumed and the regional water table forms the source of water to the springs. The model was a simple representation of a generic mountain system with similar characteristics to the Clipper Mountains, and was intended to evaluate the general response of a water table in fractured bedrock of mountains under various assumptions that are specific to the Bonanza Spring hydrogeologic conditions. The results of the Concept-2 model suggest that a ten-foot decline in groundwater levels in the alluvium adjacent to the bedrock of Bonanza Spring (an assumption derived from simulations by Geoscience discussed above) could result in about one foot of drawdown at the springs after 50 years and six to seven feet of drawdown at the springs after hundreds of years and assuming that the decline in the adjacent alluvial aquifer was maintained at ten feet of drawdown indefinitely. For example, CH2M HILL explains that after about 50 years, the drawdown would be about 10 percent of the potential maximum drawdown in the alluvial aquifer. Similarly, after about 100 years, the drawdown would be about 25 percent of the potential maximum drawdown in the alluvial aquifer. In addition, it is possible that, depending on how muted the water table response is to annual changes in precipitation, natural fluctuations of groundwater levels at the spring due to climate variability could be of a similar order of magnitude to potential Project-induced drawdown at the springs.

CH2M HILL further determined, under CEQA, that potential impacts to other springs in the southern part of Fenner Watershed are expected to be less than significant and even more remote than hypothetical potential impacts on the Bonanza Spring because those springs are at higher elevations and greater distances from the adjacent alluvial aquifer compared to Bonanza Spring. Consequently, CH2M HILL determined that any Project effect on other springs in the Fenner Watershed, assuming hydraulic continuity, should be less than significant.

In sum, because of the distance, change in elevation, and lack of hydraulic connection between the fractured crystalline bedrock and groundwater feeding the Fenner Watershed springs and the alluvial groundwater developed by the Project, there is no anticipated impact of the Project on Fenner Watershed springs. Hypothetically assuming that a hydraulic connection exists (as CH2M HILL modeled in Concept-2), impacts would be less than significant. Nonetheless, consistent with the recommendations of the Groundwater Stewardship Committee and as discussed in Chapters 5 and 6, this Management Plan provides for visual, monitoring of spring flows from Bonanza Spring, Whiskey Spring, and Vontrigger Spring. As a further precautionary management measure consistent with the County Ordinance, Project induced reductions to spring flows will be mitigated.

4.3 Potential Significant Adverse Impacts to Critical Resources: Brine Resources at Bristol and Cadiz Dry Lakes

The brine groundwater at the Bristol and Cadiz Dry Lakes support two existing salt mining operations. These operations involve evaporation of the hyper-saline groundwater from the Dry Lakes to obtain remaining salts. Potential significant adverse impacts to brine resources on Bristol and Cadiz Dry Lakes include lowering of the groundwater or brine water levels within wells and brine supply trenches used by the salt mining operations, as well as Project impacts to the chemistry of the hyper-saline groundwater evaporated by the salt mining operators (e.g., reduced calcium chloride or sodium chloride within the brine).

4.4 Potential Significant Adverse Impacts to Critical Resources: Air Quality

The Project is in the Mojave Desert Air Basin (MDAB). The MDAB is an assemblage of mountain ranges interspersed with long broad valleys that often contain Dry Lakes. Many of the lower mountains which dot the vast terrain rise from 1,000 to 4,000 feet above the valley floor. Prevailing winds in the MDAB are out of the west and southwest. These prevailing winds are due to the proximity of the MDAB to coastal and central regions and the blocking nature of the Sierra Nevada Mountains to the north; air masses pushed onshore in Southern California by differential heating are channeled through the MDAB. The MDAB is separated from the Southern California coastal and Central California valley regions by mountains where the highest elevation reaches approximately 10,000 feet, and whose passes form the main channels for these air masses.

The Mojave Desert is bordered on the southwest by the San Bernardino Mountains, which are separated from the San Gabriel Mountains by the Cajon Pass (4,200 feet). A lesser channel, the Morongo Valley, lies between the San Bernardino Mountains and the Little San Bernardino Mountains.

One potential significant adverse impact to critical resources related to air quality that, depending on physical conditions, can result from dewatering of aquifers in the vicinity of Dry Lakes is the potential to materially increase fugitive dust from the playa surface, thereby increasing the severity of area dust storms. Examples of this problem have been documented in the Mojave Desert at the Owens and Franklin Playas. To evaluate the potential for increased fugitive dust resulting from the Project, the consulting firm HydroBio was retained to evaluate whether the Project's intended groundwater production would have an adverse effect on the generation of dust from the surface playas of the Bristol and Cadiz Dry Lakes. The results of HydroBio's investigation are set forth in a report titled Fugitive Dust and Effects from Changing Water Table at Bristol and Cadiz Playas, San Bernardino County, California, dated August 30, 2011.

Based on sampling, HydroBio's investigation characterized the soil chemistry and structure on the Bristol and Cadiz Playas and their immediate margins to evaluate the relationship between groundwater and surface soils (HydroBio, Fugitive Dust and Effects from Changing Water Table at Bristol and Cadiz Playas, San Bernardino, California, August 30, 2011). HydroBio's study found that the soil and water chemistry of both Cadiz and Bristol Playas have very low quantities of the sodium salts of carbonate, bicarbonate, and sulfate that are known to cause severe fugitive dust storms from Owens and Franklin Playas. (*Id.*) The study explains that Bristol Playa does produce fugitive dust from erosion by sand grains driven by high wind across the playa surface. In this process, the quantity of sand available on the playa margin is responsible for the magnitude of the dust release. The available sand appears to have diminished over time and this is hypothesized to be due to the action of a mix of weedy species that have grown increasingly dominant over the past 50 years. As a result, the severity of Bristol Playa fugitive dust is believed to be diminishing with time. (*Id.*) Importantly, the HydroBio study concluded that changes in groundwater level, which may result from the Project's groundwater production, will likely have no impact upon the amount of dust production from the playas or the severity of area dust storms. (*Id.*)

With respect to the Cadiz Playa, the study concluded that the Cadiz Playa appears to be the sink for the sand blown from the region of the Bristol Playa directly upwind to the northwest. (*Id.*) This sand tends to be stabilized by the growth of Russian thistle (tumbleweed). While the Cadiz Playa has the same soil and water chemistry as the Bristol Playa, the copious sand dunes around the shore, particularly in the north to northeast regions result in large amounts of available sand to erode the playa surface, thereby adding dust to area dust storms. (*Id.*) However, the HydroBio study concluded that the potential lowering of groundwater levels within the Cadiz Dry Lake will not affect the amount of dust or severity of dust storms emanating from the Playa. (*Id.*)

The HydroBio study explains that the reason that the potential lowering of water levels in the Bristol and Cadiz Playas will not affect fugitive dust concentrations and occurrence is that the chemistry of the soil comprising the central portions of the Playas is not of the type that causes an increase in fugitive dust as a result of lowered groundwater levels. Specifically, the study explains that the chemistry of the Bristol and Cadiz Playas is low in carbonate, bicarbonate and sulfate ions that are implicated in other playas that produce major dust storms (such as Owens and Franklin Playas). Instead, the Bristol and Cadiz Dry Lakes playa contains chemistry that has been noted to induce surface stability (Ca, Na and Cl). For these reasons, the EIR and HydroBio study concluded that the Project is not anticipated to have any material effect on the concentration of dust emanating from the Bristol and Cadiz Playas nor the severity of area dust storms. Nonetheless, consistent with the County's anticipated conditions under its Ordinance, the recommendations of the Groundwater Stewardship Committee, and as discussed in Chapters 5 and 6, this Management Plan provides for the installation and monitoring of four nephelometers to confirm these technical conclusions and institute corrective actions if necessary.

4.5 Potential Significant Adverse Impacts to Critical Resources: Project Area Vegetation

Another potential significant adverse impact to critical resources that, depending on physical conditions, can result from lowering of groundwater levels is the lowering of groundwater tables that are accessed by area vegetation, thereby causing the stress or death of that vegetation. Vegetation in environments like that found in the Project area provides important stabilization of soils against the action of wind erosion. The consulting firm HydroBio was retained to evaluate whether the Project's intended groundwater production would have an adverse effect on the occurrence and health of area vegetation. The results of HydroBio's investigation are set forth in a report titled, Vegetation, Groundwater Levels and Potential Impacts from Groundwater Pumping Near Bristol and Cadiz Playas, San Bernardino, California, dated September 1, 2011. The HydroBio study concludes that there is no connection of vegetation to groundwater in the Project area, and hence, no vegetation will be affected by changes in water table elevation (HydroBio, September 1, 2011).

HydroBio began its investigation by locating the most likely vegetation in the area potentially affected by the planned groundwater pumping. This "most likely" cover was identified by its higher activity (denser growth, larger plants) than all other locations around the Bristol Playa. Observations of the Cadiz Playa indicated that this region could be eliminated from concern because the vegetation around the playa is generally no more verdant than the surrounding area, hence obviously receiving no promotion from groundwater. HydroBio observed that the lowermost edge of the higher shrub zone was the region with higher vegetation activity that appeared to have the highest potential for connection of vegetation to groundwater. (*Id.*)

The HydroBio study explains that there are three shrub species that grow around the Bristol Playa: creosote bush [Larrea tridentata], cattle saltbush [Atriplex polycarpa] and four-wing saltbush [Atriplex canescens]. Of these, the only species that may act as a phreatophyte (a plant species that uses groundwater), is the four-wing saltbush, and this species is specifically a facultative phreatophyte, meaning it can benefit from but does not require shallow groundwater. (*Id.*) To determine whether any of the four-wing salt brush in the area are presently accessing groundwater, HydroBio reconstructed a curve for depth to water (DTW) versus elevation based on hydrographic data collected in the region of the Cadiz Ranch. A DTW point was added on the Bristol Playa that was reconstructed using photogrammetry. The study found that together, these points describe a highly linear relationship of DTW versus elevation above sea level (r2 = 99.9%). (*Id.*) Based on the robust and accurate relationship of the DTW curve, HydroBio estimated the DTW at the lowermost edge of the higher vegetation cover – the location most likely to have a vegetation/groundwater connection was 65 feet. Root excavations of four-wing saltbush have been measured to reach a maximum of 25 feet on only rare occasions when soils and hydrology permit, while typical root depths for the species average about 13 feet. Thus, based on measured and estimated DTW, the HydroBio study concluded that the shallowest water table position is 40 feet below the record rooting depth for the four-wing salt brush – the only species that could be potentially affected by groundwater decline. HydroBio therefore concluded that there is no connection of vegetation to groundwater in the Project area. (*Id.*) HydroBio further hypothesized that the promotional effect of periodic surface flows from the upstream catchments is the reason for the apparent promotion of this vegetation. (*Id.*)

4.6 Potential Significant Adverse Impacts to Critical Resources: the Colorado River and its Tributary Sources of Water

It is assumed that the groundwater that would be extracted by the Project at the Fenner Gap is not tributary to the Colorado River because the aquifer systems within the Fenner, Bristol and Cadiz Watersheds are believed to be a closed basin, isolated from aquifer systems to the east that are tributary to the Colorado River by bedrock and groundwater divides. It is important to ensure that the Project groundwater is not tributary to the Colorado River for several reasons. First, the Colorado River is fully appropriated and rights to divert water therefrom are governed by a complex set of federal and state laws. Material extractions of tributary groundwater could reduce flows in the Colorado River, thus frustrating the administration of the Colorado River and affected environmental resources.

It is also important to confirm that the Project groundwater is not tributary to the Colorado River for purposes of satisfying the provisions of the Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead (Guidelines) administered by the U.S. Bureau of Reclamation (Reclamation), for purposes of establishing Intentionally Created Surplus (ICS) credits under the Guidelines for potential Project participants that have contracts with Reclamation for diversions from the Colorado River. Under the Conservation Component of the Project, groundwater that is non-tributary to the Colorado River would be introduced into the Colorado River Aqueduct as "new," non-tributary water. For potential participants who have contracts with Reclamation for Colorado River water, the receipt of Project water creates the opportunity to establish ICS Credits based on the use of non-tributary water supplies in lieu of Colorado River diversions pursuant to Reclamation contracts. This opportunity could allow a participant to further augment its water supplies and improve overall water supply reliability. To qualify for ICS credits under the Guidelines, the surplus water used in lieu of Colorado River diversions must be non-tributary to the Colorado River.

While the assumption that the Project groundwater is non-tributary to the Colorado River is supported by substantial physical evidence (e.g., bedrock and groundwater divides), two monitoring wells (one existing and another to be installed) on property owned by Cadiz within the adjacent Piute Watershed that is tributary to the Colorado River will be monitored.

CHAPTER 5
MONITORING NETWORK

To ensure continued protection of the watershed and other resources, a comprehensive monitoring network has been developed to assess and continually evaluate the technical aspects of the Project, and any potential impacts to critical resources during the life of the Project, as designated in Chapter 4. The development of the monitoring network was based on the groundwater flow model that has been developed to better understand the hydrogeologic impacts of the Project's proposed groundwater production. The groundwater flow model will be continuously refined as additional monitoring data are obtained (see discussion of groundwater flow model in Chapter 4).

This Management Plan will be implemented with a set of monitoring features and parameters as discussed in this Chapter 5. The term "feature" refers to any fixed object, either natural or man-made, from which data will be collected. Man-made features include wells from which water level measurements and water quality samples could be retrieved, weather stations, bench marks, etc. A detailed list of monitoring features is given in this Chapter 5. As new data become available during Project operations, these monitoring features, monitored parameters, and monitoring frequency may be refined to protect critical resources in and adjacent to the Project area. Refinements to monitoring features will be made in accordance with the decision-making process described in Chapters 6 and 8.

A total of twelve different types of monitoring features have been identified for assessing potential impacts to critical resources during the term of the Project, as identified in Chapter 4. A summary of these twelve types of monitoring features, as well as monitoring frequencies and parameters to be monitored, is provided in Tables 5-1 and 5-2. Locations are shown in Figures 5-1 and 5-2.

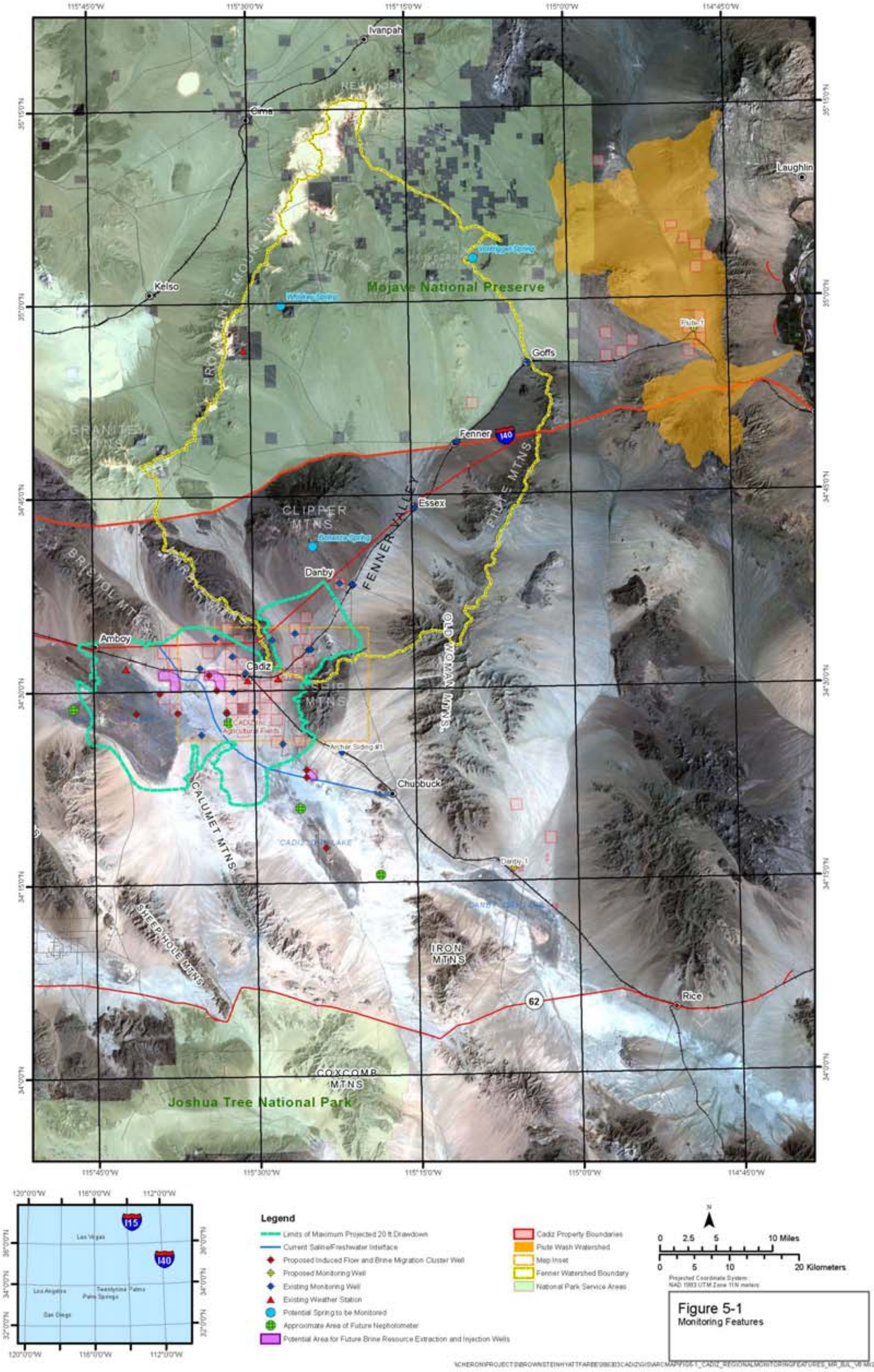


Figure 5-1
Monitoring Features

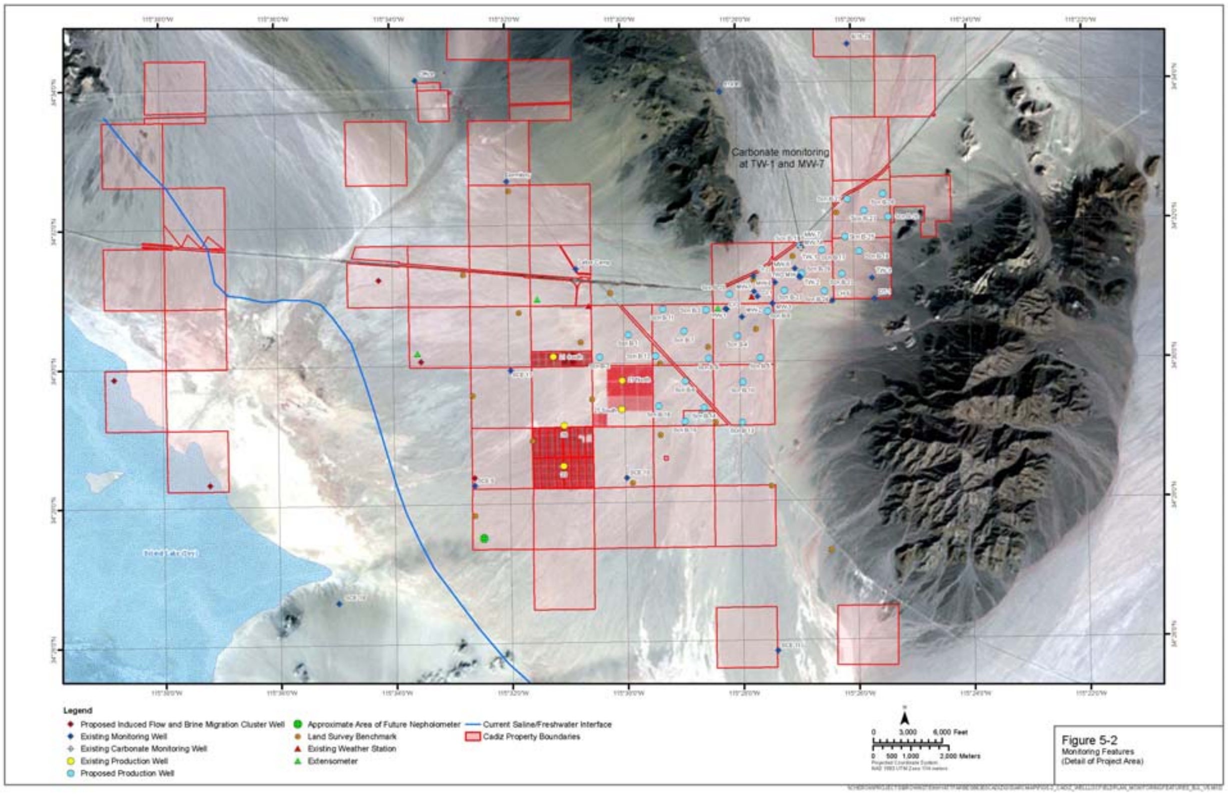


Figure 5-2
Monitoring Features
(Detail of Project Area)

Installation of certain monitoring features, where construction of facilities is required, will be subject to site-specific approval and permitting by applicable regulatory agencies. Cadiz will complete and deliver all needed permits for monitoring facilities as soon as practicable prior to the 12-month pre-operational phase. Cadiz will construct all facilities that are agreed to in this Management Plan and for which permits have been received. Construction of these facilities will be completed within one year of receipt of permits. If the implementation of monitoring features currently contained in this Management Plan is not approved, Cadiz will evaluate and implement alternate monitoring sites subject to approval by SMWD and the County and the applicable regulatory agencies.

The following text describes in detail the various proposed monitoring features.

5.2 Springs (Feature 1)

An inventory of 28 known springs within the Fenner Watershed was completed by the USGS (USGS, 1984). Locations of these springs are shown on Figure 5-3. As discussed in detail in Chapter 4, the potential significant adverse impacts to these critical spring resources has been evaluated. It is not anticipated that the Project will have any impact on the springs. Nonetheless, this Management Plan provides for quarterly monitoring of the Bonanza Spring as an "indicator spring" because it is the spring that is in closest proximity to the Project wellfield (approximately 11 miles from the center of Fenner

Gap), and, of all springs within the Fenner Watershed, this one would be the first one to be affected by the Project, if it were somehow possible to be in hydraulic connection with the alluvial aquifers, which appears unlikely. The Whiskey and Vontrigger Springs, which are located beyond the Project's projected effects on groundwater levels in the alluvial aquifers of the Fenner Watershed, will also be monitored quarterly to compare variations in spring flow from those springs to variations in spring flow from the Bonanza Spring to assist in determining whether any material reduction of flow at the Bonanza Spring is attributable to the Project operation, or instead, is attributable to regional climate conditions.

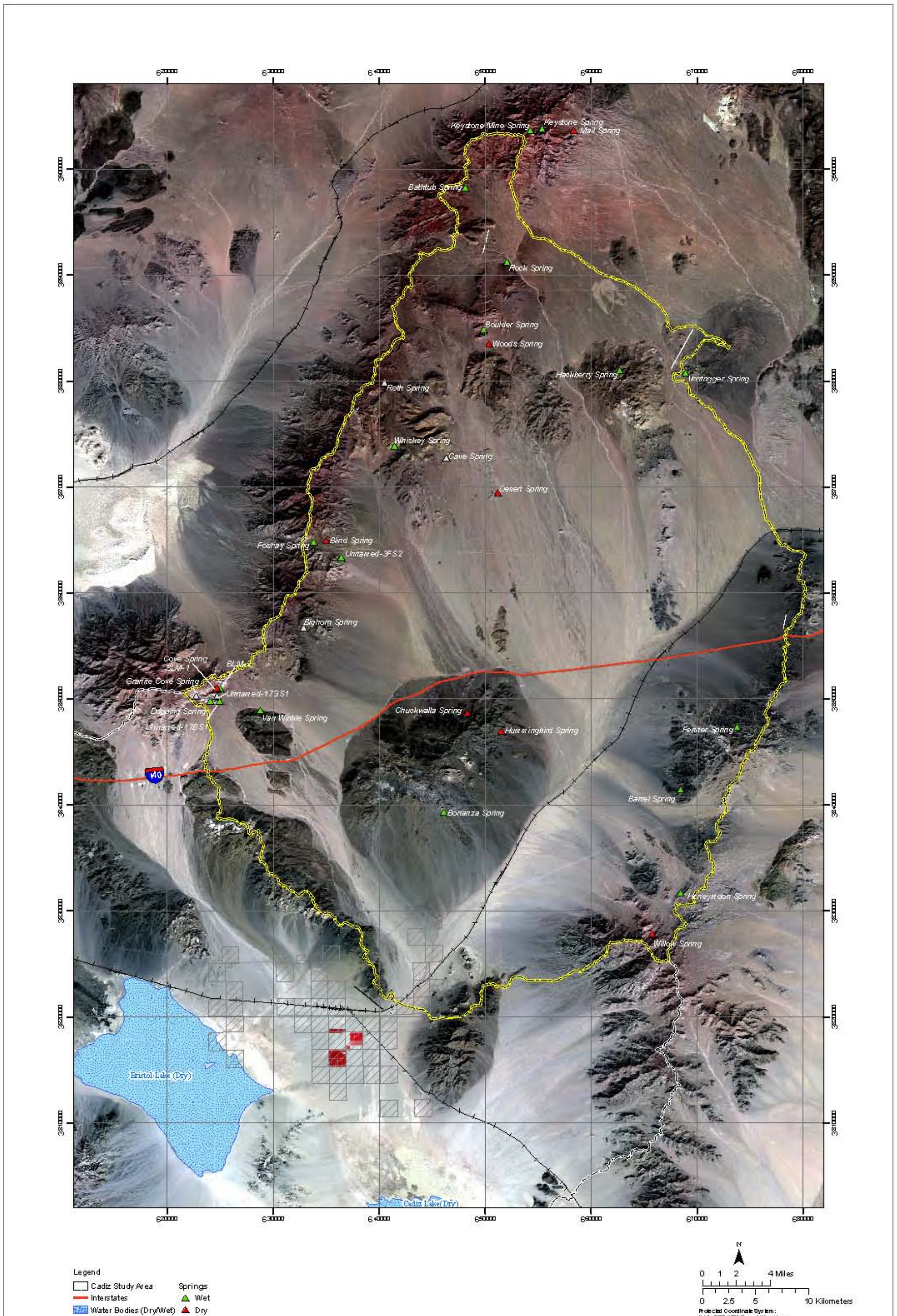


Figure 5-3
Location of Springs

The springs will be monitored on a quarterly basis by visual observations and flow measurements. Visual observations will include starting and ending points of observed ponded or flowing water, estimated depth of ponded water and flow rate of flowing water, conductivity, pH and temperature of water, any colorations of water, and general type and extent of adjacent vegetation.

5.3 Observation Wells (Features 2)

A total of 14 existing observation wells and 2 new observation wells will be used to monitor groundwater levels during the Project (see Tables 5-1 and 5-2). Locations of these wells are shown on Figures 5-1 and 5-2. Five of these wells were installed in the 1960's by Southern California Edison as part of a regional investigation (wells whose designation begins with "SCE"). Four of the observation wells (Labor Camp, Dormitory, 6/15-29, 6/15-1) are owned and monitored by Cadiz as part of their agricultural operation. Existing well CI-3 was installed in Fenner Gap during the pilot spreading basin test for the Project. Existing wells at Essex, Fenner, Goffs, and Archer Siding #1 are related to railroad operations or municipal supply. All of these existing wells will be utilized as observation wells, provided that appropriate permission and approval is obtained.

One new well, Piute-1, will be installed in the Piute Watershed, north of the Fenner Watershed, and is tributary to the Colorado River. This well will be installed on property owned by Cadiz and will be used as a "background" monitoring well to monitor undisturbed groundwater levels in an adjacent watershed, to provide information on groundwater level variations due to climatic changes only. In addition, this will serve to demonstrate that the Project will not impact groundwater that is tributary to the Colorado River.

Another new well, Danby-1, will be installed in the Danby Watershed to the east. Similar to Piute-1, this Danby-1 observation well will be used to demonstrate that impacts on groundwater levels do not extend beyond the Cadiz Watershed on the west. This well will also provide information on regional groundwater level conditions and is expected to provide additional background monitoring and information concerning groundwater level changes that may be due to climatic variations as well.

In addition to the observation wells, five additional well clusters will be located between Cadiz and Bristol Dry Lakes on the freshwater side of the saline-freshwater interface to monitor the potential migration of saline water in an area in which historical data on subsurface conditions is limited and a greater degree of certainty on geologic conditions and saline water migration is necessary. These new well clusters are set forth in Features 3 and 9 and are depicted in Figures 5-1 and 5-2 as Proposed Induced Flow and Brine Migration Cluster Wells. Additional monitoring well clusters to monitor for potential saline water migration may be necessary in areas along the saline-freshwater interface where there is an ability to assess whether saline water migration may exceed the action criteria presented in Section 6.

Groundwater levels will be measured in accordance with the monitoring procedure presented in Appendix B[9]. All water samples would be collected according to the protocol described in Appendix C. Field parameters such as groundwater temperature, pH, electrical conductivity, and total dissolved solids (TDS) will be collected at each well during well purging and prior to sampling. Samples from each well will be analyzed for the general mineral and physical parameters specified in Appendix D. In addition, all samples collected during the pre-operational phase will also be analyzed for bromide, boron, iodide barium, arsenic, hexavalent chromium, total chromium, nitrate, and perchlorate. The sample analytical protocol is presented in Appendix D.

Groundwater monitoring frequency will be revisited as determined appropriate by the decision-making process should any of the action criteria be exceeded, as discussed in Chapter 6.

5.4 Proposed Observation Well Clusters (Feature 3)

Three well clusters will be established in the immediate vicinity of the Project wellfield (see Figure 5-2). These cluster wells will provide a basis to compare groundwater level and water quality changes in both the shallow and deep portions of the alluvial and bedrock aquifer systems. Two well clusters, using existing monitoring well MW-7, MW-7a, and TW-1, and TW-2 and TW-2MW will be established for monitoring in the immediate vicinity of the Project. The screened intervals are in the upper alluvial, carbonate aquifer, and bedrock. TW-1 and MW-7 will monitor depths in the carbonate aquifer. The other three Proposed Induced Flow and Brine Migration Cluster Wells will be installed in the area between Bristol Dry Lake and the Project wellfield to monitor groundwater elevations and water quality. All new Project monitoring wells shall be designed, installed, and completed in manner consistent with all applicable state and local regulations and industry standards. Monitoring will occur as presented in Tables 5.1 and 5.2.

5.5 Project Production Wells (Feature 4)

Data from the wellfield (new Project wells and existing Cadiz agricultural wells) will be collected to provide information on the groundwater levels and discharge rates. Each well will be equipped with a flow meter to monitor well discharge and a sounding tube

[9] These procedures are being reviewed for consistency and will be made available on October 26, 2012.

for obtaining groundwater level measurements. Production data from the Project wells will also be collected using totaled readings of flow at the CRA.

5.5.1 *Existing Cadiz Agricultural Wells*

The Cadiz agricultural operation owns and operates seven agricultural wells used for irrigation, which are located west and southwest of Fenner Gap (see Figure 1-3). Five of the seven Cadiz irrigation wells could be incorporated into the Project wellfield (Wells 21S, 27N, 27S, 28, and 33). The remaining two wells (21N and 22) could used as standby pumping or monitoring wells.

5.5.2 *New Production Wells*

The Project wellfield would consist of between approximately 17 and 29 additional production wells (depending on Configuration) to be located as shown on Figure 5-2. Each new well would be completed to a depth of about 1,000 feet (see Figure 5-4). This well design may be modified based on observations in the field and expectations of drawdown that may be encountered during Project operations. The total capacity of the wellfield would allow for a pumping range of 25,000 afy to 75,000 afy. All new Project production wells shall be designed, installed, and completed in manner consistent with all applicable state and local regulations, and industry standards, and shall be equipped with flow meters.[10]

[10] County Guidelines for Preparation of a Groundwater Monitoring Plan, § 2.0.

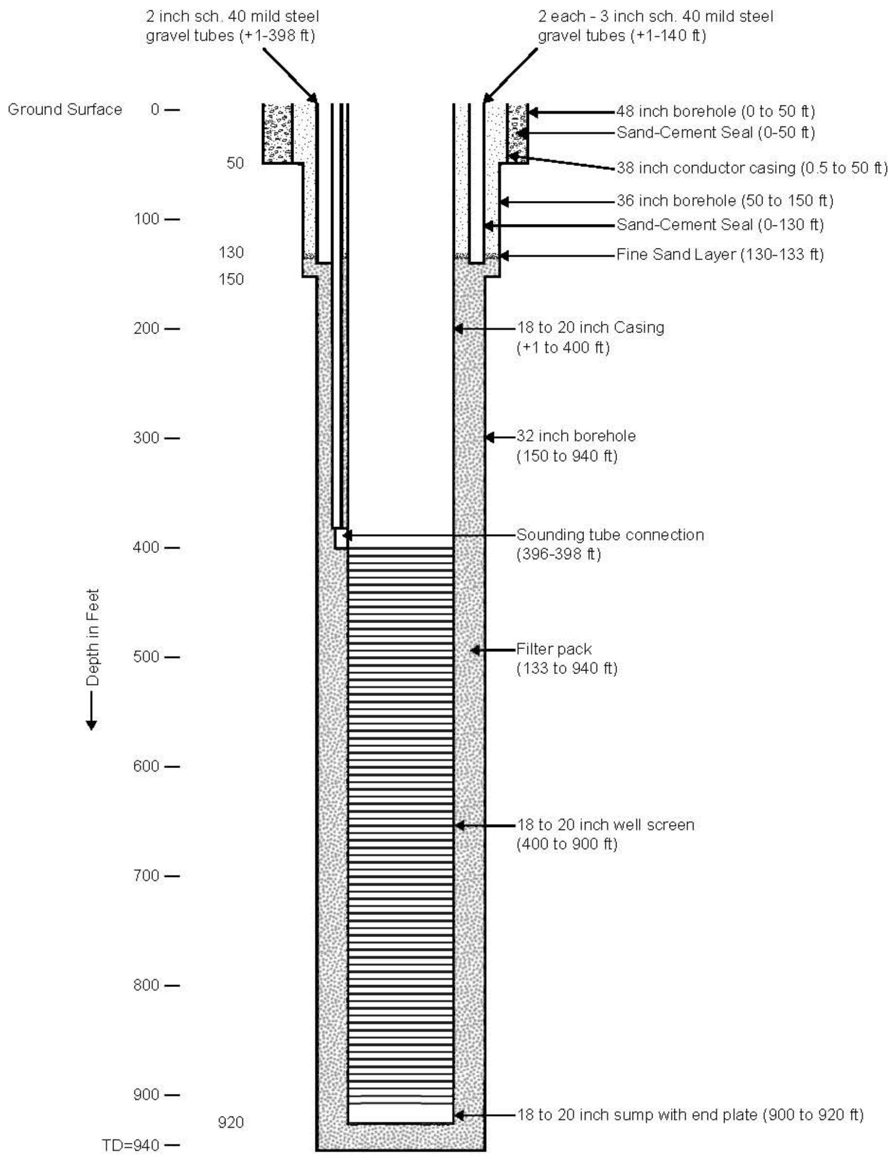


FIGURE 5-4
Conceptual Well Design Diagram

SCO386303.AA.05 well_design.ai 10/11

5.6 Land Surface Monitoring (Feature 5)

A network of approximately 20 land survey benchmarks will be installed at the approximate locations shown on Figure 5-2 to monitor changes in land surface elevation should they occur. Horizontal and vertical accuracy will be established in accordance with a second order Class I survey standard (1:50,000). Each benchmark will be established and surveyed by a California licensed land surveyor. All locations will be dependent upon permitting from the appropriate agencies. Benchmark surveys will be conducted on an annual basis during the term of the Project (see Table 5-1).

Pre-operational baseline Interferometric Synthetic Aperture Radar (InSAR) will be used to evaluate potential impacts in conjunction with the benchmarks. Cadiz will obtain surveyed baseline land surface elevations which then will be compared to each other along with any InSAR data collected by FVMWC during the course of the Project. The InSAR data would be used to monitor relative changes of land surface elevation that could be related to aquifer system deformation in the Project area. This pre-operational InSAR data (collected at two separate times during the year prior to the operational phase of the Project) will complement the land survey data to establish changes in land surface elevations. During the operational phase, annual benchmark surveys will be conducted and InSAR images will be obtained and evaluated every 5 years to evaluate potential impacts. During the post-operational phase, InSAR data and benchmark survey will be obtained every 5 years (Table 5-1).

5.7 Extensometers (Feature 6)

To evaluate potential impacts during the operational phase, FVMWC will construct three extensometers in the area of the highest probability of subsidence (see Figure 5-2). One extensometer will be located north of existing Cadiz agricultural supply well 21S. Another extensometer will be located at the eastern margin of Bristol Dry Lake near the location of a planned monitoring well cluster described in Section 5.9 below. Another extensometer will be located near well PW-1 within the wellfield. The extensometers will be constructed to continuously measure non-recoverable compaction of fine-grained materials interbedded within the alluvial aquifer systems.

5.8 Flowmeter Surveys (Feature 7)

Downhole static and dynamic flowmeter surveys will be generated in five selected new extraction wells. This is expected to occur during the initial period of operation and also after 10 years to assess whether flow conditions have changed as a result of Project operations. The flowmeter surveys will provide data regarding vertical variation in groundwater flow to the well screens. Depth-specific water quality samples will also be collected to assess vertical variation of groundwater quality in the Project wellfield area. Data will be used to help refine geohydrologic parameters regarding layer boundaries used in the groundwater models.

5.9 Proposed Observation Well Clusters At Bristol Dry Lake (Feature 8)

A total of three new observation well clusters will be installed and monitored in the vicinity of Bristol Dry Lake during the initial phases of the Project (see Table 5-1 and Figure 5-2). Two well clusters will be located along the eastern margin of Bristol Dry Lake to monitor the effects of Project operations on the movement of the saline-freshwater interface (see Figure 5-2). One additional well cluster will be installed on the Bristol Dry Lake playa to monitor brine levels and chemistry at different depths beneath the Dry Lake surface. This well cluster will be positioned in relation to the well clusters at the margin of the Dry Lake so as to provide optimum data for the variable density transport model.

A typical observation well cluster completion is illustrated on Figure 5-5. Screened intervals for each of the wells within each cluster will be determined from the logging of cuttings and geophysical logging of the deep borehole which will be drilled first. Each deep well will be completed with PVC or other suitable well casings and screens to allow for dual induction geophysical logging. Shallow wells will be completed with PVC or other suitable well casings and screens.

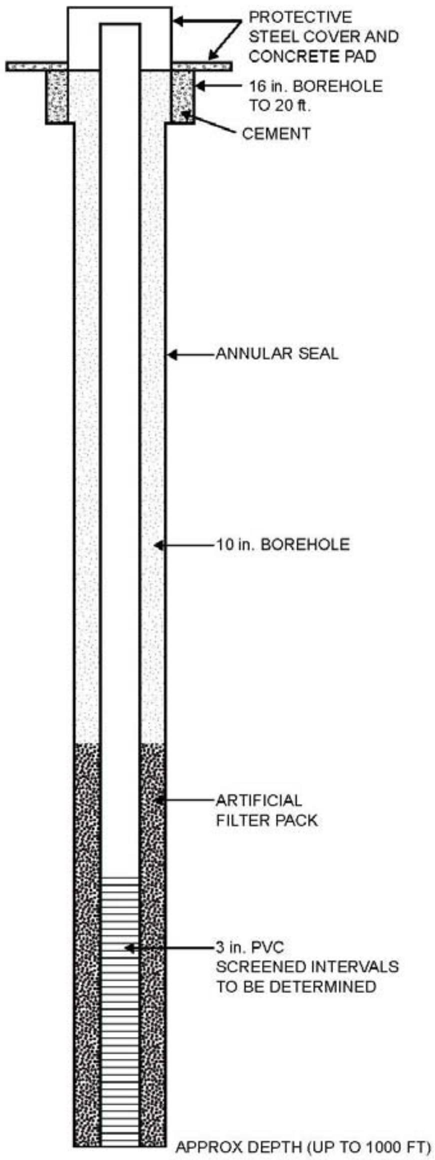


FIGURE 5-5
Typical Observation Well Cluster

SCO386303.AA.05 well_cluster.ai 10/11

During the pre-operational phase, static groundwater levels will be monitored on a continuous basis from each well cluster using downhole pressure transducers. Project monitoring will begin immediately following well installation and development.

5.10 Proposed Observation Well Clusters At Cadiz Dry Lake (Feature 9)

At least two well clusters will be located along the northern margin of Cadiz Dry Lake to monitor the migration of the saline-freshwater interface between the wellfield and Cadiz Dry Lake (see Figure 5-1). The third well cluster will monitor brine levels and depth distribution of water quality on the Cadiz Dry Lake, similar in nature to Bristol Dry Lake. This well cluster will be positioned in relation to the well clusters at the margin of the Dry Lake so as to provide optimum data for the variable density transport model. During the pre-operational phase, static groundwater levels will be monitored on a continuous basis from the well clusters using downhole transducers. Project monitoring will begin immediately following well installation and development and continue through the post-operational period (Gamma-Ray/Dual Induction Downhole Geophysical Logs (Feature 10)).

Gamma-Ray and Dual Induction electric logs will be run for the deepest observation wells of each well cluster to be installed at the Dry Lakes (four total). These Downhole geophysical techniques allow for the measurement of groundwater electrical conductivity with depth and could be conducted in observation wells constructed of PVC casings and screens.

Gamma-Ray/Dual Induction geophysical logs will be run as a one-time measurement to be conducted during observation well cluster installation during the pre-operational phase of the Project.

5.11 Weather Stations (Feature 11)

Data from four existing weather stations will be collected over the course of the Project (see Figures 5-1). Existing weather stations include the Mitchell Caverns weather station (located in the Providence Mountains), the Project weather station (located in Fenner Gap adjacent to the spreading basins), the Cadiz CIMIS station (operated by/for CDWR at the Cadiz Field Office), and the Amboy weather station (located near Bristol Dry Lake in the town of Amboy).

The Mitchell Caverns weather station would provide precipitation, temperature, and other climatic data for the mountain regions of the Fenner Watershed. The Fenner Gap weather station would provide climatic data in the immediate vicinity of the Project area. The Amboy and Cadiz Field Office weather stations would provide climatic data representative of the lowest area of the regional watershed. Data obtained from the weather stations will be incorporated into the water resource models described in Chapter 4, along with complementing data analysis of Feature 12.

5.12 Air Quality Monitoring (Feature 12)

5.12.1 Monitoring at Bristol and Cadiz Dry Lakes

The relationship between groundwater and the surface of Bristol and Cadiz Dry Lakes has been evaluated in a technical study conducted by HydroBio.[11] The technical study concludes that unlike some other playas in the arid southwest such as Owens and Franklin Playas, the soil and water chemistry of both Cadiz and Bristol Dry Lakes has very low quantities of the sodium salts of carbonate, bicarbonate and sulfate that are known to generate excessive fugitive dust in high wind storms. Rather, the Bristol and Cadiz Dry Lakes are characterized by sodium and calcium chlorides that maintain a rigid structure when desiccated, reducing the amount of loose dust on the ground surface that can be lofted by the wind. This surface crust is not aided or maintained by direct contact or indirect contact with the groundwater through capillary action.

Under current conditions, dust storms are not uncommon in the valley as sand particles saltate across the desert floor, dislodging other sand particles and lofting dust into the air.[12] Under current conditions, depth to groundwater in some areas beneath the Dry Lakes is over 60 feet below ground surface, and the surface soils in these areas exhibit the same crusty surface as areas with shallow groundwater. This crusty surface soil provides some resistance to wind erosion and limits dust emissions. It is not reliant on groundwater for maintenance of its crust integrity. Therefore, drawdown of the groundwater beneath the Dry Lakes is not expected to have an effect on surface soils or dust emissions in the valley.

To monitor the condition of the Dry Lakes consistent with recommendations of the Groundwater Stewardship Committee and to provide additional data on the environment of the area, four nephelometers will be installed, including one downwind and one upwind of Bristol Dry Lake and one downwind and one upwind of Cadiz Dry Lake. These nephelometers will be placed on privately-owned property and outside the wind shadow of the agricultural properties.

[11] HydroBio, Fugitive Dust and Effects from Changing Water Table at Bristol and Cadiz Playas, San Bernardino, California, August 30, 2011, pg. i

[12] HydroBio, Fugitive Dust and Effects from Changing Water Table at Bristol and Cadiz Playas, San Bernardino, California, August 30, 2011, pg. 6

In addition, FVMWC will conduct annual visual observations at four points on each of the Dry Lakes to record surface soil conditions. The visual observations will note soil texture and record susceptibility to wind erosion. Photographs of the soil will be taken. This data will record conditions over time on the two Dry Lake surfaces at the same locations each time.

These nephelometers will provide data on a daily basis that records opacity of the air, measuring the effect of dust on visibility. Data will be collected in the pre-operational phase of the Project and in the early years of the Project, establishing a baseline before groundwater levels beneath the Dry Lakes are affected. Since wind velocity and dust storms are highly variable, the data will record trends over time. Data will also be collected during the operational and post-operational phase of the Project and compared to baseline data to evaluate whether Project operations result in a significant adverse impact to critical air quality resources.

CHAPTER 6
MONITORING AND MITIGATION OF SIGNIFICANT ADVERSE IMPACTS TO CRITICAL RESOURCES (ACTION CRITERIA, DECISION-MAKING PROCESS AND CORRECTIVE MEASURES)

This Management Plan identifies specific quantitative criteria or trends (action criteria) that will "trigger" review and corrective actions where necessary to protect critical resources or otherwise avoid Undesirable Results. When action criterion are triggered, a review of the triggering event will be conducted to determine whether the event is attributable to or exacerbated by Project operations, and if so, which specific corrective measures should be implemented to avoid adverse impacts to critical resources or Undesirable Results. It is the intent of this Management Plan to identify deviations from baseline conditions, along with deviations from groundwater model projections, at monitoring features as early as possible in order to identify and prevent the occurrence of adverse impacts to critical resources or Undesirable Results as a result of Project operations. Triggering events may, in some circumstances, necessitate immediate corrective actions and subsequent review to ensure that the triggering event resulted from Project operations.

6.1 Decision-Making Process

A decision-making process has been developed which outlines the process to be followed in the event an action criterion is triggered, or when refinements to the Management Plan are considered. Potential corrective measures to be implemented, if appropriate, are identified. Critical resources and Undesirable Results, action criteria, the decision-making process, and potential corrective measures are discussed in Chapter 6 and summarized in Table 6-1.

The initial action criteria and corrective measures presented in this Management Plan are considered conservative. FVMWC may propose refinements to the action criteria and monitoring network after additional data has been accumulated which indicates that the monitoring is unnecessary. However, any such refinement would occur in accordance with the terms of this Management Plan. If FVMWC proposes a refinement to action criteria or monitoring features, it will submit a written proposal describing the refinement along with supporting data and materials to the TRP. The TRP will then issue a recommendation concerning the proposed refinement to the County, which will determine whether the refinement is warranted, based on all available technical data, all Project conditions of approval, the analysis set forth in the Project EIR, and adopted CEQA findings. Before any refinement to an action criteria or monitoring feature which is also a mitigation measure adopted by SMWD as part of its approval of the Project may occur, SMWD must first determine that substantial evidence supports a finding that the refined action criteria or monitoring feature will continue to mitigate the impact identified in the Project EIR. The County and SMWD will make a decision regarding the proposed refinement in accordance with the decision-making process presented here, and further described in Chapter 8.

Action criteria are intended to be used as predictors of potential adverse impacts to critical resources, and these criteria as applied are meant to help avoid material adverse impacts to critical resources and Undesirable Results.

The decision-making process followed in this Management Plan, if an action criterion is triggered or when the County considers refinements to the Management Plan, is described in detail as follows.

Initial Notification – 10 Business Days

If an action criterion (as defined in this Chapter 6) is triggered, FVMWC will, within ten (10) business days of the trigger, inform SMWD, the County Representative (Chief Executive Officer), and the members of TRP that an action criterion has been triggered and commence the decision-making process described herein. If the action criterion threatens an immediate or irreparable injury to a critical resource or other immediate Undesirable Result, FVMWC will promptly implement appropriate corrective action(s) or the County may promptly issue an administrative enforcement order as set forth in Section 8.2, below.

Initial Assessment and Recommendation – 60 Calendar Days

Within sixty (60) calendar days of issuing notice that an action criterion is triggered, FVMWC will undertake a three-step assessment process. First, FVMWC will assess whether the triggering of any action criterion is attributable to Project operations. Second, for any triggering of an action criterion attributable to Project operations, FVMWC will assess whether the triggering of the action criterion constitutes a potential adverse impact. Third, for any triggering of an action criterion that is attributable to the Project and constitutes a potential adverse impact, FVMWC will assess, recommend, and implement corrective measure(s) (including refinements in monitoring or to this Management Plan) necessary to avoid or mitigate the potential adverse impact or Undesirable Result.

FVMWC shall provide its written assessment and recommendation, along with supporting data, to SMWD, the County Representative, and the members of TRP within the sixty (60) day assessment period.

TRP Review and Recommendation – 90 Calendar Days

Upon receiving FVMWC's written assessment and recommendation, the TRP will have ninety (90) calendar days to determine whether it concurs with the assessment and recommendation (including but not limited to modifications to the monitoring network, corrective actions, etc.). During the TRP review period, the TRP may request additional data and analysis from FVMWC and will have access to all monitoring data. Within the ninety (90)-day TRP review period, the TRP will issue a written report of its review of FVMWC's assessment and recommendation, including whether it concurs with the assessment and recommendation, to the County Representative, FVMWC, and SMWD, and if it does not concur, the basis of its disagreement and any alternative recommended actions. The TRP's written report shall state whether or not the report reflects a consensus of the TRP members. If the TRP members cannot reach a consensus, the members' differing opinions and recommendations shall be set forth in the written report.

County Review and Determination

The County Representative will consider the findings and actions taken or recommended by FVMWC and the TRP, but will exercise his or her own independent judgment concerning whether the triggering of the action criterion is attributable to Project operations, whether the triggering of the action criterion involves a potential adverse impact or Undesirable Result, and to determine the appropriate corrective measure(s) necessary to avoid or mitigate the potential adverse impact or Undesirable Result. The County will issue its determination in writing to FVMWC, SMWD, and to each member of the TRP. FVMWC shall promptly comply with the determination and instructions set forth in the County's written correspondence concerning the matter. With the exception of corrective actions necessary to address an immediate or irreparable threat of harm, the oversight, management, and enforcement actions concerning assessment, application, and refinement of action criteria and corrective measures shall be made by the County subject to the dispute resolution provisions of the MOU set forth in Chapter 8.

As lead agency for the Project, SMWD shall enforce the implementation of all adopted mitigation measures, including those measures which correspond to provisions of the Management Plan, as conditions of Project approval. SMWD will, pursuant to CEQA Guideline section 15097(a), delegate the reporting and monitoring responsibilities for those mitigation measures to the County. SMWD shall review and consider the County's ongoing determination of compliance with those mitigation measures which are also provisions of the Management Plan in assessing compliance with the Mitigation Monitoring and Reporting Program and with the conditions of Project approval.

Because compliance with the Management Plan is a condition of SMWD's approval of the Project, SMWD in its discretion, will also consider the findings and actions taken or recommended by FVMWC and the TRP, and will exercise its own independent judgment concerning whether the triggering of the action criterion is attributable to Project operations, whether the triggering of the action criterion involves a potential adverse impact or Undesirable Result, and to determine the appropriate corrective measure(s) necessary to avoid or mitigate the potential adverse impact or Undesirable Result. If SMWD determines that appropriate corrective measure(s) are necessary to avoid or mitigate the potential adverse impact or Undesirable Result, but the County does not, SMWD will independently impose those corrective measures it determines necessary to avoid adverse impacts to critical resources or Undesirable Results, provided that independent enforcement by SMWD shall be subject to the same procedural requirements and remedies applicable as if the County were enforcing the Management Plan, including the dispute resolution procedure in Section 8.3.

Communications by and to FVMWC, the TRP, SMWD and the County, as provided in this chapter, shall be made by and to, respectively, a point of contact for the FVMWC designated by the FVMWC Board of Directors (FVMWC Representative), a member of the TRP designated by the TRP as its point of contact (TRP Chair), the SMWD General Manager and a point of contact for the County designated by the County (County Representative).

6.2 Third-Party Wells

It is the intent of the Project to operate without adverse material impacts to wells owned by neighboring landowners in the vicinity of the Project area, and those operated in conjunction with salt mining operations on the Bristol or Cadiz Dry Lakes. To avoid such potential impacts, the groundwater monitoring network will include monitoring wells located in and around the wellfield, near neighboring landholdings, and on and adjacent to the Dry Lakes (see Figures 5-1 and 5-2). Groundwater levels will be monitored on a continuous to semi-annual basis (see Table 5-1) during the pre-operational and operational periods, then annually during the post-operational period. Water quality will be monitored on a quarterly to annual basis during the pre-operational period, annually during the operational period of the Project, and triennially during the post-operational period (see Table 5-1). Further, FVMWC shall monitor static (non-pumping) water levels within any third-party wells that are representative of the local groundwater impacts and located within the northern Bristol/Cadiz Sub-Basin or elsewhere in the Fenner Watershed. Such monitoring of third-party wells will be performed on a semi-annual basis during the pre-operational and operational periods, then annually during the post-operational period as established in the Closure Plan.

6.2.1 *Action Criteria*

The decision-making process will be initiated if any of the action criteria are triggered. The action criteria are: 1) a decline of static water levels of more than twenty feet from pre-Project static water levels or to a degree in which the reduction in static water levels results in an inability to meet existing the production of any third-party well drawing water from the northern Bristol/Cadiz Sub-Basin or elsewhere in the Fenner Watershed; and 2) the receipt of a written complaint from one or more well owner(s) regarding decreased groundwater production yield, degraded water quality, or increased pumping costs submitted by neighboring landowners or the salt mining operators on the Bristol and Cadiz Dry Lakes. Any written complaint by a well owner in accordance with this action criterion shall be directed to FVMWC.

6.2.2 *Decision-Making Process*

If any of the action criteria are triggered, the decision-making process will include:

- If a written complaint with a documented change in water level as provided for in Section 6.2.1 is received from a third-party well owner located within the area of influence (see Figure 5-1), FVMWC will immediately implement Corrective Measure 6.2.3.1, below;

- Assessment of whether water level changes, decreased yields, increased pumping costs, and/or degraded water quality in the third-party wells are attributable to Project operations or other causes;

- If such water level changes, decreased yields, increased pumping costs and/or degraded water quality are determined to not be attributable to Project operations, then FVMWC would discontinue any interim arrangement to provide water as set forth in Section 6.2.3.1;

- If such water level changes, decreased yields, increased pumping costs and/or degraded water quality are determined to be attributable to Project operations, then one or more of the corrective measures set forth in Section 6.2.3 shall be implemented.

6.2.3 *Corrective Measures*

6.2.3.1 *Interim Water Supply*. If a written complaint as provided for in Section 6.2.1 is received from a third-party well owner located within the area described above (see Figure 5-1), FVMWC will arrange for an immediate interim supply of water to the third-party well owner until the decision-making process is complete in an amount necessary to fully offset any reduced yield to the third-party well owner, as compared to the yield from the impacted well prior to Project operations or, if the impacted well was installed after Project operations commenced, then as compared to the yield of the well immediately after installation.

6.2.3.2 *Further Corrective Measures*. If any of the Action Criteria set forth in 6.2.1 are triggered and the impacts are determined to be attributable to Project operations, one or more of the following further corrective measures shall be implemented to correct the impairment to the beneficial use of the groundwater:

- Continued provision of substitute water supplies;

- Deepening or otherwise improving the efficiency of the impacted well(s);

- Blending of impacted well water with another local source;

- Constructing replacement well(s) on disturbed land subject to the same mitigation measures imposed on the Project wellfield as set forth in the SMWD's Mitigation Monitoring and Reporting Program;

- Paying the impacted third-party well owner for any increased material pumping costs incurred by the well owner; or
- Entering into a mitigation agreement with the impacted third-party well owner.

6.3 Land Subsidence

Twenty land survey benchmarks will be established and surveyed by a licensed land surveyor on an annual basis to identify and quantify potential subsidence within the Project area (see Figures 5-1 and 5-2). Three extensometers will be constructed in areas of projected subsidence (see Figure 5-2). The extensometers, which would be monitored continuously from installation through the post-operational period, would verify if the land surface changes (also potentially identified from land surveys and InSAR satellite data obtained and analyzed every 5 years through the post-operational period) are due to (1) subsidence due to groundwater withdrawal; or (2) other mechanisms (e.g. regional tectonic movement).

6.3.1 *Action Criteria*

The decision-making process will be initiated if either of the action criteria is triggered. The action criteria are: 1) a trend in subsidence that would result in a decline in the ground surface elevation of more than 0.3 feet within 10 years when compared to baseline Project conditions; or 2) a trend in subsidence which, if continued, would be of a magnitude within 10 years that impacts existing infrastructure within the Project area. The magnitude for the railroad tracks is more than one inch vertically over 62 feet linearly along the existing railroad tracks.

6.3.2 *Decision-Making Process*

If either of the action criteria is triggered, the decision-making process will include:

- Assessment as to whether the subsidence is attributable to Project operations;
- If the subsidence is determined to be attributable to Project operations, then an assessment will be made to determine whether the subsidence constitutes a potential adverse impact to the aquifer or surface uses. Potential adverse impacts include potential damage to surface

structures as a result of differential settlement or fissuring, general subsidence sufficient to alter natural drainage patterns or cause damage to structures, or a non-recoverable loss of aquifer storage capacity that affects the beneficial uses of the storage capacity of the aquifer system;

- If no such significant adverse impacts to critical resources are identified, potential actions may include:
  - No action;
  - Proposed refinements to the action criteria;
  - Additional verification monitoring, including a field reconnaissance to assess and detect any differential settlement; or
  - Proposed revisions to the benchmark survey and/or InSAR monitoring frequency.
  - If the subsidence is determined to be attributable to Project operations and the subsidence is determined to constitute a potential adverse impact to the aquifer or surface uses then one or more of the corrective measures set forth in Section 6.3.3 shall be implemented.

6.3.3 *Corrective Measures*

Corrective measures that shall be implemented to repair damaged structures and/or arrest the subsidence shall include one or more of the following:

- Repairing any structures damaged as a result of subsidence attributable to Project operations;
- Entering into a mitigation agreement with any impacted party(s).

If the forgoing corrective measures are ineffective or infeasible, Project operations shall be modified to arrest the subsidence. For the purposes of these action criteria, "ineffective" shall be defined as a corrective measure that when put into place did not meet the objective set forth in the corrective action, i.e.. to repair damaged structures and arrest the subsidence. "Infeasible" is a corrective measure which cannot be implemented due to cost, technical challenges, or legal restraints. Modifications to Project operations shall include one or more of the following:

- Reduction in pumping from Project well(s);
- Revision or reconfiguration of pumping locations within the Project wellfield; or
- Stoppage of groundwater extraction for a duration necessary to correct the adverse impact.

6.4 Induced Flow of Lower-Quality Water from Bristol and Cadiz Dry Lakes

Saline water migration is allowed up to and not to exceed 6,000 feet from the baseline location of the saline-freshwater interface. To prevent migration of saline groundwater beyond 6,000 feet, FVMWC will implement mitigation measures that may include injection or extraction wells or other physical means to maintain the saline-freshwater interface. If these physical measures prove ineffective, reductions in Project pumping will be required (see Sections 6.4.3, below).

6.4.1 *Monitoring*

To monitor the influence of the Project's operation on the migration of the saline-freshwater interface located between the Project wellfield and the Bristol and Cadiz Dry Lakes, a network of "cluster type" observation wells will be established between the Project wellfield and the saline-freshwater interface. Groundwater TDS concentrations in the well clusters will be monitored on a quarterly basis during the pre-operational period of the Project, semi-annually throughout the operational period, and annually during the post-operational period of the Project. Of the monitoring well network, SCE Well no. 5 and SCE Well no. 11, along with other newly installed well clusters located between the interface and the Project wellfield will be located such that that they are appropriate to serve as "sentinel" wells to determine whether there is a progressive migration of the saline-freshwater interface. The locations of SCE Well no. 5, SCE Well no. 11, and the other sentinel well clusters are shown in Figures 5-1 and 5-2.

6.4.2 *Action Criteria*

The decision-making process will be initiated if the action criterion is triggered. The action criterion is a migration of the interface, as measured by an increase in TDS concentration in excess of 600 mg/L in any cluster or observation well located within a distance of 6,000 feet from pre-Project locations of the interface.

6.4.3 *Decision-Making Process*

If the action criterion is triggered, the decision-making process will include:

- Assessment of whether the increased TDS concentration or migration of the saline-freshwater interface is attributable to Project pumping;
- Assessment of trends and updated projections of whether and when the saline-freshwater interface is expected to migrate 6,000 feet from its baseline location;
- If the increased TDS concentration within the monitoring wells is determined to be attributable to the Project and the saline-freshwater interface is expected to migrate more than 6,000 feet from its baseline location within 10 years, then one or more of the corrective measures set forth in Section 6.4.3 shall be implemented.

6.4.4 *Corrective Measures*

Corrective measures that will be implemented to eliminate the further migration of saline groundwater towards the Project wellfield may include the following:

- Installing one or more extraction well(s) or injection well(s) at the northeastern edge of Bristol Playa and/or north of Cadiz Playa where the salt mining source wells are located to maintain the saline-freshwater interface within its 6,000-foot limit subject to the same mitigation measures imposed on the Project well-field as set forth in the SMWD Mitigation Monitoring and Reporting Program (see Figures 5-1 and 5-2).

If the forgoing corrective measures are ineffective or infeasible, Project operations shall be modified to eliminate the further migration of saline groundwater towards the Project wellfield. Modifications to Project operations will include one or more of the following:

- Reduction in pumping from Project wells;
- Revision of pumping locations within the Project wellfield; or
- Stoppage of groundwater extraction for a duration necessary to correct the predicted impact.

6.5 Brine Resources Underlying Bristol and Cadiz Dry Lakes

To monitor potential Project impacts on the salt mining operations on the Bristol and Cadiz Dry Lakes, a network of "cluster type" monitoring wells will be established between the Project wellfield and the margins of the Dry Lakes (see Figures 5-1 and 5-2). Groundwater levels will be monitored on a continuous basis throughout the operational and post-operational term of the Project.

6.5.1 *Action Criteria*

The decision-making process will be initiated if either of the action criteria is triggered. The action criteria are:

- A declining trend in groundwater or brine water levels of greater than 50 percent of either (a) the water column above the intake of any of the salt mining operators' wells, or (b) the average depth of brine water level within the brine supply trenches operated by the salt mining operators. Changes in such groundwater or brine water levels, shall be determined by monitoring changes in the static water levels within the network of clustered monitoring wells identified above, as changes in the static water levels within these monitoring wells are correlated with the groundwater or brine water levels within the salt mining operator's wells and brine supply trenches; or

- The receipt of a written complaint from a salt mining operator regarding decreased groundwater production yield or increased pumping costs from one or more of its wells, or decreased water levels within its brine supply trenches. Any written complaint by a salt mining operator in accordance with this action criteria shall be directed to FVMWC.

6.5.2 *Decision-Making Process*

If either of the action criteria is triggered, the decision-making process will include:

- Assessment of whether the change in groundwater/brine level in excess of the action criteria is attributable to Project operations;

- If the change in groundwater/brine water level in excess of the action criteria is determined to be attributable to Project operations, then an assessment will be made to determine whether the groundwater/brine level change constitutes a potential adverse impact to one or more of the salt mining operations on the Dry Lakes. Adverse impacts include changes to brine chemistry or yields from existing brine production wells or brine supply trenches attributable to Project operations. If no such impacts are identified, potential actions may include:

- Continued or additional verification monitoring;
- Proposed refinements to the action criteria;
- Proposed revision to the monitoring frequency at the observation well clusters at the margins of the Dry Lakes;
- If the decline in groundwater/brine water level(s) approaching the action criteria is determined to be attributable to Project operations, and the changes constitute a potential adverse impact to one or more of the salt mining operations on the Dry Lakes, then one or more of the corrective measures set forth in Section 6.5.3 shall be implemented.

6.5.3 *Corrective Measures*

Action(s) necessary to mitigate changes to brine chemistry or yields from existing brine production wells or brine supply trenches attributable to Project operations, and thereby maintain or restore the beneficial use of the groundwater/brine water by the salt mining operations, shall include one or more of the following:

- Compensating the mining operator(s) for the additional costs of pumping;
- Installing one or more brine extraction well(s) and/or injection well(s) where the salt mining source wells are located subject to the same mitigation measures imposed on the Project well-field as set forth in the SMWD Mitigation Monitoring and Reporting Program (see Figure 5-1); or
- Entering into a mitigation agreement with the salt mining operator(s).

If the forgoing corrective measures are ineffective or infeasible, Project operations shall be modified until adverse impacts to the salt mining operations are eliminated. For the purposes of these action criteria, "ineffective" shall be defined as a corrective measure that when put into place did not meet the objective set forth in the corrective action, i.e., to maintain or restore the beneficial use of the groundwater/brine water by the salt mining operations. "Infeasible" is a corrective measure which cannot be implemented due to cost, technical challenges, or environmental and permitting issues as defined under CEQA. Modifications to Project operations shall include one or more of the following:

- Reduction in pumping from Project wells;
- Revision of pumping locations within the Project wellfield; or
- Stoppage of groundwater extraction for a duration necessary to correct the predicted impact.

6.6 Adjacent Basins, Including The Colorado River and its Tributary Sources of Water

Adjacent basins will be monitored to provide verification that the Project does not impact groundwater levels in these adjacent basins. Because the Bristol, Cadiz, and Fenner Watersheds are assumed to be closed watersheds, it is expected that the observation wells will demonstrate no Project impact. Baseline groundwater conditions observed in these adjacent basins will also provide information on climatic change effects on groundwater levels on a regional basis.

The Piute Watershed is tributary to the Colorado River. Groundwater flow from this watershed ultimately discharges to the Colorado River, so it is a part of the water resource of the Colorado River. As discussed above, it would be an adverse impact if this groundwater flow was impacted by Project operations. The Piute-1 observation well will provide data on groundwater levels in this basin. In addition, the Piute-1 well is located approximately equi-distant from the next southerly well from the proposed Goffs observation well, so this well can be compared to these observation wells to assess groundwater level differences between them, if any.

The Danby basin is located immediately to the east. A new observation well, Danby-1, will provide information on groundwater conditions in this adjacent basin.

6.6.1 *Monitoring*

Because the Bristol, Cadiz, and Fenner Watersheds are assumed to be closed watersheds that are isolated from aquifer systems in neighboring basins by bedrock and groundwater divides, no action criteria are necessary to protect these critical resources. However, to accommodate requests of stakeholders in the Danby area, and to demonstrate the lack of any hydrogeologic connectivity between the alluvial groundwater developed by the Project and the Piute Basin, the monitoring wells in these adjacent basins, along with all the other Project observation wells, will be monitored to verify these factual conclusions.

6.7 Springs

As discussed at Section 4.2 of Chapter 4 above, because of the distance, change in elevation, and lack of hydraulic connection between the fractured bedrock groundwater feeding the Fenner Watershed springs and the alluvial groundwater developed by the Project, the Project is not anticipated to affect the spring flows within any of the Fenner Watershed springs.

6.7.1 *Monitoring*

The Project is not anticipated to have an effect on the spring flows in any of the Fenner Watershed springs. However, consistent with the recommendations of the Groundwater Stewardship Committee and as a conservative monitoring protocol conditioned under the County's Groundwater Management Ordinance, baseline and periodic visual observation and flow estimates shall be performed at the Bonanza Spring in the Clipper Mountains, the Whiskey Springs in the Providence Mountains (near Colton Hills), and Vontrigger Spring in the Vontrigger Hills east of the Hackberry Mountains no less often than quarterly during the pre-operational and operational period of the Project and annually during the post-operational period. The Bonanza Spring will be monitored as an "indicator spring" because it is the spring that is in closest proximity to the Project wellfield (approximately 11 miles from the center of Fenner Gap). The Whiskey and Vontrigger Springs will be monitored to compare variations in spring flow from those springs to variations in spring flow from the Bonanza Spring to determine whether reductions of flow at the Bonanza Spring are attributable to the Project operations, or instead, are attributable to annual precipitation. Monitoring of groundwater levels in monitoring wells located between Bonanza Spring and the wellfield will also be conducted to provide data which could be used to correlate changes in groundwater levels attributed to the Project to changes in flow in the Bonanza Spring.

6.7.2 *Action Criteria*

The decision-making process will be initiated if the action criterion is triggered. The action criterion is a reduction in the average annual or seasonal flows at Bonanza Spring that exceed the baseline annual (or seasonal) flow fluctuations established as correlated to precipitation and established during the first 10 years of monitoring. If such a reduction of flow is measured, the decision-making process will be initiated.

6.7.3 *Decision-Making Process*

If the action criteria is triggered, the decision-making process will include:

- Assessment of whether the reduction in flow is attributable to Project operations and not the result of changes in annual precipitation or climatic conditions;
- If the reduction in flow is determined to be attributable to Project operations, one or more of the corrective measures shall be implemented.

6.7.4 *Corrective Measures*

Action(s) necessary to re-establish baseline flows shall include one or more of the following in addition to a reevaluation of the relationship between the aquifer and the springs within the watershed:

- Reduction in pumping from Project wells;
- Revision of pumping locations within the Project wellfield;
- Stoppage of groundwater extraction for a duration necessary to correct the predicted impact.

6.8 Air Quality

The EIR concludes that groundwater is not connected to the erosion potential of the Dry Lake surface soils and therefore the lowering groundwater levels beneath the Dry Lakes is not expected to increase dust generation from the Dry Lakes or otherwise affect regional air quality. Consistent with the recommendations of the Groundwater Stewardship Committee and as a conservative monitoring protocol to be conditioned by the County under its Ordinance, Cadiz will prepare a monitoring plan in consultation with the TRP to address possible sources of fugitive dust emissions (depth to groundwater, surface vegetation, surface soil chemistry) and local air quality over time (nephelometers and weather stations) to verify that the Project does not increase dust generation (i.e., particulate matter) from the Dry Lakes. The monitoring plan, at a minimum, shall set forth specific performance criteria and identify monitoring methods, the location of weather stations and nephelometers, measures to protect quality assurance and quality control, and reporting parameters. The monitoring plan shall be reviewed and approved by the County Representatives before the Project commences construction.

6.8.1 *Monitoring*

As described in Section 5.3, above, a network of observation wells will be established between the Project wellfield and Bristol and Cadiz Dry Lakes (see Figures 5-1 and 5-2). Groundwater levels will be monitored in many wells on a continuous basis throughout the term of the Project, which can help identify specific depths to groundwater and hydrological connections to surface soils and vegetation.

Furthermore, Cadiz will install weather stations and four nephelometers—upwind and downwind of the Bristol and Cadiz Dry Lakes—to establish baseline data of visibility in the valley, along with providing air quality data throughout the duration of Project operations. In addition, FVMWC will conduct annual visual observations at four points on each of the Dry Lakes to record surface soil conditions. The visual observations will note soil texture and record susceptibility to wind erosion. Photographs of the soil will be taken. This data will record conditions over time at the same locations on each of these Dry Lake surfaces.

These nephelometers will provide data on a daily basis that records opacity of the air, measuring the effect of dust on visibility. Data will be collected in the early years of the Project, establishing a baseline before groundwater levels beneath the Dry Lake are affected and will continue during Project operations. Since wind velocity and dust storms are highly variable, the data will record trends over time. Data from the nephelometers will be analyzed by FVMWC, with the results of the analysis and associated data summaries submitted annually to the TRP. This data will inform the TRP on the environmental setting, augmenting the weather station data, and provide information for the long term management of the facilities in the valley. The TRP will provide recommendations over time regarding modifications to the verification data collection activities if needed.

6.8.2 *Action Criteria*

The decision-making process will be initiated if the action criteria are triggered. The action criteria are (1) changes in annual average or peak concentrations of airborne particulate matter as measured by nephelometers that exceed average annual or peak baseline conditions by 5 percent or more, or (2) changes in surface soil conditions on the Dry Lakes that show a degradation of soil structure and increased susceptibility to wind erosion compared to baseline conditions established through monitoring prior to Project pumping. If such changes are measured, the decision-making process will be initiated.

6.8.3 *Decision-Making Process*

If the action criteria is triggered, the decision-making process will be include:

- Assessment of whether the change in air quality or soil conditions are attributable to Project operations;
- If air quality changes are determined to be attributable to Project operations or if degradation of soil structure and increased susceptibility of wind erosion are determined to be attributable to Project operations, one or more of the corrective measures shall be implemented.

6.8.4 *Corrective Measures*

Action(s) necessary to re-establish baseline airborne particulate levels and soil structure shall include one or more of the following:

- Reduction in pumping from Project wells;
- Revision of pumping locations within the Project wellfield;
- Stoppage of groundwater extraction for a duration necessary to restore baseline air quality conditions to correct for Project impacts.

6.9 Management of Groundwater Floor

Pursuant to the MOU, the parties agreed to (i) identify the groundwater levels that will serve as monitoring targets and a "floor" for the maximum groundwater drawdown level in the Project wellfield, and (ii) establish a projected rate of decline in the groundwater table. The floor and rate of decline are designed to, among other things, set a designated maximum drawdown elevation in the Project wellfield and help assess trends and operate the Project in a manner that avoids Undesirable Results or other physical impacts enumerated in the MOU (including saline water migration).

6.9.1 *Groundwater Management Level*

The Project may drawdown the aquifer in the center of the Project wellfield area to a maximum drawdown level (the "floor") of elevation 530 feet (80 feet below baseline elevations). The floor will be calculated as an average groundwater elevation over a 2-mile radius from the center of the Project wellfield area. Once the floor is reached, and absent approval of a new floor by the County, pumping must be reduced to a quantity at or below the amount that will maintain water levels at or above the 80-foot floor. The floor is a management level, meaning annual, short-term incursions below the floor (3 consecutive years or less) are acceptable under the following conditions:

(a) No management criteria or corrective actions under this Management Plant have been triggered as necessary to avoid the threat of Undesirable Results; and

(b) Average groundwater levels must remain at or above the floor as measured on a 10-year average.

6.9.2 *Monitoring*

As described above, monitoring wells will be placed within a two-mile radius of the center of the Project wellfields to monitor declines in groundwater levels and to develop data to evaluate actual rates of recharge. Monitoring wells, if they do not exist, will also be added between the Project wellfields and the Bristol and Cadiz Dry Lakes to monitor groundwater flow directions and saline groundwater migration outside this two-mile radius area. Groundwater levels and migration will be monitored on a continuous basis throughout the term of the Project.

6.9.3 *Adaptive Management*

Any time after 15 years of operation, FVMWC or SMWD may apply to the County to lower the floor below 530 feet (by 80 feet) to 510 feet (by 100 feet), on the following conditions:

(a) FVMWC or SMWD shall first consult with and obtain a recommendation from the TRP on whether the following requirements can be satisfied:

  (i) Sufficient operational data exists to support a decision concerning the floor or whether additional operational data is needed;

  (ii) The Project will achieve additional conservation benefits at the proposed floor; and

  (iii) The lowering of the floor will not trigger either the management criteria or the corrective actions under this Management Plan (other than the floor itself) in order to avoid the threat of Undesirable Results.

(b) The County must approve a lowering in the floor if it can make the following findings:

(i) Sufficient operational data exists to support a decision to lower the floor and avoid Undesirable Results;

(ii) The urban water management plans for each of the municipal water agencies and purveyors receiving water from the Project have disclosed the 50-year limit on the Cadiz water supply;

(iii) Additional conservation benefits will be realized at the proposed floor;

(iv) Lowering the floor would not result in the triggering of either the action criteria or the corrective actions under this Management Plan as necessary to avoid the occurrence of Undesirable Results; and

(v) There is no other threat of adverse environmental consequences that may arise due to changed or unforeseen circumstances.

(c) The new 510-foot (100-foot) floor would operate as a new management level, meaning annual, short-term incursions below the floor would be acceptable under the conditions set forth in Sections 6.9.1(a)-(b), above.

6.9.4 *Action Criteria*

The decision-making process will be initiated if the action criteria are triggered. The action criteria are trends in groundwater levels that demonstrate that the designated floor elevation will be exceeded within 10 years. If such changes are measured, the decision-making process will be initiated.

6.9.5 *Decision-Making Process*

If the action criteria is triggered, the decision-making process will be include:

- Assessment of trends and updated projections of whether and when the Project is anticipated to reach the designated floor;
- If it is determined that the groundwater levels may drop below the designated floor within 10 years, one or more of the corrective measures shall be implemented.

6.9.6 *Corrective Measures*

Action(s) necessary to manage or avoid incurring below the designated floor shall include one or more of the following.

- Reduction in pumping from Project wells;
- Revision of pumping locations within the Project wellfield;
- Stoppage of groundwater extraction for a duration necessary to correct the predicted impact.

CHAPTER 7
CLOSURE PLAN AND POST-OPERATIONAL REPORTING

A Closure Plan will be developed as part of this Management Plan to ensure that no residual effects of Project operations after 50 years will result in adverse impacts to the groundwater system and environment (as defined in Chapter 4) in or adjacent to the Project wellfield area and outlying areas that monitoring has determined have been influenced by Project operations.

7.1 Closure Plan Approval

A draft Closure Plan will be prepared by FVMWC and submitted to SMWD, the TRP, and the County no later than December 31 of the 25th year of Project operations. FVMWC will consult with the TRP to provide input and guidance throughout the development and refinement of the draft Closure Plan. The TRP shall submit a formal written recommendation to the County within one year of its receipt of the draft Closure Plan from FVMWC. A final Closure Plan will be approved by the County, as it determines appropriate in its discretion after consideration of the draft Closure Plan and any recommendations of the TRP.

Once prepared, the Closure Plan will be reevaluated every 5 years in consultation with the TRP. Such reevaluation may include refinements to the Closure Plan. Any modification to the Closure Plan must be reviewed and approved by the County.

7.2 Closure Criteria

Subject to additional or alternative terms and conditions that may be developed as part of the Phase II Imported Water Storage Component, the Closure Plan shall, at a minimum, include the following conditions:

- Monitor groundwater levels and groundwater quality for a minimum period of 10 years to confirm no significant environmental effects or Undesirable Results may occur and to protect critical resources and groundwater quality;

- All Project wells that are abandoned shall be destroyed in manner consistent with all applicable state and local regulations and industry standards;

- Injection wells or other mitigation to address saline water migration shall continue unless and until stable groundwater flow gradients from the wellfield toward the Dry Lake playas are restored such that the saline-freshwater boundary can be maintained naturally at 6,000′ (or less);

- The Project as proposed and approved is a 50-year project. Any proposal to pump water after Year 50 will require new discretionary approvals and subsequent environmental review. Post-closure groundwater pumping by the Project, if approved, would be expected to be limited to average rates at or less than the rate of recharge and as necessary to avoid Undesirable Results;

- The provisions and mitigation obligations under this Management Plan will remain in effect and run concurrently with the term of the Closure Plan; and

- To ensure that the Closure Plan can be fully implemented, FVMWC will establish and maintain an escrow account or other equivalent financial assurances mechanism for post-closure operations.

Under this Management Plan, FVMWC will collect data and review and analyze groundwater levels, water quality information, air quality, and other monitoring data, as well as prepare the annual reports for review by TRP and approval by the County. One purpose of the annual reports is to identify any actions that may be taken to ensure that any decline in groundwater levels would recover to levels necessary to protect critical resources and avoid Undesirable Results during or after the post-operational phases of the Project.

CHAPTER 8
PROJECT OVERSIGHT, MANAGEMENT, AND ENFORCEMENT

8.1 Technical Review Panel

An integral part of this Management Plan involves regular and ongoing review of data collected during the term of the Project. The understanding and analysis of the data will require technical expertise. For this reason, a Technical Review Panel (TRP) will be organized for the purpose of data review and analysis, report preparation, and advising the parties on technical aspects of the Project as set forth in Chapter 8. TRP Operating Procedures will be developed by the parties before the TRP is constituted to aid the TRP in fulfilling its roles under this Management Plan.

8.1.1 *Members*

The TRP shall consist of one technical representative appointed by the SMWD and one technical representative appointed by the County. Each of these individual appointments shall be in the discretion of the SMWD and the County, respectively. A third technical representative shall be jointly selected by the technical representatives from SMWD and the County, subject to review and approval by the County and SMWD. All three members of the TRP shall possess professional technical qualifications appropriate to the tasks of the TRP (e.g., state certifications in engineering, hydrology, or geology) and must have a minimum of 10 years professional experience working in the groundwater field. In the event the County and SMWD representatives cannot agree on the designation of the third representative, they may petition the San Bernardino Superior Court for the appointment of the third technical representative.

8.1.2 *Responsibilities*

The TRP is responsible for critical review and analysis of protocols for monitoring (including quality assurance and quality control) and methods of data collection and processing; data analysis, the rate of decline in the groundwater elevations; groundwater levels and quality; and the Project's potential to cause Undesirable Results. The TRP may make recommendations to SMWD and/or the County or SMWD and/or the County may request recommendations from the TRP on additional monitoring, mitigation, and modification to Project operations as set forth in Chapter 8.

As discussed above in Chapter 6, the TRP shall be responsible for data review and analysis along with advising SMWD and the County with respect to FVMWC's assessment of any triggering of an action criterion concerning a potential impact to a critical resource, corrective measures adopted, and any proposed refinements to the Management Plan. The TRP shall review data, technical analyses compiled by FVMWC, as well as FVMWC's assessment of technical data and responsive actions, proposed refinements to the Management Plan, and corrective measures regarding compliance with the provisions of the Management Plan. Determinations and recommendations from the TRP are to be provided to SMWD and the County for final oversight decisions. Whenever there are differing views among the TRP, those views will be provided, and the views of all members of the TRP shall be considered.

The TRP shall coordinate with FVMWC to review and monitor Project data and conditions in the northern Bristol/Cadiz Sub-Basin, as well as in the larger watershed area and adjacent region, including all information set forth for monitoring and reporting pursuant to Chapter 9 below, and shall issue recommendations to the County. The TRP may also undertake or cause to be made studies which may assist in determining the following: (i) status and trends in the progressive decline in groundwater levels and freshwater storage below the "floor" established in this Management Plan; (ii) the progressive decline in groundwater levels and freshwater storage at a rate greater than the established rate in this Management Plan; (iii) land subsidence; (iv) the progressive migration of hyper-saline water from beneath the Cadiz or Bristol Dry Lakes toward the Project wellsites; (v) increases in air quality particulate matter; (vi) loss of surface vegetation; or (vii) decreases in spring flows. FVMWC shall have the preliminary responsibility for collecting, collating, and verifying the data required under the monitoring program, and shall present the results thereof in annual monitoring reports provided to the TRP. FVMWC shall also make all raw data available to the TRP via an electronic network (e.g., a web page or FTP site within 90 days of its collection) or other appropriate means to enable regular updates on Project operation and management activities and to allow the TRP to verify the data and any results therefrom.

The TRP shall also review and comment to the County on annual reports developed by FVMWC as provided for in Chapter 9 belowl.

TRP's costs will be borne by FVMWC, including those of the technical representatives, provided that annual costs do not exceed $50,000 per year, escalated by 2 percent per year. Special reports recommended or prepared by the TRP may necessitate additional funding if so ordered by the County or SMWD or accepted by FVMWC.

8.1.3 *TRP Convening, Determinations, and Reporting*

As discussed above in Chapter 6, the TRP shall convene as necessary to review and advise the County with respect to any monitoring data or other assessments provided by FVMWC concerning the triggering of action criterion and any associated impacts to a critical resource, corrective measures adopted, and any proposed refinements to the Management Plan. The TRP shall also convene at least once every year to discuss and take action with respect to its other responsibilities set forth in Chapter 8. Convening of the TRP may occur by face-to-face meetings, telephone conferencing, or video conferencing.

The TRP shall designate one of its members as the Chair and this position shall shift among the members annually such that each member shall be the Chair every third year. The Chair shall take minutes of all convening meetings of the TRP, which shall be submitted to the County Representative and the SMWD Representative within 10 days of the TRP convening. The minutes shall also be submitted to the General Manager of SMWD within ten days of the TRP convening in order to facilitate SMWD's monitoring of compliance with those mitigation measures which correspond to provisions of the Management Plan.

Determinations and recommendations of the TRP shall require the affirmative agreement of at least two of the TRP Members, and the Chair shall notify the County Representative and SMWD's Representative in writing within 10 days of any determination by the TRP. In the event a determination or recommendation does not reach a consensus, the views and opinions of the dissenting member shall also be submitted.

8.2 Oversight and Enforcement by The County

The MOU and this Management Plan provide for the County to exercise oversight and enforcement of the Management Plan subject to the dispute resolution process referenced in Section 8.3, below. The County exercises its management authority over County groundwater resources through its Desert Groundwater Management Ordinance (Ordinance). Through the MOU and Management Plan, the County is responsible for ensuring that the Project is operated to avoid Overdraft[13] and Undesirable Results as set forth in the MOU. The County must separately fulfill its duties as a Responsible Agency under CEQA to ensure compliance with those measures in the MMRP that are within the County's jurisdiction.

The County Representative (Chief Executive Officer) will consider written reports submitted by the TRP and will review actions taken or recommended by FVMWC and the TRP. The County, in its sole determination, will issue any final determination of whether FVMWC's assessment of the triggering of action criteria and recommended responsive actions are appropriate based on all available technical data and are otherwise consistent with the EIR and its MMRP, the MOU, and the County Ordinance. If the County determines that FVMWC's assessment or recommended responsive actions are not appropriate, the County may order FVMWC to take alternative corrective actions as set forth in Chapter 6, above. If it is concluded by the County that corrective action or alternative corrective action is necessary, the County will provide notice of its determination and any administrative order in writing to FVMWC, SMWD,

[13] "Overdraft" means the condition of a groundwater supply in which the average annual amount of water withdrawn by pumping exceeds (i) the average annual amount of water replenishing the aquifer in any ten-year period, and (ii) groundwater that may be available as Temporary Surplus. MOU p. 3 ¶ 2(g).

and to each member of the TRP. FVMWC shall, within a time period reasonable to the applicable circumstances, comply with the determination and instructions set forth in SMWD's or the County's written administrative order. The County in its administrative order may specify the time period that it deems reasonable for FVMWC to implement any corrective actions under the given circumstances. With the exception of enforcement actions concerning the threat of immediate or irreparable injury, including actions necessary to avoid Overdraft or Undesirable Results, the County's written determinations and administrative orders will be subject to the dispute resolution provisions of the MOU as referenced in Section 8.3. Likewise, certain administrative actions by the County shall be subject to direct judicial review, as set forth in the MOU.

Because compliance with the Management Plan is a condition of SMWD's approval of the Project, SMWD in its discretion, will also consider the findings and actions taken or recommended by FVMWC and the TRP, and will exercise its own independent judgment concerning whether the triggering of the action criterion is attributable to Project operations, whether the triggering of the action criterion involves a potential adverse impact or Undesirable Result, and to determine the appropriate corrective measure(s) necessary to avoid or mitigate the potential adverse impact or Undesirable Result. If SMWD determines that appropriate corrective measure(s) are necessary to avoid or mitigate the potential adverse impact or Undesirable Result, but the County does not, SMWD will independently impose those corrective measures it determines necessary to avoid adverse impacts to critical resources or Undesirable Results, provided that independent enforcement by SMWD shall be subject to the same procedural requirements and remedies applicable as if the County were enforcing the Management Plan, including the dispute resolution procedure in Section 8.3.

Nothing in this process is intended to alter or supersede SMWD's responsibility, as the lead agency for the Project, to enforce, as a condition of Project approval, the implementation of all adopted mitigation measures, including those measures which correspond to provisions of the Management Plan.

8.3 Dispute Resolution

The County, SMWD, FVMWC, and Cadiz will exercise good faith and reasonable efforts to implement the Management Plan and to make any required determinations and resolve any issues, claims, or disputes that arise under the oversight and enforcement of the Management Plan, including without limitations matters concerning implementation and funding, the triggering of action criterion pertaining to critical resources, corrective measures, proposed refinements to action criteria or corrective measures, development and approval of the Closure Plan provided for in Chapter 7, edits to and completion of the reports provided for in Chapter 9, and any necessary actions to enforce the provisions of this Management Plan. As set forth in the MOU, in the event a dispute arises between the County, SMWD, FVMWC, and/or Cadiz relating to an action taken by FVMWC or a decision or determination concerning the County's and SMWD's management and enforcement responsibility under this Management Plan, the parties shall first attempt in good faith to resolve the dispute through informal means. In the event that such efforts are unsuccessful, any party may invoke the dispute resolution provisions set forth in Paragraph 8 of the MOU except where dispute resolution is excused due to the threat of immediate or irreparable injury (see MOU and Section 8.2, above).

CHAPTER 9
MONITORING AND REPORTING

9.1 Project Data Monitoring

Monitoring is essential to making informed decisions regarding Project operations. FVMWC will be responsible for preparation of the annual reports beginning one year after agreements for delivery of Project water are entered into or commencement of Project construction, whichever occurs first and Five Year Reports shall be prepared 5 years from commencement of Project construction.

9.2 Project Reports

9.2.1 *Annual Reports*

Each year during the operational and post-operational periods of the Project, an annual report shall be prepared by FVMWC that shall include a summary and analysis of all Project data obtained through the monitoring described in Chapters 5 and 6, above. The report shall also include any requested or suggested changes in the monitoring proposed to occur in successive years. In addition to the components required under Section 2.5.1 of the County Guidelines for Preparation of a Groundwater Management Plan (June 2000), annual monitoring reports will contain the following components:

- Summary of precipitation from climate stations;
- Baseline groundwater level and water quality conditions (as referenced in the EIR). Presentation of baseline conditions will include groundwater level elevation contours, water quality contours, and a figure showing the results of the initial land survey;

- Tables summarizing annual groundwater production for each Project extraction well and cumulative extraction from the Project;

- Tables summarizing depth to static water level and groundwater elevation measurements for all observation wells;

- Report on Bonanza, Whiskey and Vontrigger Springs, including visual observations such as starting and ending points of observed ponded or flowing water, estimated depth of ponded water and flow rate of flowing water, conductivity, pH and temperature of water, any colorations of water, and general type and extent of vegetation;

- Hydrographs for all production and observation wells;

- Groundwater elevation contours;

- Tables summarizing water quality analyses for the observation wells;

- Results of land subsidence monitoring surveys and any changes relative to baseline;

- Summary tables of any data collected from wells owned by neighboring landowners in proximity to the Project area (provided that permission was granted for such data collection);

- Summary of Project developments, such as changes in storage or extraction operations or construction of new production wells;

- Discussion of Project storage and extraction operations, and trends in groundwater levels and groundwater quality as compared to the baseline conditions;

- Updated groundwater flow, transport and variable density model results;

- Tables summarizing changes in frequency and severity of dust mobilization recorded on Bristol and Cadiz Dry Lakes and analysis correlating dust emissions with wind speed and direction, groundwater levels underlying the Dry Lakebeds and soil surface chemistry;

- Tables and figures (wind roses) summarizing wind data from regional meteorological towers addressing wind speed and direction, and stability frequency distributions. This data shall be collected during the operation phase of the Project, and may be extended if required by the County to address the post-operational (closure) period;

- Summary of FVMWC and TRP assessments, proposed refinements to the Management Plan, and corrective measures.

9.2.2 *Five-Year Reports*

As discussed in Chapters 2 and 4 above, it is anticipated that as the Project proceeds, new data and analysis as well as any new Project operational considerations will be used to refine the calibration of the Project's various water resources models. It is also appropriate to periodically report on observed trends in observed data from the monitoring features and predictions of future trends. Thus, a "Five-Year Report" shall be prepared 5 years from commencement of construction, and on every five-year anniversary thereafter. In addition to the report components required under Section 2.5.2 of the County's Guidelines for Preparation of a Groundwater Monitoring Report, the Five-Year Report shall report on the following matters in addition to the contents of previous annual reports:

- Changes to the number or locations of monitoring features;
- Changes in monitoring frequency;
- Changes in monitoring technology;
- Refinements in the action criteria for critical resources;
- Refinements in the models;
- Modifications of this Management Plan;
- Summary of total Project storage and extraction operations;
- Documentation of any trends in groundwater levels evident from the monitoring data;
- Hydrogeologic analysis and interpretation of all Project storage and extraction operations during the previous five-year period;
- Hydrogeologic analysis and interpretation of all water level elevation, water quality, and land survey data collected during the previous five-year period;

- Results of refined model output from the INFIL3.0 (or updated) model, saturated groundwater flow and solute transport models, the variable density groundwater flow model and the solute transport model;
- Detailed evaluation of impacts (if any) of Project operations on surface or groundwater resources;
- Proposed refinements to the Management Plan to address any identified gaps or inadequacies in the monitoring regimes or operational data;
- Summary of projections and trends associated with groundwater elevations and description of any Project operations designed to prevent declines in static groundwater levels in excess of the designated floor and projected rates of decline both during the operation and post-operational phases of the Project;
- Documentation of any trends in water quality measurements or migration in the saline boundary evident from the monitoring data;
- Aquifer specific contours of the most recent static groundwater level elevations and groundwater level elevation changes over the previous 5 years;
- Documentation of any complaints or possible impacts to wells owned by neighboring landowners recorded for the period;

- Tables summarizing changes in frequency and magnitude (to the extent that can be determined from the data) of dust mobilization recorded on Bristol and Cadiz Dry Lakes, and analysis correlating wind-mobilized particulate matter with wind speed and direction, groundwater levels underlying the Dry Lakebeds, and soil moisture on the lakebed surfaces;
- Summary and trends of regional wind and air quality data with conclusions for potential for Project-mobilized lakebed dust to be transported throughout the Mojave Desert region; and
- Once the draft Closure Plan is developed on or before Year 25 of operations, recommended revisions to the Closure Plan.

All Five-Year Reports will include electronic data files and model input and output files. The annual reports will be available to agencies, organizations, interest groups, and the general public upon written notification to the County. All Five-Year Reports shall be distributed to the lead and responsible agencies and made available to the public electronically.

9.2.3 *Report Preparation Process*

The draft reports and supporting data as provided for in this chapter shall be prepared by FVMWC and submitted to the TRP, General Manager of SMWD, and the County Representative on or before April 1 of each year for Annual Reports, and on or before December 31 for Five-Year Reports. Annual reports prepared for any continuing agricultural operations by Cadiz shall also be provided. The TRP shall then review the report and determine whether any recommended edits or additions are appropriate, which it shall provide to the County Representative, FVMWC, and the General Manager of SMWD within 45 days of receipt from FVMWC.

Within 60 days of receipt of the TRP's recommendation, the County Representative shall then consider the report and any recommended edits or additions by the TRP, and determine whether the report is complete or requires revisions or additions. If complete, the County shall accept and file the report as complete and provide written notice of its determination to FVMWC, SMWD, and the TRP. If questions arise and revisions are required, however, FVMWC shall submit a revised report to the TRP, the General Manager of SMWD, and the County Representative within 45 days of notice of the County Representative's request for revisions or clarifications. If, upon receipt of the revised report, questions or disputes over the content of the report remain, any party may either meet and confer on a mutual resolution of the final report or invoke the Dispute Resolution provisions in Section 8.3 of this Management Plan.

Table 5.1

Critical Resource Area	**Feature No.**	**Monitoring Features**		**No.**	**Pre-Operational Monitoring Frequency**			**Operational Monitoring Frequency Extraction**			**Post-Operational Monitoring Frequency**		
					Water Level	**Water Quality**	**Other Monitoring**	**Water Level**	**Water Quality**	**Other Monitoring**	**Water Level**	**Water Quality**	**Other Monitoring**
Springs	**1**	**Springs, Monitoring**	Existing	3	-	-	Quarterly, Visual Observations and Flow at 3 Springs	-	-	Quarterly, Visual Observations and Flow at 3 Springs	-	-	Annual, Visual Observations and Flow 3 Springs
Aquifer System	**2**	**Observation Wells (16 total)**	Existing	12	Monthly	4 Quarterly, 8 Annually	-	Monthly for First 3 Months of Cycle, then Semi-Annually	Annually	-	Annually	Triannually	-
			Existing	2	Continuous	Annually	-	-	Annually	-	Annually	Triannually	-
			New	2	Monthly	Quarterly	-	Monthly for First 3 Months of Cycle, then Semi-Annually	Annually	-	Annually	Triannually	-
	3	**Project Area Well Clusters - Saturated Zone Only (1 x 3 well cluster + 2 x 2 well cluster = 2 existing and 3x2 new well**	Existing	5 wells	Continuous	Quarterly	-	Continuous	Semi-Annually	-	Continuous (Until No Longer Deemed Necessary)	Annually	-

		cluster for 5 total Clusters)	New	6 wells	Continuous	Quarterly	-	Continuous	Semi-Annually		Continuous (Until No Long Deemed Necessary)	-Annually	-
	4	**Production Wells (34 total)**	Existing	5	Depth to Water Upon Completion	Sample after completion	-	Continuous	Composit e Quarterly	Summarize Data Monthly	Annually	-	-
			New	29	Depth to Water Upon Completion	Sample after completion	-	Continuous	Composit e Quarterly	Summarize Data Monthly	Annually	-	-
	5	**Land Surface Elevation Surveys (20 total)**	New Benchmark	20	-	-	Annually, reduce if warranted	-	-	Annually, reduce if warranted	-	-	Annually, reduce if warranted
			InSAR (New)	2/yr (If Warranted)	-	-	Once	-	-	Every 5 years	-	-	Twice at 5-year interval
	6	**Extensometer (3 total)**	New	3	-	-	Establish baseline	-	-	Records Daily	-	-	Summarize data annually
Aquifer System	**7**	**Flowmeter Surveys (5 total)**	New	5	-	One Time	One Time	-	-	-	-	-	-
Bristol and Cadiz Dry Lakes	**8**	**Bristol Dry Lake Well Clusters (2 per Cluster x 3 total Clusters)**	New	3 clusters 6 wells	Continuous	Quarterly	-	Continuous	Semi-Annually	-	Continuous (until no longer deemed necessary)	Annually as necessary	-

	9	**Cadiz Dry Lake Well Clusters (2 per Cluster x 3 total Clusters)**	New	3 clusters 6 wells	Continuous	Quarterly	-	Continuous	Semi-Annually	-	Continuous (until no longer deemed necessary)	Annually as necessary	-
	10	**Gamma / EM Logs (up to 6 total)**	New	6	-	-	One Time	-	-	-	-	-	-
Other (Regional)	**11**	**Weather Stations (4 total)**	Existing	3	-	-	Records Daily	-	-	Records Daily	-	-	-
			Cadiz Field Office	1	-	-	Records Hourly	-	-	Records Hourly	-	-	-
Air Quality	**12**	**Nephelometers**	New	4	-	-	Hourly	-	-	Hourly	-	-	-

NOTES:
a - See Table 5-2 for details of monitoring features.
b - Monitoring frequencies pertain to the initial monitoring period of each program operational phase. Monitoring frequency may be increased or decreased based on the initial monitoring results.

Table 5.2

Critical Resource Area	Feature No.	Feature Type	When Monitored	Name	State Well Number	Location Coordinates	Monitoring Protocol		
							Water Level	Water Quality	Other Monitoring
Springs in the Mojave National Preserve and BLM Wilderness Area	1	Springs, Monitoring	Pre-Operational Operational Post-Operational	Bonanza Spring	NA	34° 41' 08" N 115° 24' 20" W	-	-	See Section 5.1 and 6.1
		Springs, Monitoring	Pre-Operational Operational Post-Operational	Whiskey Spring	NA	34° 59' 52" N 115° 26' 59" W	-	-	See Section 5.1 and 6.1
		Springs, Monitoring	Pre-Operational Operational Post-Operational	Vontrigger Spring	NA	35° 03' 20" N 115° 08' 52" W	-	-	See Section 5.1 and 6.1
Aquifer System	2	Observation Well	Pre-Operational Operational Post-Operational	Dormitory	5N/14E-5F1	34° 32' 38" N 115° 31' 57" W	Transducer, See Sections 5.2 and 6.3	See Appendices B, C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	6/15-1	6N/15E-01H	34° 38' 23" N 115° 21' 22" W	Transducer, See Sections 5.2 and 6.4	See Appendices B, C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	6/15-29	6N/15E-29P1	34° 34' 20" N 115° 26' 04" W	Transducer, See Sections 5.2 and 6.4	See Appendices B, C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	SCE-11	4N/14E-13J1	34° 25' 51 N 115° 27' 25" W	Transducer, See Sections 5.2 and 6.5	See Appendices B, C & D	-

		Observation Well	Pre-Operational Operational Post-Operational	CI-3	5N/14E-24D2	34° 30' 40" N 115° 28' 01" W	Transducer, See Sections 5.2 and 6.6	See Appendices B, C & D	-
		Observation Well	Pre-OperationalOperationalPost-Operational	Archer Siding #1	4N/15E-24E1	34° 25' 11" N115° 21' 57" W	Manual,See Appendix B	See Appendices C & D	-
Aquifer System	2	Observation Well	Pre-Operational Operational Post-Operational	Essex	8N/17E-31	34° 43' 49" N 115° 14' 53" W	Manual, See Appendix B	See Appendices C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	Fenner	8N/17E-2	34° 48' 59" N 115° 10' 40" W	Manual, See Appendix B	See Appendices C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	Goffs	10N/18E-26	34° 54' 57" N 115° 03' 44" W	Manual, See Appendix B	See Appendices C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	Labor Camp	5N14E-16H1	34° 31' 22" N 115° 30' 46" W	Transducer, See Sections 5.2 and 6.6	See Appendices B, C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	SCE-5	5N/14E-32N1	34° 28' 17" N 115° 32' 37" W	Manual, See Appendix B	See Appendices C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	SCE-10	5N/14E-34Q1	34° 28' 22" N 115° 29' 59" W	Manual, See Appendix B	See Appendices C & D	-
		Observation Well	Pre-OperationalOperationalPost-Operational	SCE-17	5N/14E-29B1	34° 29' 54" N115° 31' 58" W	Manual,See Appendix B	See Appendices C & D	-

		Observation Well	Pre-Operational Operational Post-Operational	SCE-18	5N/13E-11R1	34° 26' 37" N 115° 34' 59" W	Manual, See Appendix B	See Appendices C & D	-
Aquifer System	2	Observation Well	Pre-Operational Operational Post-Operational	Danby-1	5N/13E-11R1	34° 26' 37" N 115° 34' 59" W	Manual, See Appendix B	See Appendices C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	Piute-1	TBD	34° 57' 22" N 114° 48' 16 W	Manual, See Appendix B	See Appendices C & D	-
	3	Project Area Well Cluster-Groundwater (3 well Cluster)	Pre-Operational Operational Post-Operational	MW-7a MW-7 TW-1	TBD	34° 31' 39" N 115° 26' 55" W	Transducer, See Sections 5.3 and 6.4	See Appendices C & D	Monitor Alluvium/Carbonates/Bedrock
		Project Area Well Cluster-Groundwater (2 well Cluster)	Pre-Operational Operational Post-Operational	TW-2MW TW-2	TBD	34° 31' 13" N 115° 26' 57" W	Transducer, See Sections 5.3 and 6.4	See Appendices C & D	Monitor Alluvium//Bedrock
		Project Area Well Cluster-Groundwater (2 well Cluster)	Pre-Operational Operational Post-Operational	New Cluster Well	TBD	TBD	Transducer, See Sections 5.3 and 6.4	See Appendices C & D	Monitor Alluvium//Bedrock
		Project Area Well Cluster-Groundwater (2 well Cluster)	Pre-Operational Operational Post-Operational	New Cluster Well	TBD	TBD	Transducer, See Sections 5.3 and 6.4	See Appendices C & D	Monitor Alluvium/Bedrock
		Project Area Well Cluster-Groundwater (2 well Cluster)	Pre-Operational Operational Post-Operational	New Cluster Well	TBD	TBD	Transducer, See Sections 5.3 and 6.4	See Appendices C & D	Monitor Alluvium/Bedrock
	4		Operational	28	5N/14E-28Q1	34° 31' 05" N 115° 29' 59" W	-	-	See Sections 5.4

	4		Operational	27N	5N/14E-27B1	34° 29' 54" N115° 29' 59" W	-	-	See Sections 5.4
			Operational	27S	5N/14E-27Q1	34° 28' 14" N 115° 29' 59" W	-	-	See Sections 5.4
Project Area Aquifer	4		Operational	21S	5N/14E-21P1	34° 30' 08" N 115° 31' 12" W	-	-	See Sections 5.4
			Operational	33	5N/14E-33K1	34° 28' 32" N 115° 31' 07" W	-	-	See Sections 5.4
		New Production Wells (29 total)	Operational	TBD (see Figure 5-2)	TBD	TBD	-	-	See Sections 5.4
	5	Benchmark Stations (20 total)	Pre-Operational Operational Post-Operational	TBD	NA	TBD	-	-	See Sections 5.5 and 6.3
		InSAR (2 per year)	Pre-Operational Operational Post-Operational	NA	NA	NA	-	-	See Sections 5.5 and 6.3
	6	Extensometer (3 total)	Pre-Operational Operational Post-Operational	TBD	NA	TBD	-	-	See Sections 5.5 and 6.3
	7	Flowmeter Surveys (5 total)	Pre-Operational	TBD	TBD	TBD	-	-	See Section 5.7

		Bristol Dry Lake Well Cluster[b]	Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Sections 5.8, 5.9, 6.4 and 6.5	See Appendices C & D	-
	8	Bristol Dry Lake Well Cluster[b]	Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Sections 5.8, 5.9, 6.4 and 6.5	See Appendices C & D	-
		Bristol Dry Lake Well Cluster[c]	Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Sections 5.8, 5.9, 6.4 and 6.5	See Appendices C & D	-
Bristol and Cadiz Dry Lakes		Cadiz Dry Lake Well Cluster[d]	Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Sections 5.8, 5.9, 6.4 and 6.5	See Appendices C & D	-
	9	Cadiz Dry Lake Well Cluster[d]	Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Sections 5.8, 5.9, 6.4 and 6.5	See Appendices C & D	-
		Cadiz Dry Lake Well Cluster[e]	Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Sections 5.8, 5.9, 6.4 and 6.5	See Appendices C & D	-
	10	Gamma/EM Logs (up to 6 total)	Pre-Operational	TBD	TBD	TBD	-	-	See Section 5.10
Other (Basin-wide)	11	Weather Station	Pre-Operational Operational Post-Operational	Amboy	NA	34° 31' 52" N 115° 41' 42" W	-	-	See Section 5.11

		Weather Station	Pre-Operational Operational Post-Operational	Mitchell Caverns	NA	34° 56' 06" N 115° 30' 58" W	-	-	See Section 5.11
		Weather Station	Pre-Operational Operational	Fenner Gap	NA	34° 30' 57" N 115° 27' 45" W	-	-	See Section 5.11
		Weather Station	Pre-Operational Operational Post-Operational	Cadiz Field Office (CIMIS Station)	NA	34° 30' 49" N 115° 30' 39" W	-	-	See Section 5.11
Air Quality	12	Nephelometers	Pre-Operational Operational Post-Operational	TBD	NA	TBD			See Section 5.12

NOTES:
a - Location coordinates to be verified in the field during initial Pre-Operational activity.
b - Two new well clusters to be installed at eastern margin of Bristol Dry Lake (see Figure 5-1).
c - One new well cluster to be installed on Bristol Dry Lake (see Figure 5-1).
d - Two new well clusters to be installed north of Cadiz Dry Lake (see Figure 5-1).
e- One new well cluster to be installed on Cadiz Dry Lake (see Figure 5-1).
Also see Table 5-1 for details of proposed monitoring features and frequencies.

Table 6.1

Cadiz Groundwater Conservation Recovery and Storage Project

Summary of Action Criteria, Impacts and Corrective Measures

Potential Impact	Method of Measurement	Triggers (Action Criteria)	"Close Watch" Measures	Corrective Measures
Third-Party Wells	Groundwater observation wells; voluntary third-party well monitoring	A decline of static water levels of more than twenty (20) feet from pre-Project static water levels or to a degree in which the reduction in static water levels results in an inability to meet existing production of any third-party well drawing water from the northern Bristol/Cadiz Sub-Basin or elsewhere in the Fenner Watershed Receipt of a written complaint by from one or more well owner(s) regarding documented decreased groundwater production yield, degraded water quality, or increased pumping costs submitted by neighboring landowners or the salt mining operators on the Bristol and Cadiz Dry Lakes	Investigation to determine if caused by Project operations, and significance of impact Provision of substitute water to impacted party	Continued provision of substitute water supplies Deepen or otherwise improve the efficiency of the impacted well(s) Blend impacted well water with another local source Construct replacement well(s) Compensation Enter into a mitigation agreement
Land subsidence	Benchmark stations; InSAR; extensometers	Land surface elevation changes of greater than -0.3 ft within ten years when	Determine if elevation changes were directly attributable to Project	Repair damaged structures Enter into a mitigation

		compared to baseline conditions A declining trend which if continued would be of a magnitude within ten years which impacts existing infrastructure in the Project area. The magnitude for railroad tracks is more one inch vertically over 62 feet linearly along the existing railroad tracks	operations Conduct ground surveys to look for evidence of differential compaction	agreement Modification of Project wellfield operations to arrest subsidence
Induced flow of lower-quality water from Bristol and Cadiz Dry Lakes	Groundwater observation wells and cluster wells at Dry Lakes; cluster wells and sentinel wells between Dry Lakes and well-field	TDS concentration changes in excess of 600 mg/L at cluster wells located within a distance of 6,000 feet from pre-Project locations of the interface	Determine if concentration changes are directly attributable to Project operations Determine saline-freshwater interface is expected to migrate more than 6,000 feet within ten years Install additional observation wells to further assess saline water migration	Compensation Installation of injection and/or extraction well(s) to maintain saline-freshwater interface within its 6,000-foot limit Modification of Project operations to maintain beneficial use
Brine resources underlying Bristol and Cadiz Dry Lakes	Groundwater observation wells and cluster wells at Dry Lakes	Changes in brine water levels of greater than 50 percent above water column of the brine company's pump intake in comparison to pre-operational static levels in cluster wells at the margins of the Dry Lakes Receipt of a written complaint from salt mining company	Determine if brine water level changes are directly attributable to Project operations	Compensation Installation of injection and/or extraction well(s) Enter into a mitigation agreement Modification of Project operations to maintain beneficial use

Adjacent groundwater basins	Groundwater observation wells	No action criteria necessary; verification monitoring only	None	None
Springs	Visual observation and manual flow measurements annually of bonanza, whiskey, and Vontrigger springs and groundwater levels measurements in observation wells	Reduction in average annual or seasonal flow at Bonanza Spring as correlated to precipitation	Determine if reduction in flow is attributable to Project operations	Modification of Project operations to re-establish baseline flow
Air quality	Groundwater observation wells (cluster wells at Dry Lakes), open-air nephelometers Soil testing	Changes in air quality that exceed baseline conditions by 5 percent Changes in soil conditions showing degradation of soil structure	Determine if change is air quality or soil structure is attributable to Project operations	Modification of Project operations to re-establish baseline air quality levels
Management of groundwater drawdown	Well monitoring within 2-mile radius of center of Project wellfield	Lowering of groundwater level in Project wellfield area below management "floor."	None.	Modification of Project operations to avoid drawdown below management "floor."

APPENDIX A

Groundwater Stewardship Committee Final Report

April 2012

GROUNDWATER STEWARDSHIP COMMITTEE

April 2012 Summary of Findings and Recommendations
Cadiz Groundwater Conservation, Recovery and Storage Project

The Groundwater Stewardship Committee (GSC) is a multi-disciplinary panel of earth science and water professionals assembled to provide advice and comment on the proposed Cadiz Conservation, Recovery and Storage Project (Project). The GSC specifically reviewed:

1) Project operating strategies to maximize the beneficial use of groundwater without causing harm to the resource, natural and built environment and community, and

2) proposed monitoring and mitigation strategies to be incorporated into a groundwater management plan for the Project.

Maximizing beneficial use of groundwater is defined as reducing the loss of groundwater to evaporation from the dry lakes by pumping and delivery of this water to meet Southern California water demands. The roster of the GSC members is attached.

Project background.

The Project site is located at the base of the Fenner Valley Watershed and Orange Blossom Wash upgradient of the Bristol and Cadiz Dry Lakes. The combined area of these watersheds is in excess of 1,300 square miles. Cadiz, a private company, owns land, under which the bulk of the groundwater flows, and on which the Project facilities will be located. The GSC understands that the Company has access to the ARZC Railroad right of way that provides private pipeline access to the Colorado River Aqueduct. The GSC understands that Cadiz actively farms approximately 1,500 acres under prior land use approvals and could expand the operation to as many as 9,600 acres.

As proposed, the Project would be implemented in two phases. The first phase emphasizes control of hydraulic gradients by groundwater pumping that would provide for:

1) active capture of natural recharge, within the watershed, and

2) recovery of groundwater, presently in storage, that would otherwise continue to flow under natural gradients toward the dry lakes and be lost to evaporation.

The Project would withdraw an average of 50,000 acre-feet per year (AFY) over a 50-year period, with individual annual extractions varying in any year between 25,000 to 75,000 acre feet to suit the needs of the people of Southern California. The GSC understands that future water conservation would benefit from the dewatered storage in the aquifer (effectively a “subsurface reservoir”) and hydraulic control that will allow deep and secure storage of large quantities of imported water. Imported water can be stored as the volume of dewatered storage increases and elimination of hydraulic gradients away from the well field toward the dry lakes. The GSC did not evaluate the technical proposals for future conservation. However, the GSC supports the general concept and is willing to review or comment upon any such proposals.

GSC findings and recommendations.

The GSC was presented with historical and new technical investigations of geology, hydrogeology, climatic data, groundwater recharge, groundwater conditions, water quality, air quality, and plant and vegetation surveys. These reports document no observed plant or wildlife that relies upon groundwater (except springs in the mountains, which are not dependent upon the alluvial aquifer from which the Project wells will extract groundwater). The GSC reviewed technical reports prepared by Cadiz consultants to evaluate potential impacts for the first phase of the Project in four specific areas including: (1) subsidence; (2) springs; (3) air quality; and (4) water quality degradation.

The current estimate of natural recharge estimate is approximately 32,500 acre-feet per year. This is based upon modeling of the catchment area recharge and supported by both numerical modeling of groundwater flow and recent direct measurements of evaporation from Bristol and Cadiz Dry Lakes. However, as other estimates of recharge had been developed by other previous investigators, to assess the potential magnitude of impacts, the modeling and impact analysis employed three different recharge scenarios; 5,000 AFY, 16,000 AFY and 32,000 AFY. The Project is designed to extract an average of 50,000 AFY regardless of actual natural recharge, so this range of natural recharge was assessed to examine the impacts of the Project extraction, allowing for conservative natural recharge estimates and assessment of potential impacts.

The anticipated withdrawal of groundwater in the proposed well field will intercept natural recharge and retrieve groundwater in storage that is currently escaping to the dry lakes. The range of potential evaporation from the dry lakes has been estimated to be between 12,000 AFY on the low end and as high as 143,000 AFY on the high end. However, actual evaporation is expected to balance actual recharge, so that long-term average annual recharge is equal to the long-term average annual evaporation off the dry lakes. Although there is some variability in the projected evaporation rates from the dry lakes, assuming the highest evaporation over a 100-year period, as much as 2.2 million acre-feet could be saved from evaporation, and used for public benefit if the Project is implemented as proposed. To achieve this objective, there will be potential drawdown in well-field groundwater levels that may range from 70 feet to 270 feet depending upon the actual quantity of natural recharge, variations in aquifer hydraulic properties, and well-field design. Based on the information available, the committee finds that the average annual extraction of 50,000 AFY for 50 years is feasible and that total average annual extraction of 50,000 AFY can be applied to the cumulative agricultural and Project demands. The GSC understands that if the Project is carried out as proposed, to produce an annual average of 50,000 AFY for delivery to Project participants, the agricultural use of groundwater is expected to cease.

The GSC reviewed and discussed the methods of investigation and evaluation and concludes that these analyses are reasonable and consistent with standard professional practice and adequately assess the four identified areas of potential impacts from the proposed Project, as described below.

Subsidence. Significant subsidence is not expected in any of the scenarios. The Fenner Gap area is underlain by sediments that are not rich in clays and silts, which are normally associated with subsidence. There is increasing silt and clay content in the alluvial aquifer sediments nearer the dry lakes, which is where subsidence, if any, is projected to be 2.7 feet under the lowest natural recharge scenario which creates the highest groundwater drawdown. Permanent compaction due to subsidence would not significantly impact the alluvial aquifer's storage capacity as consolidation of the aquifer will occur in clay and silt intervals, which do not contribute significantly to the useable storage capacity. However, we recommend that the Project managers consult with the railroad and pipeline companies and include extensive monitoring for early warning in the interest of safety. Monitoring through the use of extensometers, designated bench marks, In-SAR (interferometric synthetic aperture radar), and the ability to manage pumping patterns in concert with the monitoring in the event significant subsidence is observed would mitigate problems.

The springs. The springs in the watershed area rely on rainfall recharge of shallow fractured bedrock, and there is no evidence that the springs are dependent on the deep alluvial groundwater system from which the Project proposes to pump groundwater or that they will be affected in any way by the pumping. All of the springs are more than 11 miles away and are located in fractured crystalline (granitic and metamorphic) rocks at substantially higher elevations than the alluvial aquifer from which the Project wells will pump groundwater. Therefore, pumping in the alluvial aquifer in the Project well field should not affect groundwater levels in these crystalline rocks, so it will not adversely impact springs. Nevertheless, the GSC supports ongoing observation of the springs and the flow conditions as proposed, including the closest spring (Bonanza Spring), and several more distant springs (such as Whiskey and Vontrigger) for comparison and to account for climatic changes.

Air quality. The GSC reviewed the technical reports provided on the Bristol and Cadiz Dry Lakes that conclude that these dry lakes do not pose a substantial risk of elevated dust levels arising from the underlying sediments being dewatered. High concentration of chloride salts in the surface soils act to bind the surface soils so as to minimize soil becoming airborne as dust. The GSC also reviewed the technical report on the dry lakes that revealed that plant life in the area of the dry lakes is precipitation and runoff fed and does not rely upon groundwater. The evidence presented in these reports seems conclusive. However, verification monitoring is strongly recommended to confirm these conclusions. Monitoring can be relaxed if these findings are further proven during Project operations.

Water quality. The migration of saline (> 1,000 mg/l) groundwater towards the well field is predicted by modeling to be less than 12,000 feet. The modeling demonstrates that the movement is not increased under the higher drawdown levels that are associated with the lower recharge rates, as these scenarios have low aquifer transmissivity. There are no known or projected beneficial users of fresh (<1,000 mg/l) groundwater in the affected area. However, monitoring and mitigation elements of the groundwater management plan are proposed to monitor this condition. If necessary and appropriate, the migration could potentially be stabilized through either extraction of saline groundwater (which possibly could be used by the salt mines), injection of fresh water to create a barrier to mitigate further migration, or alteration of pumping patterns. These approaches are reasonable.

Concluding summary

The GSC finds that the average annual extraction of 50,000 AFY for 50 years is feasible. The GSC concludes that the monitoring, proposed action criteria, and mitigation elements are reasonable and, if adopted, should provide assurance against harm resulting from the conservation, recovery, and beneficial use of groundwater as proposed in the Project. The GSC recommends that proposed monitoring elements be adopted and incorporated into a groundwater management plan for the Project.

GROUNDWATER STEWARDSHIP COMMITTEE MEMBERS

- Jack Sharp, Professor of Geology, University of Texas (Chair)
- Terry Foreman, CH2M Hill
- Dennis Williams, Geoscience
- Bill Blomquist, Indiana University
- Andrew Stone, American Ground Water Trust
- Greg Thomas, Natural Heritage Institute
- Bob Wilkinson, The Bren School of Environmental Science and Management, University of CA at Santa Barbara
- Steve McCaffrey, University of the Pacific, McGeorge School of Law
- Rod Banyard, Australia Water Policy Branch, Department of Environment and Water Resources
- Tim Parker, Parker Groundwater
- Toby Moore, Golden State Water Company
- Charles Groat, Director of the Center for International Energy and Environmental Policy, University of Texas

Dr. John M. Sharp, Professor Geology, University of Texas

EDUCATION:
Ph.D., 1974, M.S., 1974, University of Illinois. Ph.D. dissertation: An Investigation of Energy Transport in Thick Sequences of Compacting Sediments.
32 semester hours, Midwestern University. Business Administration (attended nights while in the U.S. Air Force). Emphasis on economics and management science.
B. Geological Engineering with Distinction, 1967, University of Minnesota (emphasis on rock mechanics, porous media flow, and site development). B.Geol.E. thesis: Eastern Minnesota Copper Prospects, 43p.

PROFESSIONAL EXPERIENCE:
The University of Texas, Austin, Texas: 1982-present, currently David P. Carlton Professor of Geology
C.S.I.R.O. Centre for Groundwater Studies, Adelaide, Australia, 1994, visiting scientist
U.S. Geological Survey, Reston, Virginia, 2010 , visiting scientist
University of Missouri, Columbia, Missouri: 1974 -1982, associate professor
University of Illinois, Urbana, Illinois: 1971-1974, Teaching Assistant and Research Fellow
U.S. Air Force: 1967-1971 – Captain (civil engineering)

SELECTED SERVICES TO PROFESSION:
Geological Society of America: President and Councilor; Executive Committee; Finance Committee; GSA representative to the Council of Scientific Society Presidents; Editor, Environmental and Engineering Geoscience; GSA Representative to U.S. Committee, International Assoc. of Hydrogeologists; Associate Editor, Geological Society of America Bulletin; Chairman, Hydrogeology Division

American Institute of Hydrology: Chairman, Board of Registration; Executive Committee; Vice President for Academic Affairs; Registration Board; Editorial Board: Hydrological Science and Technology

National Research Council: Advisory Committee on the Waste Isolation Pilot Plant (WIPP)

International Association of Hydrogeologists: Scientific Advisory Committee, 2012 International Conference on Groundwater in Fractured Rocks, Prague, Czech Republic; North American Scientific Advisory Committee,2012 39th Congress, Niagara Falls, Canada; Executive Committee & Finance Committee (US National Committee); Treasurer; Chairman (US National Committee); co-editor, Selected Papers Volume 9, Groundwater in Fractured Rocks; Vice Chairman, Commission on Education and Training; Vice President; Associate editor, Journal of Hydrogeology
Council of Scientific Society Presidents:; 2010 Treasurer; 2009-2011 Board of Directors

Other miscellaneous services to profession:

Editor board, Aqua mundi
Biological Advisory Team for the Barton Springs/Edwards AquiferConservation District
Edwards Aquifer Authority, Aquifer Sciences Advisory Panel
Luminant Energy (formerly Texas Utilities Co.) Environmental Steering Committee

Terry Foreman, Vice-President, CH2M Hill, Thousand Oaks, CA

Terry Foreman's roles at CH2M HILL include Senior Hydrogeologist, Vice President and the Thousand Oaks Area Office Manager. Mr. Foreman's technical expertise is in the management and development of groundwater resources, including water supply development, conjunctive use of surface waters, groundwater, and recycled water, remediation of contaminated groundwater, and regulatory support. Mr. Foreman has over 30 years of consulting experience in water resources projects, mostly in the Southwestern United States. Mr. Foreman has served as project manager for the Las Posas Basin ASR project, the largest ASR project in California, the West Basin Water Recycling Program Injection Barrier Project, which involves injection of highly treated wastewater into the 9-mile long West Coast Basin Seawater Intrusion Barrier, the Dominguez Gap Seawater Intrusion Barrier Extension project. Mr. Foreman has authored over 30 technical papers and presentations. Mr. Foreman received his Bachelors and Masters degrees in Geology from the University of Missouri – Columbia. He is a Registered Geologist and Certified Hydrogeologist in California. He is on the Board of Directors of the American Ground Water Trust, where he has held offices of Secretary, Vice Chairman, and Chairman (2002). He is the President of the Central Coast Branch of the Groundwater Resources Association of California.

Dennis Williams, Geoscience

Dr. Dennis E. Williams, founder and president of the Southern California based firm GEOSCIENCE Support Services, Inc. has over 35 years of experience in ground water hydrology. During that time he has directed geohydrologic investigations domestically and worldwide which includes the design and supervision of construction of over 800 deep large-scale municipal and irrigation water supply wells. Dr. Williams also pioneered the use of slant wells for desalination feedwater supply. He has been a consultant to the United Nations and several foreign governments and is currently a part-time research professor at the University of Southern California's Civil and Environmental Engineering Department where he has taught graduate level courses in geohydrology and ground water modeling since 1980. Dr. Williams is currently directing research on ground water and wells at USC's geohydrologic laboratory which houses the largest sand-tank model in the world. Dr. Williams is author of over 30 publications on ground water and wells and was the principal author of the Handbook of Ground Water Development (John Wiley & Sons, 1990); the Handbook was awarded Honorable Mention in the

Engineering Category of the Fifteenth Annual Awards for Excellence in Professional and Scholarly Publishing by the Association of American Publishers. Dr. Williams was also chief reviewer for the American Society of Civil Engineers (ASCE) Manual of Water Well Design, Construction, Testing and Maintenance and primary author for two chapters, Water Well Construction, and Developing and Testing, and of Appendix Example of Water Well System Design (currently in press). Dr. Williams is a contributor for three entries in the Encyclopedia of Water: “Radial Wells”, “Well Tests”, and “Well Screens” published by John Wiley and Sons. Dr. Williams is a technical consultant to the American Water Works Association (AWWA) Standards Committee for Wells (ANSI/AWWA A100-04).

William Blomquist, Dean, School of Liberal Arts, Indiana University

William Blomquist is Dean of the School of Liberal Arts, Professor of Political Science, and Adjunct Professor of Public and Environmental Affairs, at Indiana University Purdue University Indianapolis (IUPUI). He is also an affiliated faculty member of the Workshop in Political Theory and Policy Analysis, and the Center for Earth and Environmental Science. The focus of his teaching is American government and public policy.

He received his B.S. in Economics (1978) and M.A. in Political Science (1979) from Ohio University, and his Ph.D. in Political Science (1987) from Indiana University. He joined the IUPUI faculty in 1987.

His research interests concern governmental organization and public policies, with a specialization in the field of water institutions and water management. He is the author or co-author of several publications related to these topics, including the books Dividing the Waters (1992), Common Waters, Diverging Streams (2004), and Integrated River Basin Management through Decentralization (2006), and articles in Society and Natural Resources, Political Research Quarterly, Water Resources Research, and Natural Resources Journal, among others.

His research has been supported by the United States Geological Survey, the United States Advisory Commission on Intergovernmental Relations, the National Water Research Institute, the National Science Foundation, the United States Environmental Protection Agency, and The World Bank. He serves on the Board of Directors of the American Ground Water Trust, the Research Advisory Board of the National Water Research Institute, and a study committee of the National Research Council on sustainable underground water storage.

He has provided formal and informal consultation to the United States Advisory Commission on Intergovernmental Relations, the U.S. Bureau of Reclamation, Sandia National Laboratories, the International Center for Self-Governance, and local agencies involved in the management of water supplies in Southern California. He led an inter-agency planning process involving 33 agencies in Orange County, California, and has facilitated workshops for the Santa Ana Watershed Project Authority, the University of California-Davis, and the University of California-Irvine.

Andrew Stone, Executive Director, American Ground Water Trust

Andrew Stone is a hydrogeology graduate from London University with additional academic qualifications in geology, geography and education. He has over thirty five years of ground water experience in Africa and the U.S. as a university professor, ground water consultant and ground water advocate & educator. He has first-hand experience of ground water exploration, well design and source protection in a wide variety of geologic environments. As the director of the AGWT's education programs he has convened and coordinated over one hundred conference programs related to geothermal technology, well design, ground water management, aquifer storage recovery, conjunctive use, water banking, and asset management. From 1990 to 2003 he taught an annual course on Groundwater Protection Policy at Antioch New England University. In recognition of his work in promoting ground water resource education in the US, he received the 1998 National Ground Water Association "Oliver Award" for outstanding contributions to the ground water industry.

The American Ground Water Trust (AGWT) is a non-profit education organization with programs that include teacher training, and conferences and workshops that focus on resources, technology and environmental issues. The AGWT promotes sustainable use and resource protection. AGWT programs provide science-based information to professionals, the public and decision-makers.

Gregory Thomas, Founder and President, Natural Heritage Institute

Gregory A. Thomas, J.D., is the founder and president of the Natural Heritage Institute. Greg has practiced natural resources law since 1974, primarily for non-profit conservation organizations. In the 1970's, he played a central role in the enactment of much of the foundational federal laws in the energy and environmental field. He was a senior staff attorney with the Natural Resources Defense Council's international program, and became the managing attorney of its San Francisco office. He was a Fulbright Professor and advisor to the national environmental ministry of China, and he taught law at UCLA and UC Berkeley. Greg's practice has encompassed many areas of natural resource management, including water resources, energy, air quality, biodiversity, environmental planning, and international conservation. He has 35 years experience in litigation, administrative trials, legislative advocacy, policy analysis, institutional design, and consensus building processes. At NHI, he develops and manages large-scale projects in California, throughout the United States and internationally.

Dr. Robert C. Wilkinson, The Bren School of Environmental Science and Management, University of CA at Santa Barbara

Dr. Robert C. Wilkinson is Director of the Water Policy Program at the Bren School of Environmental Science and Management at the University of California, Santa Barbara, and he is a Lecturer in the Environmental Studies Program at UCSB. Dr. Wilkinson's teaching, research, and consulting focus on water policy, energy, climate change, and environmental policy issues. Dr. Wilkinson is also a Senior Fellow with the Rocky Mountain Institute. Dr. Wilkinson advises businesses, government agencies, and non-governmental organizations on water policy, climate research, and environmental policy issues. Additionally, Dr. Wilkinson advises various federal agencies including the, US DOE National Renewable Energy Laboratory and the US EPA on water and climate research, and he served as coordinator for the climate impacts assessment of the California Region for the US Global Change Research Program and the White House Office of Science and Technology Policy. He has worked extensively in Western Europe, every country of Central Europe from Albania through the Baltic States, and throughout the former Soviet Union including Siberia and Central Asia.

Stephen McCaffrey, University of the Pacific, McGeorge School of Law

Stephen C. McCaffrey is a Distinguished Professor and Scholar at the University of the Pacific, McGeorge School of Law in Sacramento. Professor McCaffrey served as a member of the International law Commission of the United Nations (ILC) from 1982-1991 and chaired the Commission's 1987 Session. He was the ILC's special rapporteur on the Law of the Non-Navigational Uses of International Watercourses from 1985 until 1991, when the Commission provisionally adopted a full set of draft articles on the topic. The ILC's draft articles formed the basis for the 1997 United Nations Convention on the same subject. Professor McCaffrey served as Counselor on International Law in the Office of Legal Advisor, U.S. Department of State, from 1984-1985. He was counsel to Slovakia in the *Gabcikovo-Nagymaros Project* case decided by the International Court of Justice in 1997 and currently serves as counsel to Nicaragua in the *Navigational and Related Rights* case (Costa Rica v. Nicaragua). He also advised India in the *Bagihar HEP* case, before the Neutral Expert appointed under the 1960 Indus Waters Treaty. He has served as Legal Adviser to both the Nile River Basin Negotiating Committee and the Palestinian Authority/PLO and was a member of the U.S. National Research Council's Committee on the Scientific Bases of Colorado River Basin Water Management. Professor McCaffrey's publications include *The Law of International Watercourses* (Oxford University Press, 2d ed. 2007), *Understanding International Law* (Lexis Publishing, 2006) and *International Environmental Law & Policy*, with Edith Brown Weiss, Daniel Magraw and A. Dan Tarlock (Aspen, 2d ed., 2007).

Rod Banyard, Australia Water Policy Branch, Department of Environment and Water Resources

Rod is a civil engineer who has worked in the Western Australian public sector as an engineer, administrator, legal advisor and policy developer for forty years. Rod has recently worked in the Commonwealth public sector, responsible for the development of legislation to implement the National Plan for Water Security. He has extensive experience in the areas of water engineering, groundwater development, water resource management, policy development, legislative drafting and administration that allows him to develop practical solutions to water resource management problems.

Tim Parker, Parker Groundwater

Tim Parker is a nationally recognized groundwater expert and currently is with Parker Groundwater in Sacramento, California, a firm he founded in 2009. He has worked in private and public sector, was formerly with Schlumberger, Law, Dames & Moore, and has worked for California Department of Water Resources, California Geological Survey, and Department of Toxic Substances Control. Mr. Parker's groundwater experience spans more than 25 years and includes water policy analysis, groundwater resources development, groundwater recharge, groundwater management, modeling, monitoring, contaminant hydrogeology, and geologic carbon sequestration. He is a California Professional Geologist, Certified Engineering Geologist, and Certified Hydrogeologist. Tim serves the Groundwater Resources Association of California as a Director and Legislative Committee Chair, the California Groundwater Coalition as Director, and American Ground Water Trust as Chair. He is a member of the Public Advisory Committee for the development of the 2013 California Water Plan, and the Oversight Work Group for Pilot Projects for the Nationwide Ground Water Monitoring Network, under the Subcommittee on Ground Water, Advisory Committee on Water Information, U.S. Department of the Interior. Mr. Parker recently served as a Director on the National Ground Water Association-Association - Scientists and Engineers Division. Mr. Parker coauthored the books

California Groundwater Management published by GRA in 2005, and *Potential Groundwater Quality Impacts Resulting from Geologic Carbon Sequestration* published by the Water Research Foundation in 2009.

Toby Moore, PhD, PG, CHG, Golden State Water Company

Dr. Moore is the Water Resources Manager and Chief Hydrogeologist for Golden State Water Company, a California based investor-owned water utility and subsidiary of American States Water Company. GSWC operates 38 water systems and has a diverse portfolio of water rights managed by Dr. Moore's department. This includes groundwater extractions in 17 groundwater basins throughout California. Toby has a multidisciplinary background in geology, geochemistry, hydrogeology, and biology. He received his Bachelor's degree in Biology and his Doctorate in Geology, both from UCLA. He also holds registrations in the State of California as a Professional Geologist and Certified Hydrogeologist. With over 18 years of professional experience in Water Resources and environmental consulting, Toby has been focusing his expertise on water resource development, water quality and contaminant fate and transport. Toby also currently serves as a Director on the California Groundwater Coalition, a Director on the Pomona Valley Protective Association, Technical Advisory Member of the Southern Branch of the California Groundwater Resources Association and a committee member of the Joint Management Committee of the Alamitos Barrier Project.

Charles G. Groat, PhD, Director of the Center for International Energy and Environmental Policy, University of Texas

Chip Groat is Director of the Center for International Energy and Environmental Policy, Associate Director of the Energy Institute, and Director and Graduate Advisor of the Energy and Earth Resources Graduate Program. He holds the John A. and Katherine G. Jackson Chair in Energy and Mineral Resources in the Department of Geological Sciences, Jackson School of Geosciences, and is Professor, LBJ School of Public Affairs at The University of Texas at Austin. He assumed these positions in June 2005 after serving 6 ½ years as Director of the U.S. Geological Survey, having been appointed by President Clinton and retained by President Bush. He served as interim dean of the Jackson School of Geosciences at UT from July 2008 to August 2009.

Prior to his position with the U.S. Geological Survey, he was Associate Vice President for Research and Sponsored Projects at The University of Texas at El Paso following a term as Director of the Center for Environmental Resource Management and Professor of Geological Sciences there. His previous experience includes Associate Director and Acting Director of the Bureau of Economic Geology and Associate Professor of Geological Sciences at The University of Texas at Austin; Chairman of the Department of Geological Sciences at The University of Texas at El Paso; State Geologist and Director of the Louisiana Geological Survey; Assistant to the Secretary of the Louisiana Department of Natural Resources administering the Coastal Zone Management and Coastal Protection programs; Professor of Geology and Geophysics and Director of the

Center for Coastal, Energy and Environmental Resources at Louisiana State University; and Executive Director of the American Geological Institute.

He has been a member of the National Research Council Board on Earth Sciences and Resources and the Outer Continental Shelf Policy Board. He is a past President of the Association of American State Geologists and of the Energy Minerals Division and Division of Environmental Geosciences of the American Association of Petroleum Geologists.

His degrees in geology are from the University of Rochester (A.B.), University of Massachusetts (M.S.), and The University of Texas at Austin (Ph.D.)

His current interests focus on advancing the role of science and engineering in shaping policy and informing decisions, and on ways to increase the integration of the science disciplines as a means of improving the understanding of complex resource and environmental systems.

Appendix B

Groundwater Water Level Monitoring Protocol

APPENDIX B

Groundwater Water Level Monitoring Protocol

All groundwater level measurements will be made using an electric water level sounder calibrated to the nearest 0.01 foot. The sounder will be cleaned before monitoring and between use in each well using a Liqui-Nox soap (or equivalent) solution wash and potable and distilled water rinses. Measurements will be made to the nearest 0.01 foot relative to an established reference mark at the top of each well casing. Water level depths will be compared, in the field, to previous results and re-measured if significantly different. Water level measurements will be recorded using a permanent ink pen on established forms and subsequently entered into an electronic database. Depth to groundwater measurements will be converted to groundwater elevations (above mean sea level) by subtracting the depth to water from the reference point elevation.

Appendix C

Groundwater Sampling Protocol

APPENDIX C

Groundwater Sampling Protocol

Groundwater samples will be collected using either permanent or temporary pumps. These may include centrifugal or other types of pumps. Samples will be collected using one of the following methods:

- Standard Purge Method – Prior to collecting groundwater samples from monitoring wells, approximately three to four well casing volumes of groundwater will be removed from each well using a pump set at least 10 feet above the bottom of the well. Samples will be collected after three to four casing volumes of groundwater have been removed and field parameters have stabilized, as further described below.
- Low-Flow (Minimal Drawdown) Method – Prior to collecting groundwater samples from monitoring wells, the pump will be set at approximately the mid-point of the screened interval if the water surface is above the screen or at the mid-point of the water column if the water surface is below the screen. Samples will then be collected using EPA's Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures (EPA/540/S-95/504).

All purging and sampling information will be recorded on standard sampling forms.

During pumping for the standard purge method, temperature, pH, electrical conductivity and turbidity will be measured periodically using field calibrated instrumentation. Groundwater samples will be collected when parameters have stabilized to within 10 percent in three consecutive readings. If the field parameters do not stabilize before three casing volumes have been removed, additional groundwater will be purged until the parameters stabilize. Total water volume removed will be approximated using the time required to fill a graduated 5-gallon bucket or inline flowmeter. In the event the well goes dry before three casings volumes have been removed or before parameters have stabilized, the well will be allowed to recover to at least 80 percent of the static water level before the sample is collected.

Field parameter data will be collected using instruments calibrated to standard solutions at the beginning of each sampling day and operated in accordance with the manufacturer's instructions. Calibration results will be recorded in the field daily report. Deviations in calibration will be noted. Field parameter data will be checked and validated by a Certified Hydrologist.

Groundwater samples will be collected following pumping using either the sampling pump discharge line or a disposable bailer constructed of polyethylene or Teflon. Samples will be discharged from the pump or decanted from the bailer into properly labeled, laboratory-prepared sample containers. Each sample label will include the well number, project number, date and time sampled, analytical test, preservative (if any) and sampler's initials. Samples will be sealed in sealable plastic bags and placed in a field cooler with ice immediately after collection.

For QA/QC purposes, duplicate samples will be collected in the field from two wells during each sampling event. These samples will be submitted to the laboratory "blind" with a fictitious well designation so the repeatability of the analytical results can be objectively evaluated. Duplicate samples will be collected from the same bailer whenever possible to maximize the representativeness of the analytical results. The label given the duplicate sample will be noted on standard sampling forms and/or in the field daily notes to enable later identification and comparison.

If non-dedicated pumps are used in multiple wells, one equipment blank per day of sampling will be collected to ensure the effectiveness of pump cleaning between wells. The blank sample will consist of distilled water decanted from a cleaned bailer into a laboratory prepared sample container. The blank sample will be collected between sampling of wells.

All groundwater samples will be submitted to a California Department of Public Health certified laboratory under chain-of-custody protocol within 24 hours of collection. The laboratory will be certified under the State Environmental Laboratory Accreditation Program (ELAP).

Appendix D

Water Quality Analytical Protocol

APPENDIX D

Water Quality Analytical Protocol

Prior to the initiation of pre-project groundwater sampling, a state of California-certified laboratory will be selected to conduct analytical testing. The laboratory will be certified by the California Department of Health Services under the State Environmental Laboratory Accreditation Program (ELAP). The laboratory will provide a copy of its QA/QC manual to the Projects's technical experts for review. The laboratory will be contracted contingent on acceptance of the QA/QC manual by the Project's technical experts and, if necessary, a laboratory audit will be conducted.

In general, the selected laboratory will adhere to those recommendations promulgated in Title 21, Code of Federal Regulations, CFR Part 58 *Good Laboratory Practices*; criteria described in *Methods for Chemical Analysis of Water and Wastes* (EPA 1979; EPA-600/4-79-202); and requirements outlined in *Standard Methodsfor Examination of Water and Wastewaster* (APHA, 1999; 20th Edition). Groundwater samples collected for chemical analysis during the Project will be tested in accordance with the standard analytical procedures established by EPA. The laboratory will be required to submit analytical results that are supported by sufficient backup data and QA/QC results to enable the Project's technical experts to conclusively determine the validity of the data.

Analytical tests to be conducted during quarterly groundwater sampling events are summarized in Table D-1. The table summarizes each individual analyte to be tested, the appropriate EPA method number, and the proposed detection limit to be achieved. The appropriate sample containers, holding times, and preservation methods are summarized in Table D-2.

TABLE D-1
Proposed Quarterly Analytical Suite

Method	Target Anayte	Units	Reporting Limit	California Public Drinking Water (Title 22 CCR) Water Quality Standards[a]
General Physical Parameters				
SM 2120B	Color	Color units	3	15
SM 2150B	Odor—Threshold	TON	1	3
EPA 180.1	Turbidity	NTU	0.05	5
General Minerals				
SM 4500-H+B	pH	pH units	NA	NA
SM 2320B	Bicarbonate	mg/L	2	NA
SM 2320B	Carbonate	mg/L	2	NA
SM 2320B	Alkalinity	mg/L	2	NA
SM 2320B	Hydroxide	mg/L	2	NA
SM 2340B	Hardness	mg/L	1	NA
SM 2540C	Total Dissolved Solids (TDS)	mg/L	10	500 / 1000 / 1500[b]
SM 5540C	Foaming Agents (MBAS)	mg/L	0.05	0.5
SM 2510B	Specific Conductance	µS/cm	0.05	900 / 1,600 / 2,200[b]
EPA 300.0	Chloride	mg/L	1	250 / 500 / 600[b]
EPA 300.0	Sulfate	mg/L	0.5	250 / 500 / 600[b]
EPA 300.0	Nitrate (as NO_3)	mg/L	0.1	45
EPA 200.7	Calcium	mg/L	1	NA
EPA 200.8	Chromium	mg/L	0.001	0.05
EPA 218.6	Chromium - 6	ug/L	0.06	0.02[c]
EPA 200.8	Copper	mg/L	0.001	1.0[d] (1.3)[e]
EPA 200.7	Iron	mg/L	0.02	0.3
EPA 200.7	Magnesium	mg/L	0.1	NA
EPA 200.8	Manganese	mg/L	0.002	0.05
EPA 200.7	Potassium	mg/L	1	NA
EPA 200.7	Sodium	mg/L	1	NA
EPA 200.8	Zinc	mg/L	0.02	5.0
Other Inorganics				
EPA 200.8	Arsenic	mg/L	0.001	0.010
EPA 300.0	Bromide	mg/L	1	10[f]
EPA 314.0	Perchlorate	ug/L	4	6

Notes:
NA – not applicable (no standard)
TON – threshold odor number
NTU – nephelometric turbidity units
mg/L – milligram per liter
ug/L – microgram per liter
µS/cm – microsiemens per centimeter

a. Updated August 2011
b. Recommended, upper range and short term.
c. Public health goal
d. Secondary MCL
e. Regulatory Action Level
f. based on the MCL for bromate

TABLE D-2
Sample Containers, Preservation, and Holding Times

Analyte	Method	Container and Minimum Quantity Water	Preservation	Holding Time
Metals	EPA 200.7 EP A 200.8	1-liter P or G	Add HNO_3 to pH<2; chill to 4°C (±2°C)	180 days
Hexavalent Chromium	EPA 218.6	250-ml P	Chill to 4°C (±2°C) Laboratory or field filtration within 24 hours. After filtration adjust the pH to 9–9.5 by adding $(NH_4)_2SO_4/NH_4OH$ buffer solution	28 days
Anions and/or perchlorate	EPA 300.0 EPA 314.0	500-ml P or G	Chill to 4°C (±2°C)	Perchlorate, bromide, chloride, sulfate, 28 days Nitrate, 48 hours
TDS	SM 2540C	500-ml P or G	Chill to 4°C (±2°C)	7 days
Alkalinity and hardness	SM 2320B SM 2340B	500-ml P or G	Chill to 4°C (±2°C)	14 days
Turbidity	EPA 180.1	500-ml P or G	Chill to 4°C (±2°C)	48 hrs
Specific Conductance	SM 2510B	500-ml P or G	Chill to 4°C (±2°C)	28 days
pH	SM 4500H+B	500-ml P or G	Chill to 4°C (±2°C)	15 minutes
Odor	SM 2150B	One 1-liter G	Chill to 4°C (±2°C)	As Soon As Possible
Color	SM 2120B	250 ml P	Chill to 4°C (±2°C)	As Soon As Possible
MBAS	SM 5540C	250 ml P	Chill to 4°C (±2°C)	48 hours

Notes:

G = glass
HNO_3 = nitric acid
NaOH = sodium hydroxide
NH_4 = ammonium
$(NH_4)_2SO_4$ = ammonium sulfate
P = polyethylene