CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

Amendment to the Water Quality Control Plan for the Tulare Lake Basin

To Remove Municipal and Domestic Supply (MUN) and Agricultural Supply (AGR) as Beneficial Uses of Groundwater within the Lower Member of the Tulare Formation and Etchegoin Formation within a Portion of the Southern Lost Hills Oilfield

DRAFT STAFF REPORT

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Acronyms and Terms

AB 32 ..... Assembly Bill 32—California Global Warming Solutions Act of 2006, Health & Safety Code section 38500 et seq.

AGR ..... Designation for Agricultural Supply as Beneficial Uses of Water

Antidegradation Policy ..... *Statement of Policy with Respect to Maintaining High Quality of Waters in California*, State Water Board Resolution 68-16

APN ..... Assessor's Parcel Number

Basin Plan ..... Water Quality Control Plan for the Tulare Lake Basin (Operative Version)

bgs ..... Below Ground Surface

CalGEM ..... California Department of Conservation, Geologic Energy Management Division (formerly Division of Oil, Gas & Geothermal Resources)

CEQA ..... California Environmental Quality Act, Public Resources Code section 21000 et seq.

CRZ ..... Clay-Rich Zone

DAU ..... Detailed Analysis Unit

EC ..... Electrical Conductivity

GHG ..... Greenhouse Gas

GPD ..... Gallons per Day

gpm / ft. ..... Gallons per Minute per Foot

ILRP ..... Irrigated Lands Regulatory Program

MDBM ..... Mount Diablo Baseline and Meridian

µS/cm ..... Microsiemens per Centimeter

mg/L ..... Milligrams per Liter

MUN ..... Designation for Municipal and Domestic Supply as Beneficial Uses of Water

Project Area ..... Two-dimensional surface area composed of six sections within Township 27 South, Range 21 East, Mount Diablo Baseline and Meridian (T27S, R21E MDBM).

SED ..... Substitute Environmental Document per California Code of Regulations, title 23, section 3775 et seq.

Sources of Drinking Water Policy ..... *Sources of Drinking Water Policy*, State Water Board Resolution 88-63

SSO ..... Site Specific Objective

TDS ..... Total Dissolved Solids

UIC ..... Underground Injection Control

USACE ..... United States Army Corps of Engineers

USDW ..... Underground Sources of Drinking Water

USEPA ..... United States Environmental Protection Agency

USGS ..... United States Geologic Survey

USFWS ..... United States Fish & Wildlife Service

WQO ..... Water Quality Objective

Executive Summary

The purpose of this Staff Report is to provide the rationale and supporting documentation for a proposed amendment to the Water Quality Control Plan for the Tulare Lake Basin (Basin Plan) to de-designate Municipal and Domestic Supply (MUN) and Agricultural Supply (AGR) as beneficial uses of groundwater within horizontally and vertically delineated portions of the Lower Member of the Tulare Formation (Lower Tulare Member) and the Etchegoin Formation underlying a portion of the Lost Hills Oilfield.

The proposed amendment is in response to a petition from Seneca Resources Company, LLC (Seneca) for de-designation, or exemption, of the MUN and AGR beneficial uses for the confined aquifers into which produced water is injected as a result of oil production operations. The designated land use for the Lost Hills Oilfield is currently oil and gas production; it is also anticipated that this land use will continue into the foreseeable future. (Kern County General Plan: Land Use, Open Space, and Conservation Element, p. 54.) The very poor quality of groundwater within the Lower Tulare Member and the Etchegoin Formation, as well as their status as non-Underground Source of Drinking Water (USDW), and their authorization to receive underground injection of fluids associated with oil and gas operations under the Safe Drinking Water Act exemption (De-Designation Report, §§ 2, 4.2; Appendices A-B), are inconsistent with their current designated use as sources of drinking water in the Basin Plan.

When State Water Resources Control Board (State Water Board) Resolution 88-63 (*Sources of Drinking Water Policy*) was incorporated into the Basin Plan, all groundwaters in the Tulare Lake Basin were, unless specifically exempted per a Basin Plan Amendment, designated for the beneficial use of MUN by default.[1] The inclusion of the Lower Tulare Member and the Etchegoin Formation within the "Project Area" (as described below) under the blanket MUN designation potentially subjects Seneca to unreasonable and unnecessary requirements that are inconsistent with the actual quality of the groundwater and its regulatory status under the California Geologic Energy Management Division's (CalGEM's) UIC program and the federal Safe Drinking Water Act.

The rock formations within the Lost Hills Oilfield have been deformed and folded into a wave-like structure (anticline) whose fold axis trends northwest to southeast and where the rock beds dip to the northeast on the east of the fold axis and to the southwest on the west side of the axis, with rock formations shallowest along the axis and getting progressively deeper the further away from the axis towards the northeast and

[1] The *Sources of Drinking Water Policy* was similarly incorporated as part of the Central Valley Water Board's Water Quality Control Plan for the Sacramento River Basin and San Joaquin River Basin.

southwest. The anticline structure also tilts or plunges to the southeast, with rock formations also getting deeper in that direction (imagine a stack of printer paper with both sides bent down forming a wave-like shape and then the fold axis or wave crest is tilted down away from you).

For the purposes of this Staff Report, the **Project Area**[2] is a two-dimensional surface area composed of six "sections" (Sections 14, 15, 22, 23, 26 and 27) within Township 27 South (T27S), Range 21 East (R21E), Mount Diablo Baseline and Meridian (MDBM) (**See Figure ES-1**); it is wholly contained within the administrative boundaries of the Lost Hills Oilfield.

The **Project Zone** is the three-dimensional space consisting of the Lower Tulare Member and the Etchegoin Formation (collectively, Formations) within the Project Area. Whereas the Project Area reflects the Project's horizontal footprint, the Project Zone also encompasses the Project's vertical element as well. In other words, the Project Area encompasses the Project Zone without regard to vertical limitation.

The top of the Project Zone (the top of Lower Tulare Member) varies from a depth of approximately 600 feet below ground surface (ft bgs) in the northwestern portion of the Project Area to approximately 2,000 ft bgs in the southeastern portion of the Project Area. Depth to the bottom of the Project Zone (the bottom of the Etchegoin Formation) varies from approximately 3,200 ft bgs in the northwestern portion of the Project Area to 6,600 ft bgs, in the southeastern portion of the Project Area.

Groundwater within the Formations in the Project Zone is of very poor quality with respect to total dissolved solids (TDS), which exceeds a concentration of 10,000 mg/L. Hydrogeologic information collected in the Project Area indicates that the aquifers are confined, which means there is an impermeable layer above and below that separates groundwater within the proposed zone (within the Lower Tulare Member and the Etchegoin Formation) from groundwater within the aquifer above (within the Upper Member of the Tulare Formation [Upper Tulare Member]) and the aquifer below (within the Reef Ridge Formation). The Upper and Lower Members of the Tulare Formation are separated by the Mid-Tulare Clay (also referred to as the Mid-Tulare Shale), which has been demonstrated to represent an effective barrier to vertical groundwater flow. The six MDBM sections encompass a lateral area that flow models indicate will contain the currently injected volume of oil production fluids for the next 100 years.

Property owners in the Project Area include three oil and gas operators and one agricultural operation, Wonderful Nut Orchards. No water supply wells for municipal, domestic, or agricultural use are located within the Project Area. Wonderful Nut Orchards regards even shallow groundwater within the Upper Tulare Member (vertically

[2] Alternatively referred to in this report as the proposed De-Designation Area.

above and hydro-geologically separated from the Lower Tulare Member) in the Project Area to be of such poor quality as to be “unusable.”

As indicated previously, the Central Valley Water Board has incorporated the State Water Board’s *Sources of Drinking Water Policy* into the Basin Plan, and as such, has designated all surface and ground water bodies in the Tulare Lake Basin as supporting the MUN beneficial use, unless a particular water body is specifically designated as not supporting the MUN beneficial use in the Basin Plan. Per “Exception 1a” of the *Sources of Drinking Water Policy*, which applies to water bodies where the total dissolved solids (TDS) exceeds 3,000 milligrams per liter (mg/L), groundwater in the Project Area is not considered suitable for the MUN beneficial use.

The Basin plan states that unless otherwise designated by the Central Valley Water Board, “all ground waters in the region are considered suitable or potentially suitable, at a minimum, for agricultural supply (AGR)....” The Chemical Constituents groundwater quality objectives states, “[g]round waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses. Based on the Central Valley Water Board’s salinity guidelines that are used to interpret this narrative objective, water with an electrical conductivity (EC) at 700 μS/cm (TDS 470 mg/L) is considered protective of all crops. CV-SALTS literature review found that only the most salt tolerant crops may be sustainably irrigated with water with EC exceeding 3,000 μS/cm (TDS 2,000 mg/L). Groundwater in the Project Area far exceeds these thresholds and is considered unusable for irrigation and stock watering by local growers.

De-designation of groundwater within the Lower Tulare Member and the Etchegoin Formation within the Project Area is consistent with applicable federal and state regulations regarding protection of water quality, including the federal Safe Drinking Water Act, California’s Porter-Cologne Water Quality Control Act and the State Water Board’s *Sources of Drinking Water Policy*.

De-designation of MUN and AGR beneficial uses in groundwater within the Lower Tulare Member and the Etchegoin Formation within the Project Area is not anticipated to result in significant environmental impacts, as these uses have not been historically supported, nor currently supported within the Project Area. Additionally, environmental impacts of oil and gas operations in Kern County have been identified and analyzed in the *Final Environmental Impact Report, Revisions to the Kern County Zoning Ordinance – 2015, Focused on Oil and Gas Local Permitting*. Operations being conducted by Seneca Resources and resulting in this request for an exemption to the MUN and AGR designations are being conducted in accordance with standard practices and field regulations for the oil and gas industry in California and therefore are not expected to significantly impact human health or the environment.

The naturally occurring high TDS in the groundwater of the Lower Tulare Member and the Etchegoin Formation precludes its use as an Underground Source of Drinking Water (USDW) as defined by the federal Safe Drinking Water Act. There are no known plans to produce the water for these purposes. As a result, this proposed Basin Plan

Amendment to de-designate the MUN and AGR beneficial uses will not preclude the use of any existing USDW or source of water used for AGR uses and therefore will have no economic impact.

Specific proposed Basin Pan Amendment language is contained in the following section.

Proposed Basin Plan Amendment Language

Modify Chapter 2 of the Basin Plan, adding a **new row** to the bottom of **Table 2-3** (p. 2-9), thereby establishing an Exception Area 5 (column 1) with the following Area Description (column 2), which shall be applicable to Detailed Analysis Unit (DAU) #259 (column 3):

> Ground water contained within the Lower Tulare Member and the Etchegoin Formation, at a depth of approximately 600 feet to 6,600 feet below ground surface (bgs), within the South Lost Hills Oilfield in Sections 14, 15, 22, 23, 26 and 27 of T27S R21E, MDM, is not suitable, or potentially suitable, for municipal or domestic supply (MUN) or agricultural supply (AGR), including, but not limited to, AGR applications for irrigation, stock watering and support of vegetation for range grazing .
>
> This Exemption does not extend to the Upper Tulare Member, which overlies the Lower Tulare Member and the Etchegoin Formation and is separated from the Lower Tulare Member by the Mid-Tulare Shale.

The language above reflects the staff-recommended alternatives discussed in Section 4 of the Staff Report.

No further changes to Basin Plan Table 2-3 are proposed at this time.

Section 1: Introduction and Existing Conditions

This Staff Report provides the rationale and supporting documentation for a proposed amendment to the Central Valley Regional Water Quality Control Board's (Central Valley Water Board or Board) Water Quality Control Plan for the Tulare Lake Basin (Basin Plan). The amendment will de-designate Municipal and Domestic Supply (MUN) and Agricultural Supply (AGR) as beneficial uses for groundwater within a horizontally and vertically-delineated area underlying the Lost Hills Oilfield.

The Basin Plan Amendment is being developed in response to a petition request by Seneca Resources Company, LLC (Seneca) to de-designate MUN and AGR beneficial uses from groundwater within a portion of the Southern Lost Hills Oilfield. Seneca's Petition and the Technical Report submitted in support of the Petition used the term "de-designation" to reflect the proposed amendment to remove the MUN and AGR beneficial uses from groundwater within designated portions of the Lower Tulare Member and the Etchegoin Formation. However, for purposes of the Staff Report, the terms de-designation, exemption, and exception are used interchangeably to describe various aspects of this action.

For the purposes of this Staff Report, the **Project Area**[3] is a two-dimensional surface area composed of six "sections" within Township 27 South (T27S), Range 21 East (R21E), Mount Diablo Baseline and Meridian (MDBM); it is wholly contained within the administrative boundaries of the Lost Hills Oilfield.

The Tulare Formation is divided into two member units – the Upper Tulare Member and the Lower Tulare Member, each consisting of interbedded layers of mudstone, siltstone, and sandstone. The **Project Zone** is the three-dimensional space consisting of the Lower Tulare Member and the Etchegoin Formation within the Project Area. Whereas the Project Area reflects the Project's horizontal footprint, the Project Zone also encompasses the Project's vertical element as well. In other words, the Project Area encompasses the Project Zone without regard to vertical limitation.

When State Water Resources Control Board (State Water Board) Resolution 88-63 (*Sources of Drinking Water Policy*) was incorporated into the Basin Plan, all groundwaters in the Tulare Lake Basin were, unless specifically exempted per a Basin Plan Amendment, designated for the beneficial use of MUN by default.[4] However, the *Sources of Drinking Water Policy* identifies exceptions to the MUN beneficial use applicable to certain water bodies, "Exception 1a" of which applies to water bodies where the total dissolved solids (TDS) exceeds 3,000 milligrams per liter (mg/L)

[3] Alternatively referred to in this report as the proposed De-Designation Area.

[4] The *Sources of Drinking Water Policy* was similarly incorporated as part of the Central Valley Water Board's Water Quality Control Plan for the Sacramento River Basin and San Joaquin River Basin.

(5,000 microsiemens per centimeter [μS/cm] as electrical conductivity [EC]), provided that the water body is not expected to supply a public water system. However, this exception is not self-implementing—i.e., the Central Valley Water Board is required to protect the MUN beneficial use even in water bodies that meet the exception criteria in the *Sources of Drinking Water Policy* unless and until a Basin Plan Amendment is adopted that specifically de-designates the MUN use in such water bodies.

With regard to the AGR beneficial use, the Basin Plan provides that, unless otherwise designated by the Central Valley Water Board, "all ground waters in the region are considered suitable or potentially suitable, at a minimum, for agricultural supply (AGR)…." Agricultural supply includes the use of groundwater for irrigation, livestock watering, and support of vegetation for range grazing. When protecting the AGR beneficial use, the narrative water quality objective (WQO) for Chemical Constituents generally sets the minimum regulatory requirements that the subject waste discharges must meet. The Chemical Constituents WQO for groundwater provides that "[g]round waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses." The Board typically translates the narrative to a numeric water quality objective by looking at what beneficial uses are currently occurring and then looking at what constituent concentration threshold values would protect those uses.

The Central Valley Water Board has utilized salinity concentration threshold guidelines identified in Ayers and Westcot (Ayers and Westcot, 1985) to interpret the Basin Plan's narrative objective, and has previously considered irrigation water supply at 470 mg/L TDS (700 μS/cm EC) to be protective of all crops at all times. CV-SALTS conducted a review of literature related to salinity impacts on both irrigation and stock watering, and found that the irrigation literature concurred with the Ayers and Westcot finding that only the most salt tolerant crops may be sustainably irrigated with water exceeding 2,000 mg/L TDS (3,000 μS/cm EC) ((CV-SALTS, 2012a). As part of the stock watering literature review, CV-SALTS also identified a range of acceptable salt levels for livestock watering (CV-SALTS, 2013), ranging from 3,000 mg/L (5,000 uS/cm EC) [CCME, 2013] to 5,000 mg/L TDS (8,000 uS/cm EC) [NAS/NRC 1974]. For purposes of this Basin Plan Amendment, Board staff will utilize the higher salinity threshold value for stock watering of 5,000 mg/L TDS as the outer limit for groundwater quality capable of supporting AGR beneficial use. This salinity concentration threshold is the same threshold value as utilized by the Board to de-designate AGR beneficial use in groundwater at the Royal Mountain King Mine (RMKM) in 2015. Use of this threshold value was also peer reviewed as part of the RMKM basin plan amendment project.

This Staff Report describes the proposed Basin Plan Amendment and provides the rationale behind de-designation of the MUN and AGR beneficial uses within the Project Area. This report also presents alternatives considered, the public processes utilized, and the results of environmental review under the California Environmental Quality Act (CEQA), an analysis under the State Water Board's Antidegradation Policy (State Water Board Resolution 68-16), and economic evaluations of the preferred alternatives.

If adopted, this Basin Plan Amendment will use "Exception 1a" in the *Sources of Drinking Water Policy* to de-designate the MUN beneficial use in a horizontally and

vertically defined area underlying the Lost Hills Oilfield, and the narrative Chemical Constituents WQO to de-designate the AGR beneficial use in the same area.

1.1 Background and Need for Proposed Amendment

The designated land use for the Lost Hills Oilfield is for oil and gas production. (Kern County General Plan September 22, 2009 — Land Use/Conservation/ Open Space Element, Map Code 8.4, p. 54.). It is anticipated that this land use will continue into the future.

The very poor quality of groundwater in the Lower Tulare Member and the Etchegoin Formation, as well as their status as non-Underground Source of Drinking Water (non-USDW) formations authorized to receive underground injection of fluids associated with oil and gas operations under the Safe Drinking Water Act exemption (Technical Report, §§ 2, 4.2; Appendices A, B), are inconsistent with and preclusive of use as sources of drinking water in the foreseeable future. Maintaining this portion of the Lower Tulare Member and the Etchegoin Formation under the blanket MUN and AGR designations potentially subjects Seneca to requirements that are inconsistent with the actual quality of the groundwater and its regulatory status under the UIC program and Safe Drinking Water Act, as well as potentially subjecting Seneca to requirements to protect agricultural supply beneficial uses, which do not exist.

The current designation of groundwater within the Lower Tulare Member and the Etchegoin Formation, as having MUN and AGR beneficial use in the Basin Plan, does not reflect the current production water disposal use, historical disposal use or anticipated future disposal use. As reflected above, Seneca has operated pursuant to California Department of Conservation, Geologic Energy Management Division[5] (CalGEM) authorization and permitting, in injecting produced water into Formations that do not qualify factually or legally as an Underground Source of Drinking Water (USDW) under the federal Safe Drinking Water Act. However, the fact that the Lower Tulare Member and the Etchegoin Formation are covered by default under this Basin Plan's blanket MUN designation creates inconsistency between the actual beneficial uses of the groundwater (given its quality and location) and the definition of drinking water under the Health & Safety Code. The existing groundwater quality within these Formations does not support MUN or AGR beneficial use and has never supported these uses.

1.1.1 Current Application of the MUN Beneficial Use

When the Central Valley Water Board incorporated the *Sources of Drinking Water Policy* into the Basin Plan, the Board made a blanket designation that all groundwaters support the MUN beneficial use by default. The Board may only exempt waterbodies from MUN beneficial use designations by amending the Basin Plans. (*California Assn.*

[5] Formerly, Division of Oil, Gas & Geothermal Resources (DOGGR)

of Sanitation Agencies v. State Water Resources Control Bd. (2012) 208 Cal.App.4th 1438, 1463.)

The Basin Plan further provides that waters designated as supporting the MUN beneficial use must not exceed Maximum Contaminant Levels (MCLs) of California Code of Regulations, title 22, for Chemical Constituents, Pesticides, and Radionuclides. (See Basin Plan, §§ 3.1, 3.2.) Although the *Sources of Drinking Water Policy* includes exceptions for MUN designation, their application can only occur via the formal amendment process. (Basin Plan, § 5.1(7), p. 5-2.)

In considering Basin Plan amendments that will have the effect of de-designating the MUN beneficial use, the Central Valley Water Board utilizes one or more of the following criteria from the *Sources of Drinking Water Policy:*

> The TDS must exceed 3,000 mg/L (EC exceed 5,000 μS/cm) and the aquifer cannot be reasonably expected to supply a public water system.
>
> There is contamination, either by natural processes or by human activity (unrelated to a specific pollution incident), that cannot reasonably be treated for domestic use using either Best Management Practices or best economically achievable treatment practices.
>
> The water source cannot provide sufficient water to supply a single well capable of producing an average, sustained yield of 200 gpd.
>
> The aquifer is regulated as a geothermal energy producing source or has been exempted administratively pursuant to Title 40, Code of Federal Regulation (CFR), Section 146.4 for the purpose of underground injection of fluids associated with the production of hydrocarbon or geothermal energy, provided that these fluids do not constitute a hazardous waste under 40 CFR, Section 261.3.

1.1.2 Current Application of the AGR Beneficial Use

The Basin Plan requires consistency with the *Sources of Drinking Water Policy* in making exceptions to beneficial use designations other than the MUN beneficial use. Therefore, in making any exceptions to the beneficial use designation of Agricultural Supply (AGR), the Central Valley Water Board must consider the following criteria:

1. The AGR beneficial use included in the Tulare Lake Basin Plan is defined as, “use of water for farming, horticulture, or ranching, including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.” This broad definition distinguishes the AGR beneficial use from the MUN use. While limits protective of human health are relatively well-defined (such as the primary Maximum Contaminant Levels [MCLs]), water quality limits developed to protect AGR uses range from the very stringent

standards necessary to protect the most salt-sensitive crops to relatively relaxed standards necessary to protect livestock watering. or

2. In the absence of an established specific or numeric salinity water quality objective for the protection of the AGR beneficial use, the Central Valley Water Board relies upon scientific literature to provide threshold concentrations that are generally considered to be protective of irrigation and stock watering.

3. Whether the existing groundwater quality within the Project Area currently supports or has historically supported AGR beneficial use.

For TDS numeric limits in support of the narrative water quality objective (WQO), the recommended upper range associated with irrigation and livestock watering for this project is 5,000 mg/L (electrical conductivity [EC] of approximately 8,000 µS/cm) .

As with MUN, de-designation of the AGR beneficial use for groundwater similarly requires the formal Basin Plan Amendment process, which includes subsequent approval from the State Water Board and Office of Administrative Law (OAL).

1.1.3 History of Evaluating Beneficial Uses in Groundwater

Beneficial uses in groundwater within the Tulare Lake Basin have been evaluated in the past, with the most recent comprehensive Basin-wide evaluation occurring in 1993. The Tulare Lake Basin is divided into hydrologic units and satellite basins. Hydrologic units are further subdivided into detailed analysis units (DAUs). DAUs and satellite basins are the geospatial areas for which groundwater beneficial uses have been designated.

The following beneficial uses have been identified to occur throughout the Basin:

- Municipal and Domestic Supply (MUN)
- Agricultural Supply (AGR)
- Industrial Service Supply (IND)
- Industrial Process Supply (PRO)
- Water Contact Recreation (REC-1)
- Non-Contact Water Recreation (REC-2)
- Wildlife Habitat (WILD)

As previously discussed, under the *Sources of Drinking Water Policy,* all ground waters are designated for MUN beneficial uses (the use may be existing or potential), unless specifically exempted per the formal Basin Plan Amendment process.

Portions of two DAUs within the Kern County Basin (#254, #259) have received beneficial use de-designations based on Central Valley Water Board determinations that the groundwater there was not potentially suitable for MUN beneficial uses. These

de-designations are reflected in the first and second rows of Basin Plan Table 2-3 (§ 2, p. 2-8).

Additionally, groundwater in the San Joaquin, Etchegoin, and Jacalitos Formations within one-half mile of existing and proposed surface impoundments and the Chemical Waste Management Kettleman Hills Facility have been de-designated for MUN use as municipal or domestic supply (MUN). Ground water underlying the Tulare Lakebed in a number of DAUs (DAUs # 238, 241, 243, 244, 246, 255 and part of DAU 259) has also had MUN and AGR beneficial uses removed. (Basin Plan, Table 2-3).

As defined in **Section 1.2** below, the Project Area is located in DAU 259 (Antelope Plain) of the Kern County Basin. Designated beneficial uses for the portion of DAU 259 where the project area is located, currently include MUN, AGR, and IND beneficial uses.

1.1.4 Stakeholders

Analysis and identification of stakeholders for this proposed Basin Plan Amendment are provided in **Section 3.4**. Stakeholders with possible interest in this project would include the other major oil production companies that operate within the Lost Hills Oilfield and depend on continued operation of the Tisdale water disposal wells and agricultural land owners who use or may use local groundwater for irrigation and watering.

1.2 Project Area/Zone

The two-dimensional Project Area for this proposed Basin Plan Amendment comprises six square miles that include Sections 14, 15, 22, 23, 26, and 27 of Township 27S, Range 21E (T27S/R21E), Mount Diablo Baseline and Meridian (MDBM). (See Figure 1-1.) The Project Area is entirely contained within the administrative boundary of the Lost Hills Oilfield. Rationale for the horizontal and vertical delineation of the Project Area/Zone is provided below in **Section 1.2.3**.

1.2.1 Background

The Lost Hills Oilfield is located in Kern County, west of the intersection of Interstate 5 with Highway 46 and the town of Lost Hills (**Figure 1-1**). It was discovered in 1910 and currently produces oil and gas from the Tulare, Etchegoin, Reef Ridge and Monterey Formations. Hydrocarbons have been observed in the Tulare Formation as far south as Section 22 of T27S/R21E; however, production from the Tulare Formation is currently limited to the northern portion of the oilfield (**Figure 1-2**).

Seneca's Tisdale underground injection wells in the southern portion of the Lost Hills Oilfield receive produced water from adjacent production wells (**Figure 1-3**) completed in the Reef Ridge and Monterey Formations. After being separated from the oil at the surface, the produced water is reinjected into the Lower Tulare Member and the Etchegoin Formation. The Tisdale underground injection wells are located within a portion of the Lost Hills Oilfield that is outside and south of the Tulare enhanced oil recovery (EOR) area and the underground injection activities in this area are not

associated with EOR activities. Seneca operates the four Tisdale underground injection wells (**Figure 1-2**) pursuant to CalGEM Class II UIC permits.

TDS concentrations in groundwater within the Lower Tulare Member and the Etchegoin Formation in this portion of the Lost Hills Oilfield exceed 10,000 mg/L, as acknowledged in the 1992 UIC Project Approval Letter and related correspondence for the Tisdale injection wells (Appendix A). As described in the De-Designation Petition, groundwater sources that contain TDS concentrations greater than 10,000 mg/L are not considered USDWs under the federal Safe Drinking Water Act; for purposes of this analysis, these Formations are described as "non-USDW."

Although these Formations are non-USDW their use is designated as MUN under a blanket beneficial use designation in the Basin Plan. This blanket MUN designation covers all groundwater aquifers that are not expressly de-designated as MUN. As described in Seneca's De-Designation Petition, those non-USDW portions of the Lower Tulare Member and the Etchegoin Formation are eligible for MUN de-designation as described in this proposed Basin Plan Amendment; they are referenced herein and in the attached figures as "non-USDW," "non-USDW Lower Tulare Member" and "non-USDW Etchegoin Formation." Specifically, Seneca proposes de-designating MUN and AGR from the non-USDW portions of the Lower Tulare Member and the Etchegoin Formation in the southern portion of the Lost Hills Oilfield within Sections 14, 15, 22, 23, 26 and 27 of T27S/R21E, where Seneca operates the four Tisdale UIC wells within the proposed Project Area (**Figure 1-2**).

CalGEM, in conjunction with the United States Environmental Protection Agency (USEPA), State Water Board and the Central Valley Water Board, is in the process of reviewing certain "aquifer exemptions" previously granted under the Safe Drinking Water Act in connection with oil and gas production. As described above, the Project Zone[6] (three-dimensional zone proposed for de-designation has a concentration of TDS in excess of 10,000 mg/L, and is therefore not an underground source of drinking (USDW). For that reason, the geologic formations within the Project Area proposed for de-designation are not subject to CalGEM's "aquifer exemption" process. However, some of the data, analysis, and figures from the studies supporting the CalGEM "aquifer exemption" process for nearby aquifers is pertinent to Seneca's De-Designation Petition. This Staff Report references data, analysis and figures in the Seneca's De-Designation Petition (as appropriate) in the supporting analysis provided herein.

1.2.2 Regional Subsurface Geology

The Lost Hills Oilfield overlies a zone of deformation (an area where rock formations have been deformed through folding and faulting) located between the San Andreas Fault system to the west and the axis of the San Joaquin Valley to the east. Movement

[6] See explanation of **Project Area** and **Project Zone** in Section 1 (p. 2).

related to slip along the San Andreas Fault system has created geologic deformation structures consisting of folds (synclines and anticlines) and faults. These folds generally trend northwest-southeast parallel to the trend of the San Andreas Fault and resemble waves (anticlines) and troughs (synclines). A structure cross section by Medwedeff (1989), illustrates the relationship from the Oligocene Temblor to the Pliocene Tulare Formations (**Figure 1-4**). Since the Lost Hills anticline was forming during the Pliocene, the San Joaquin Formation, a silty mudstone, was either not deposited on the structure or was eroded during uplift. The San Joaquin Formation is not present or very thin and indistinguishable from the Etchegoin sandy mudstones in the study area. The San Joaquin Formation is present in the basins off the flanks of the anticline. The cross section also shows the Etchegoin unconformity on the west flank of the oilfield, which indicates significant erosion of Pliocene and early Pleistocene strata (**Figure 1-4**). Uplift of the Temblor Range, eustatic sea level changes and structural deformation and shedding of sediments from the Temblor Range into various marine and non-marine depositional settings has created many unique sedimentary units in the Lost Hills area. Smith (1964) interpreted the Tulare Formation outcropping in the Lost Hills Oilfield.

The depth and thickness of the Tulare Formation are controlled by the structural uplift and folding of the Lost Hills anticline during the time of deposition. Tulare Formation sediments thin across the crest of the structure and to the west and outcrop along the crest two miles north of Highway 46. The Tulare Formation thickens to the east and plunges down to the south into the non-hydrocarbon bearing portion of the unit that contains groundwater with TDS concentrations exceeding 10,000 mg/L. Tulare Formation sands south of Highway 46 typically range in depth from 300 feet below ground surface (bgs) to over 600 feet bgs. Typical Tulare Formation sand thicknesses range from 150 feet where eroded at the crest, to over 750 feet in the southern portion of the oilfield.

1.2.2.1 General Stratigraphy

The stratigraphy of the southwestern San Joaquin Valley comprises marine sedimentary rocks from the Jurassic through Neogene Periods and poorly consolidated to unconsolidated sediments from Late Tertiary and Quaternary Periods (**Figure 1-5**).

The oldest marine sediments are exposed in the Temblor range from north of Highway 41, south to Highway 58. Younger marine Formations are exposed to the east, approaching the valley floor. The sedimentary units deposited in the region represent deep to shallow marine to brackish water to terrestrial lacustrine and alluvial depositional environments. The sedimentary units consist of a series of Eocene through Pliocene marine sedimentary rocks overlain by continental sediments of Plio-Pleistocene to Present age (**Figure 1-5**).

The sedimentary Formations that underlie the Lost Hills Oilfield from the uppermost unit downward include:

- Pleistocene to Holocene Alluvium
- Pleistocene Tulare Formation (Upper and Lower Members)

- Upper Pliocene San Joaquin Formation (occurs in the basin and on the flanks of Lost Hills anticline)
- Lower Pliocene Etchegoin Formation
- Miocene-Pliocene Reef Ridge Formation
- Middle to Upper Miocene Monterey Formation containing the Cahn member
- Lower Miocene Temblor Formation with the Phacoides and Carneros sandstone members
- Oligocene Tumey Formation containing the Oceanic sandstone member
- Eocene Kreyenhagen Shale containing the Point of Rocks sandstone
- Upper Cretaceous Shale.

The two units of interest within the proposed Project Area include the Lower Tulare Member and the Etchegoin Formation (i.e., Project Zone). The Etchegoin Formation unconformably overlies the Reef Ridge Formation and consists of a heterogeneous mix of marine diatomaceous mudstones, sandstones, and siltstones. Outside the Project Area, the Etchegoin is overlain by the San Joaquin Formation, a transgressive marine to brackish water mudstone. The San Joaquin Formation is not present in the Project Area, indicating it was either eroded from the top of the growing Lost Hills Anticline, or was not deposited due to positive structural relief.

In the proposed Project Area, the Pliocene-Pleistocene Tulare Formation overlies the Pliocene Etchegoin Formation with an angular unconformity and is currently not a source of hydrocarbon production. The Tulare Formation is a non-marine, interbedded sequence of poorly consolidated conglomerate, sandstone, siltstone, and mudstone. A basal sand overlies this unconformity and is interpreted to represent the first alluvial continental deposition following regression of the Etchegoin marine seas on top of the exposed Lost Hills structure.

1.2.2.2 Tulare Formation: Deposition, Stratigraphy and Lithology

The Tulare Formation and overlying Holocene alluvium consist of coarse-grained alluvial fan, fluvial channel, and lacustrine coastal plain facies shed eastward from the uplifting Temblor Range. It sits unconformably atop the Lower Pliocene Etchegoin Formation at the crest of the anticline and the Upper Pliocene San Joaquin Formation off the flanks.

West of Lost Hills, the Tulare Formation consists of poorly sorted alluvial sandy mudstones and fluvial sandstones that interfinger with coastal plain fine-grained sandstones, mudstones, and gypsum cemented mudstones of delta marsh origin. At the crest of the anticline the alluvial/fluvial facies become interbedded with fine-grained facies associated with coastal plain (marshland and delta) and lacustrine shoreline deposits from the pre-historic Lake Clyde and historic Tulare Lake (Harden, 2004). On the east flank of the field, fine-grained sandstones pinch out eastward into lacustrine mudstones.

The Tulare Formation thickens from north to south along the axis of the Lost Hills Anticline due to depositional thickening and the erosion of the upper portion of the Tulare to the north, and thickens westward and eastward, off the anticline axis.

Local topographic features like the Lost Hills Anticline enabled the deposition of shoreline deposits at the margin of the Pleistocene Lake Clyde (**Figure 1-6**). At Lost Hills the Tulare Formation was deposited as a transgressive/regressive lacustrine sequence. The initial deposit resulted from a transgressive shoreline facies deposited across the eroded topographic feature that marked the surface expression of the Lost Hills Anticline. The maximum transgressive phase resulted in the northeastward thickening claystone and mudstone wedge. Interbedded siltstones and mudstones thinned across the anticline and thickened toward the deeper portion of the lake basin. The gross thickness of sand packages is greatest downdip, but the sands thin eastward into thickening mudstone interbeds. The regressive phase of deposition resulted in broadly distributed alluvial mudstones and occasional fluvial and deltaic plain sandstones.

As indicated previously, the Tulare Formation is divided into two member units – the Upper Tulare Member and the Lower Tulare Member, each consisting of interbedded layers of mudstone, siltstone, and sandstone. The sandstone is poorly consolidated, and poorly sorted (very fine, fine, medium to coarse grained, with moderate amounts of clay and silt-sized grains); and has an average porosity of approximately 35 percent and permeabilities that range from 200 to 5,000 millidarcies (mD). Productive reservoirs typically comprise porosities of 36 to 42 percent and permeabilities ranging between 1 and 2 Darcies (1,000-2,000 mD).

The Tulare Formation contains individual sandstone intervals ranging from 5 to 25 feet thick that are separated by numerous, variably stacked, low-permeability mudstones. The sandy intervals are characterized by blocky resistivity log signatures and lack of well-developed upward-coarsening successions. The isochore maps of the Upper Tulare Member and the Lower Tulare Member (**Figures 1-7 and 1-8**) indicate both thicken to the east-northeast, east and southeast. The distribution of interbedded mudstones between sandstone layers influences fluid distribution and affects fluid migration within the reservoir.

The Upper and Lower Members of the Tulare Formation are separated by a regionally traceable clay- and silt-rich mudstone, referred to locally as the “Mid-Tulare Shale” or “Mid-Tulare Mudstone” (**Figure 1-9**), which acts as a hydraulic barrier to vertical flow. The Mid-Tulare Shale is a 10-to 50-foot thick, low permeability, high clay and silt mudstone layer that is persistent across the southern portion of the Lost Hills area as depicted on Cross Sections A-A’ and B-B’ (**Figures 1-10, 1-11,1-12 and 1-13**) and present throughout the Project Area. The Mid-Tulare Shale is the basal member of a clay-rich zone (CRZ) that comprises the lower portion of the Upper Tulare Member. The CRZ is a sequence of low-permeability mudstones, shales, and shaly sandstones that is regionally traceable and ranges in thickness from 50 feet to over 400 feet. As described below, the Mid-Tulare Shale is the marker for the top of the (non-USDW) Lower Tulare Member in the Southern Lost Hills area.

1.2.2.3 Tulare Type Log

The lithologies of the Tulare Formation are identifiable on geophysical logs. A type log demonstrating the geophysical log characteristics is shown on **Figure 1-9**. These logs, in combination with each other, enable the identification of Tulare Formation lithologies and the presence of fluids (oil and water). The oil-bearing Tulare Formation in the northern portion of the Lost Hills Oilfield is identified by high resistivity and neutron-density curves that track together.

1.2.2.4 Mid-Tulare Shale

The Tulare Formation was initially described by Arnold and Anderson (1910) with the type locality in the Kettleman Hills, which are located 20 miles to the northwest and along strike with the Lost Hills. The Tulare Formation comprises the youngest folded strata beneath the undeformed Quaternary alluvial deposits (Woodring et al ,1940). Arnold and Anderson described a measured section of the Tulare Formation in a transect of the Kettleman Hills that extends from the east flank of the anticline eastward toward the Central Valley. A review of the type log for the Tulare Formation in the Lost Hills (**Figure 1-9**) indicates that the Mid-Tulare Shale correlates with a 75-foot-thick unit described as pure clay and sandy clay in the Tulare type locality of the Kettleman Hills (Arnold and Anderson, 1910). This evidence suggests that the Mid-Tulare Shale is an extensive, mappable unit in the Tulare Formation that may be recognized elsewhere in the Basin including the type locality.

As reported by CV-SALTS (2015), the Tulare Formation in the Tulare Lake area consists largely of relatively impermeable basin soils, the predominant soil being Tulare Shale, a deep and very finely textured soil. The clay deposits have been designated from the youngest to the oldest by the letters “A” through “F.” The most prominent of these clay units is the E-Clay or Corcoran Clay Member of the Tulare Formation, which extends throughout the majority of the western and southern Tulare Lake Basin, but is absent along the eastern boundary and in the Bakersfield area. The Corcoran Clay generally separates unconfined groundwater conditions above the clay from confined conditions below the clay (CV-SALTS, 2015).

The Corcoran Clay was named by Frink and Kues (1954), but the unit was extensively correlated and mapped across the Tulare Lake Basin by Davis, Green, Olmsted, and Brown (1959) under the descriptor “Diatomaceous Clay” (Page, 1973).
Davis et al. (1959) recognize the type locality for the Tulare Formation in the Kettleman Hills after Woodring et al. (1940), and correlate the Diatomaceous Clay observed near the base of the Tulare Formation in the Kettleman Hills with the Corcoran Clay.
Croft (1972) describes the E Clay, or Corcoran Clay, as an extensive, confining unit that underlies about 3,500 square miles of bottom land and the western part of the valley. It is commonly called the “blue clay” by well drillers (Croft, 1972). Maps and cross sections of the Tulare Formation prepared by Croft (1972) and Page (1983) do not extend the Corcoran Clay directly into the Lost Hills area due to a lack of well control, but the unit is depicted in the southern Kettleman Hills to the northwest, the Semitropic

Ridge to the east, and the Buttonwillow Ridge to the southeast. However, the contoured elevations of the Corcoran Clay in the Kettleman Hills and in the Buttonwillow Ridge are consistent with the elevation of the Mid-Tulare Shale as shown in Cross Section A-A' on **Figure 1-12** (Croft, 1972, Plate 4). These field relations suggest that the Mid-Tulare Shale is correlative with the Corcoran Clay or a local equivalent on the west side of the Basin and near the western shore of the pre-historic Lake Clyde (Harden, 2004) (**Figure 1-6**).

1.2.2.5 Etchegoin Formation: Deposition, Stratigraphy and Lithology

The Etchegoin Formation is a Pliocene age shallow marine deposit that consists of a heterogeneous mix of marine diatomaceous mudstones, sandstones, and siltstones. The Formation has a significant angular discordance with the overlying Tulare Formation on the west flank of the anticline. Off the structure, the Etchegoin is overlain by the San Joaquin Formation, a transgressive marine to brackish water mudstone (non-reservoir). The Etchegoin Formation unconformably overlies the Reef Ridge Formation throughout the oilfield.

The permeable sandstone layers within the Etchegoin Formation are poorly consolidated, and poorly sorted; and have porosities ranging from 30 percent to 45 percent; and permeabilities that range from 10 to 10,000 mD. The isochore map of the Etchegoin Formation (**Figure 1-14**) indicate that it thickens to the south, down the axis of the anticline.

In the northern portion of the oilfield, sandstones are saturated with widely varying oil gravities (11 to 40 - degree API) that are developed via steam or waterflood operations. TDS concentrations in Etchegoin Formation groundwater in the Lost Hills Oilfield are typically greater than 20,000 mg/L. Water samples gathered in the 1950's had a range of 20,000-33,000 mg/L TDS (Appendix B).

1.2.2.6 Etchegoin Type Log

The lithology of the Etchegoin is identifiable on geophysical logs. A type log demonstrating the geophysical log characteristics is shown on **Figure 1-15**. These logs enable the identification of Etchegoin Formation lithologies and the presence of fluids (oil and water). The type log shows the characteristic low resistivity and spontaneous potential measurements of the Etchegoin Formation, with marker beds identified by zones of increased spontaneous potential.

1.2.3 Preliminary Project Area Delineation

As presented on **Figure 1-2**, the proposed Project Area includes Sections 14, 15, 22, 23, 26, and 27 of Township 27 South, Range 21 East, from the Mount Diablo Baseline and Meridian (MDBM). The location and dimensions of the proposed Project Area are based on the following factors:

- Location of Seneca's water injection wells
- Documentation of the non-USDW characteristic in the Etchegoin Formation and Lower Tulare Member in the South Lost Hills Oilfield
- Potential variability in groundwater flow directions
- Modeled 100-year injection plumes
- A buffer zone surrounding the injection plumes.

The four UIC injection wells used by Seneca at the Lost Hills Oilfield are 51WD-22, 53WD-22, 87WD-22, and 88WD-22; they are located in Section 22, as shown on **Figure 1-16** and **Figure 1-3**. Available water quality data for wells screened within the Lower Tulare Member and Etchegoin Formation, within, upgradient and downgradient of the modeled flow paths and buffer zone area indicate that groundwater contains TDS concentrations exceeding 10,000 mg/L.

1.2.3.1 Lateral Definition

To define the potential area that will be affected by Seneca's anticipated UIC operations over time and thus should be de-designated, Kennedy/Jenks modeled the flow path of water injected into the four wells over a 100-year time-frame (the anticipated life of UIC operations for these wells) and projected that information onto a regional map (**Figure 1-16**). These flow path projections were generated using MODFLOW. Input parameters used to generate the model include a generalized east-northeastward groundwater flow direction, a horizontal gradient of 0.02 feet/foot, an effective porosity of 35 percent, and the permitted flow limits for each injection well. The gradient and flow direction are based on a review of groundwater contour maps for groundwater in the Tulare Formation in the central portion of the Lost Hills oilfield, as well as the structure of the Tulare Formation throughout the Lost Hills Oilfield and generalized groundwater flow direction towards the center of the San Joaquin Valley. The porosity is based on log data from boreholes drilled in the Lower Tulare Member. A summary of the MODFLOW modeling is provided in Appendix C.

As depicted on **Figure 1-16**, the modeled flow paths emanating from each well have arrows that mark the projected progress of the plumes for each decade up to 100 years. Injection wells 51WD-22 and 53WD-22, which inject into both the Lower Tulare Member and Etchegoin Formation, have 100-year injection plumes that are approximately 350-feet wide and extend east-northeast approximately 4,300 feet. Wells 87WD-22 and 88WD-22, which inject only to the Lower Tulare Member, have narrower but slightly longer injection plumes with approximate lengths of 4,400 feet.

In addition, a buffer zone was placed around the modeled injection flow paths to provide added assurance that the proposed Project Area will contain these plumes and therefore remain appropriate for the projected 100-year modeling period. The buffer encompasses an area around the injection plumes of approximately 2,500 feet or to the Sections boundary, whichever is less (the minimum downgradient distance in the buffer is approximately 1,500 feet). The buffer zone allows for uncertainties in the groundwater flow direction, heterogeneities in the aquifer parameters that were used to generate the

modeled injection plumes, potential cumulative effects, and the displacement of existing groundwater in the Lower Tulare Member and Etchegoin Formation as water is injected into the four UIC wells. To account for uncertainty in groundwater flow directions, the buffer zones are drawn to allow a 180-degree change in flow direction (from north-northwest to south-southeast). Even with the addition of the buffer as described, the entire area that could be affected within the 100-year horizon is within the six sections contained within the administrative boundaries of the Lost Hills Oilfield. The buffer zone was not extended into Section 24 because it is already highly conservative. Water quality data collected from the Lower Tulare Member and Etchegoin Formation within the South Lost Hills Oilfield demonstrates that groundwater in these Formations is non-USDW. Information from wildcat and other wells (**Figure 1-17**) demonstrates that TDS concentrations exceeding 10,000 mg/L are prevalent in the Lower Tulare Member and Etchegoin Formation for several miles outside the proposed Project Area and the administrative boundary of the southern Lost Hills Oilfield. These data demonstrate that the formations into which Seneca's underground injection occurs are non-USDW, both in and adjacent to the proposed Project Area. Based on the model information and these data, the injection of produced water is not expected to impact the quality or actual beneficial uses of water within the Lower Tulare Member and the Etchegoin Formation beneath or in the vicinity of the oilfield.

Moreover, the Lost Hills Oilfield has a life expectancy of approximately 50 to 60 years based on current production levels, which is about half of the timeframe for the modeled flow path of the injection plume and would reduce the plume extent to about half of the modeled flow distance.

1.2.3.2 Vertical Definition and Control

Upper vertical control of injected water at the underground injection wells, and within the Project Zone, is provided by the Mid-Tulare Shale (separating the Upper and Lower Tulare Members), as depicted on **Figures 1-18 and 1-19**.

The Mid-Tulare Shale provides an upper confining boundary, separating waters in Lower Tulare Member from waters in the Upper Tulare Member. **Figure 1-20** shows two examples of mudlogs that describe the Mid-Tulare Shale as light greenish brown to brownish green, sticky, very soft clay with a pasty consistency and intermixed with sand and silt. The lithology column of the mudlogs indicate clay proportions of 80 to 95 percent

Downward vertical containment is provided by the low-permeable shales and mudstones of the lower Etchegoin Formation. These vertical hydraulic barriers are sufficient to protect groundwater in formations not subject to this De-Designation Petition.

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The effectiveness of the Mid-Tulare Shale as a vertical confining unit between the Upper Tulare Member and the Lower Tulare Member is demonstrated below using the following three lines of evidence:

- Groundwater level measurements and sample data from Mackessy Well (WD1-25);
- Permeability measurements from sidewall core samples of the Mid-Tulare Shale; and
- Injection testing results at Tisdale well WD88-22.

1.2.3.2.1 Mackessy Well (WD1-25)

The effectiveness of the Mid-Tulare Shale as a vertical hydraulic control between the two members is demonstrated at Mackessy Well (WD1-25) in two ways: (1) difference in potentiometric heads; and (2) contrasting water quality. Downward vertical containment is provided by the low permeability shales of the Etchegoin below the Lower Tulare Member and the Etchegoin sands that are utilized for injection (**Figures 1-14, 1-21 and 1-22**).

Groundwater level measurements collected from the Upper and Lower Tulare Member are available from the Mackessy Well (WD1-25), which is located in Section 25 T27S/R21E, southeast (down- and cross-gradient) of the injection wells (**Figure 1-16**). The Mackessy Well is currently being used as a SB-4 Oil and Gas Well Stimulation monitoring well for the oilfield. A well log showing the stratigraphy, screen intervals, and water levels for the Mackessy Well is provided on **Figure 1-23**. As the diagram shows, the well is perforated in the Upper Tulare Member from 480 ft bgs to 490 ft bgs, and was previously perforated in the Lower Tulare Member from 1,080 ft bgs to 1,100 ft bgs (the perforations in the Lower Tulare Member were plugged on July 17, 2014, and the Upper Tulare Member was perforated on July 18, 2014, reflecting its current completion). The 29-foot thick Mid-Tulare Shale is shown on the log at a depth interval of 1,043 ft bgs to 1,072 ft bgs. The depth to static water in the Upper Tulare Member was recorded at 294 ft bgs on 18 November 2016, and the depth to water in the Lower Tulare Member was recorded at 450 ft bgs on 11 July 2014. The contrast in hydraulic head suggests that the Mid-Tulare Shale provides an effective vertical separation between the two water-bearing zones, and that groundwater in the Lower Tulare Member is under confined conditions at the location of the Mackessy Well.

The distribution of TDS, based on geophysical log data, for the Upper and Lower Members of the Tulare Formation in the proposed De-Designation Area is shown on **Figures 1-18** and **1-19**. Water quality information is based on the results of laboratory analysis of water samples and on interpretation of well resistivity logs. Laboratory results of water samples showing water quality are summarized in **Table 1-1** and laboratory results of these samples are provided in **Appendix B**. As the data in **Table 1-1** indicate, water samples collected from the Upper Tulare Member that overlies the proposed De-Designation Area have TDS values below 10,000 mg/L. In contrast, water samples collected from within the Lower Tulare Member in the Project Area have TDS

values well over 10,000 mg/L. These data demonstrate that the Formations into which Seneca's underground injection occurs are non-USDW, both in and adjacent to the Project Area. The vertical hydraulic containment provided by the Mid-Tulare Shale is evidenced by the hydraulic heads and water quality data collected from the Mackessey well.

The cross-sections depicted on **Figures 1-18** and **1-19** show e-logs for wells in the southeastern part of the Lost Hills Oilfield that include the Project Area. The 3-ohm-m line is highlighted on the resistivity logs for each well. As illustrated, the wireline resistivity fluctuates about and above 3 ohm-m in the Upper Tulare Member. Below the Mid-Tulare Shale, wireline resistivity is generally below 3 ohm-m. This contrast demonstrates the higher TDS concentrations (greater than 10,000 mg/L) in the Lower Tulare Member and the effectiveness of the Mid-Tulare Shale as a vertical hydraulic barrier.

1.2.3.2.2 Permeability Measurements

The effectiveness of the Mid-Tulare Shale as a vertical confining unit is also demonstrated by direct measurements of permeability taken from sidewall core samples that were collected from the Mid-Tulare Shale. **Figure 1-24** presents a histogram summarizing 65 air permeability measurements that were taken from horizontal cores of shales in the northern part of the oilfield whose properties are consistent with the Mid-Tulare Shale. The samples were collected from wells that were drilled in the northern portion of the Lost Hills Oilfield.

Based on the data distribution on **Figure 1-24**, air permeability in the Mid-Tulare Shale ranges from approximately 1 to 20 millidarcies. Eighty-six percent of the samples analyzed had air permeabilities of 3 millidarcies or less. Only nine of the 65 samples that were analyzed had air permeabilities of 4 millidarcies or more.

The permeability that is illustrated on **Figure 1-24** is air permeability measured in the horizontal direction. Studies by Bloomfield and Williams (1995) found that the ratio of water permeability to air permeability generally ranges from 0.03 to 0.9 in sandstones and shales. Furthermore, studies by Weeks (1969), Lishman (1970), and Fazelalavi (2013) found that vertical permeability is generally lower than horizontal permeability by factors ranging from 0.5 to 0.05.

Based on these horizontal air permeability measurements, the water permeability of the Mid-Tulare Shale in the vertical direction is likely well below 3 millidarcies. Bear (1972) characterizes media with permeabilities below 10 millidarcies as generally impervious.

1.2.3.2.3 Injection Testing

The effectiveness of the Mid-Tulare Shale and lower Etchegoin shales and mudstones as vertical confining units is also demonstrated by the results of an injection test conducted in September 2017. To evaluate the confined nature of the Lower Tulare Member further, Seneca Resources conducted a 17-hour injection test using two water

disposal wells screened in the Lower Tulare Member (87WD-22 and 88WD-22, **Figures 1-16 and 1-18**). The 17-hour test including injecting water into well 88WD-22 and monitoring responses (changes in hydraulic pressures) in well 87WD-22.

Prior to starting the test, both wells were shut in to allow the formation pressures to stabilize. The Injection rate into 88WD-22 was maintained at approximately 100 gallons per minute throughout the duration of the test. Pressure was monitored in both wells on one-minute intervals throughout the test duration. Pressure readings were collected using Accutech GP10 gauge pressure sensors and transmitted to the remote field office using radio transmitters so the test could be monitored in real time.

Results of the injection test, illustrated on **Figure 1-25**, show a near-instantaneous increase in head pressure in well 87WD-22 at the start of the test and continued increases in head pressure readings throughout the duration of the test.

The injection test results convincingly demonstrate that the Lower Tulare Member behaves as a confined aquifer, and that the Mid-Tulare Shale and lower Etchegoin shales and mudstones represent effective confining units.

1.2.4 Soil Conditions

The ground surface in the Project Area is almost entirely unpaved. The Tulare Formation may be overlain at the surface by Holocene alluvium, which is sourced from the Temblor Range and comprises a sequence of interbedded, unconsolidated gravels, sands, silts, and muds deposited in an alluvial setting.

1.2.5 Groundwater Conditions

The Lost Hills Oilfield is located within the Tulare Lake Hydrologic Region, which covers approximately 17,000 square miles and encompasses Kings, Tulare, Fresno, and Kern counties (DWR, 2015).

Currently, surface water flow is extremely intermittent and results from infrequent storms during the winter and spring months. Due to the semi-arid to arid climate of the area, recharge in the form of precipitation is minimal and most years the water balance is in deficit. Fresh water percolation from precipitation into the Tulare and Holocene alluvium at the crest of Lost Hills would move downward into the “air sands.” Recharge from precipitation is not expected to impact deeper Formations within the oilfield.

1.2.5.1 Groundwater Occurrence and Flow

Shallow groundwater generally flows from the flanks of the northwest-trending Lost Hills anticline structure toward the synclines to the west and east.

An estimation of groundwater velocity was made in two directions, east-northeast and south-southeast, from the groundwater crest in Section 32 T27S/R21E through the proposed De-Designation Area. Water level data collected from water supply wells

outside the oilfield boundary were used to develop a regional velocity. The velocity is interpreted to vary between 5 feet per year (ft/yr) and 15 ft/yr in the east-northeast direction and between 2.5 ft/yr and 7.5 ft/yr in the south-southeast.

The formula used to calculate velocity (v) was:

$$\mathbf{v} = \mathbf{K}\,\mathbf{i} / \boldsymbol{\phi}\mathbf{eff}$$

where:

K = hydraulic conductivity

i = gradient ($\Delta y/\Delta x$ from potentiometric contour maps)

ϕeff = effective porosity

Specific capacity data from oilfield water supply wells, which varied from 16 gallons per minute per foot (gpm/ft) to 38 gpm/ft, was converted to transmissivity values using an empirical formula from Groundwater and Wells (Driscoll, 1986, p. 1021), then to hydraulic conductivities by dividing the transmissivity value by total screen length in each well. Two conservative values of effective porosity were used, 10 percent and 20 percent, in the estimate. Average hydraulic gradients were measured in the east-northeast and south-southeast directions, 0.002 and 0.001, respectively. Field and modeled values of hydraulic conductivity from the Tulare Formation in western San Joaquin Valley (Faunt et al., 2009, pp. 156-157) are at least an order of magnitude smaller than those estimated above, which makes these estimates of velocity conservative.

1.2.5.2 Groundwater Quality

In its 2009 California Water Plan, the California Department of Water Resources (DWR) indicated that “[i]n the western (San Joaquin) Valley area, groundwater quality is often poor, and availability is highly variable.” Naturally occurring oil, high evaporation rates, percolation through eroded marine sediments, and upwelling connate groundwater along fractures contribute to the overall poor groundwater quality in the Tulare Formation.

Water quality data from groundwater sampling is generally sparse due to a lack of water wells in the southern part of the Lost Hills Oilfield, but the existing data do show consistent water quality relationships between the Upper and Lower Members of the Tulare Formation. The available groundwater quality data are summarized in **Table 1-1** and well locations are illustrated on **Figure 1-17**. The vertical distribution of TDS for the Upper Tulare Member, as well as the Lower Tulare Member within the Project Area, is illustrated in the geophysical logs shown on **Figures 1-12** and **1-13**. Analytical laboratory reports are provided in **Appendix B**. As the data summary shows, groundwater samples collected from the Upper Tulare Member have TDS concentrations ranging from 3,400 to 7,400 mg/L; whereas, groundwater samples

collected from the Lower Tulare Member and Etchegoin Formation in the southern part of the oilfield have TDS concentrations exceeding 10,000 mg/L.

Water quality information is based on the results of laboratory analysis of water samples, information obtained from the GAMA database, and on interpretation of well resistivity logs. As the data in **Table 1-1** indicate, water samples collected from the Lower Tulare Member and the Etchegoin Formation in the Project Area have TDS values well over 10,000 mg/L. In the Mackessy well (**Figure 1-17**), which is currently screened in the Upper Tulare Member (**Figure 1-23**), water from the Upper Tulare Member has a TDS of 3,040 milligrams per liter (mg/L), whereas water previously sampled from the Lower Tulare Member, when this well was screened in the Lower Tulare, had a TDS of 18,960 mg/L. (See Section 1.2.3.2.1)

The relationship between the resistivity of a brine-filled Formation and the resistivity of the brine was formulated by Archie (Archie, 1941); the relationship between the resistivity of a brine and its salinity has been explored by Bateman and Konen (1977) among others. The resistivity log for the Mackessy Well (**Figure 1-23**) illustrates that below the Mid-Tulare Shale the resistivity drops below 3 ohms meters (ohm-m). **Figure 1-21** is a cross plot of TDS concentrations from the Tulare Formation and the wireline log resistivity of the sampled interval in wells in the South Lost Hills Oilfield. Water sampled from intervals with wireline resistivity values greater than 3 ohm-m correlated with TDS concentrations less than 10,000 mg/L, while water sampled from intervals with wireline resistivity values less than 3 ohm-m correlated with a TDS concentration greater than 10,000 mg/L. Electric logs of the wells outside the Tulare EOR area (northern portion of the Lost Hills Oilfield) with water quality analyses show a range in resistivity profiles that correlates with the range in measured TDS values.[7]

The cross-sections depicted on **Figures 1-12 and 1-13** show e-logs for wells in the southeastern part of the Lost Hills Oilfield that include the proposed Project Area. The 3-ohm-m line is highlighted on the resistivity logs for each well. As illustrated, the wireline resistivity fluctuates about and above 3 ohm-m in the Upper Tulare Member. Below the Mid-Tulare Shale, wireline resistivity is generally below 3 ohm-m. This contrast reflects the higher TDS concentrations (greater than 10,000 mg/L) in the Lower Tulare Member.

A number of wildcat oil wells (**Figure 1-17**) have been drilled since the early 1900's in the 8 to10 mile region between the Lost Hills Oilfield and the neighboring Semitropic Oilfield to the east. Written records and electric logs from these wells in the CalGEM database provide important stratigraphic, structural, and water quality information for the area east of the Lost Hills Oilfield. A review of these records indicates that the Tulare Formation continues to dip down to the east beneath the valley floor (**Figure 1-22**). The

[7] Generally, wireline log resistivity in the Lower Tulare decreases from North to South outside of the Tulare EOR area, indicating an increase in the conductivity of the pore fluid and a corresponding increase in TDS concentrations.

top of the Lower Tulare Member was encountered at a depth of 1,986 feet bgs in a well located five miles east of the Lost Hills Oilfield. Water quality inferred from resistivity logs in these wildcat wells indicates that TDS concentrations exceed 10,000 mg/L below a depth of 1,670 feet bgs.

Table 1-1. Tulare and Etchegoin Formations Water Quality Summary

Well ID	API	Formation	Operator	Screened Interval (ft. bgs)	Date	TDS (mg/L)	Boron (mg/L)
4M1	NA	Upper Tulare	Aera	460-500	11/24/2015	7,400	5.8
WD1-25	040298736300	Upper Tulare	Seneca	480-490	12/14/2015	3,400	8
C32G0084	040296128500	Lower Tulare	Chevron	780-815	Not Available	11,600	Not Available
51WD-22	040296547800	Lower Tulare, Etchegoin	Seneca	630-854, 944-972	4/28/1992	16,100	30
WD1-25	040298736300	Lower Tulare	Seneca	1080-1100	7/11/2014	18,960	Not Available
Cahn 7-6A	0402903985	Etchegoin	Standard	1963-2875	9/24/1968	30663.2	Not Available
Cahn 7-10A	0402905021	Etchegoin	Standard	1899-3588	9/25/1968	34002.5	Not Available
Vulcan 183	0402905041	Etchegoin	Standard	Unknown	9/18/1962	31270.5	Not Available
Vulcan 184	0402905042	Etchegoin	Standard	Unknown	9/18/1962	32987.2	Not Available
Cahn 5-14A	0402905120	Etchegoin	Standard	1939-3648	9/25/1968	32420.6	Not Available
Cahn 12-15	0402905140	Etchegoin	Standard	2490-2814, 2708-3817	10/10/1968	36754.5	Not Available
Martin 8-1	0402905136	Etchegoin	Getty	2122-3707	9/25/1968	31300.7	Not Available
Well 101	0402960111	Etchegoin	Standard	2080-2555	3/31/1980	45207	Not Available
Cahn 13	0402903927	Etchegoin	Standard	1937-2108	6/2/1953	32018.5	Not Available
Cahn 4-10	040290518	Etchegoin	Standard	1738-2628	12/17/1970	40576.1	Not Available

Well ID	API	Formation	Operator	Screened Interval (ft. bgs)	Date	TDS (mg/L)	Boron (mg/L)
Cahn 7	0402903922	Etchegoin	Standard	1952-1972	6/24/1953	31220	Not Available
Cahn 212	0402903972	Etchegoin	Standard	1874-1972	3/2/1955	32724	Not Available
Cahn 22	0402905055	Etchegoin	Standard	2055	2/20/1947	31954.4	Not Available
Theta 13	NA	Etchegoin	Standard	1618-1718	6/23/1948	21487.7	Not Available

1.2.5.3 Groundwater Use

Groundwater from the Tulare Formation within the vicinity of the Lost Hills Oilfield is naturally poor due to depositional environments, low recharge in an arid environment, and the presence of connate groundwaters originating from marine-derived Formations. Water quality data demonstrates that Tulare Formation groundwater contains elevated concentrations of TDS, boron, and other minerals. Based on discussions with agricultural operations within the Project Area (the Wonderful Nut Orchards company), imported surface water is utilized for crop irrigation and groundwater within the Project Area, because of the high salinity, is considered unusable for agricultural use.

Wonderful Nut Orchards does perform some blending of groundwater with surface water from wells located over 2 miles east of the Project Area. Groundwater from these wells has a TDS concentration of approximately 2,500 mg/L and requires a blending ratio of 4 and 5 to 1 surface water to groundwater in order for groundwater from these wells to be useable for crop irrigation. Since groundwater within the Project Zone has a salinity roughly four times the salinity of groundwater from the blending wells, it is considered neither practical nor economical to utilize groundwater from within the Project Zone for blending purposes. The only known use of the Tulare Formation groundwater in the Lost Hills Oilfield is Industrial Service Supply[8] (IND) by oilfield operators.

Notwithstanding the general MUN designation in the Basin Plan, no groundwater in the Lost Hills Oilfield is actually used for MUN. Groundwater within the Tulare Formation has not been developed for municipal use because of the poor mineral quality and depth of the resource. The nearest municipal water source well is located approximately 9.4 miles east of the Lost Hills Oilfield as shown on **Figure 1-26**.

A review of DWR well records for the six sections comprising the Project Area indicates that three wells are located in Section 26, Township 27S, Range 22E. No wells are identified for the other five Sections 14, 15, 22, 23 or 27 of the same Township and Range. The three wells are identified as follows:

- 27/21-26 Well #142, installed 1989, total depth 250 ft., perforation: None, use: Cathodic Protection
- 27/21-26 Well #163, installed 1989, total depth 250 ft., perforation: None, use: Cathodic Protection

[8] The “Industrial Service Supply” or “IND” beneficial use of water encompasses uses of water for industrial activities that do not depend primarily on water quality (e.g., mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection and oil well repressurization). (See Basin Plan, § 2, p. 2-2.)

- 27/21-26 Well #173, installed 1989, total depth 250 ft., perforation: None, use: Cathodic Protection

Cathodic protection wells are not perforated at any zone and are not used to produce groundwater.

Based on the findings of the well search, there is no State record of wells installed in any of the six sections of the Project Area for groundwater use of any kind.

A list of water wells located in a five-mile vicinity of the Lost Hills Oilfield is provided in **Table 1-2**. In general, wells outside the Lost Hills Oilfield are located to the east on the valley floor, as shown on **Figure 1-16**. The 26 wells listed in **Table 1-2** and shown on **Figure 1-16** have the following designations:

- Irrigation wells (17)
- Industrial wells (1)
- Domestic wells (1)
- Abandoned oilfield development wells (2)
- USGS water quality test wells (1)
- Use info not available (4)

The wells above are typically screened within the upper-most water bearing unit (see, e.g., **Figure 1-22**). The information reviewed to date indicates that there are no water sources wells outside the Lost Hills Oilfield screened within the Lower Tulare Member or Etchegoin Formation within 5 miles of the proposed De-designation Area, as illustrated on **Figure 1-22**.

Table 1-2. Water Wells Within Approximately Five Miles of South Lost Hills Oilfield

State Well ID Number	Approx. Distance from Project Area (miles)	Direction from Project Area	Town-ship	Range	Section	Tract	Use	Bottom of Screen (ft. bgs.)	Top of Lower Tulare Member (ft. bgs)	Distance Between Bottom of Screen to Top of Lower Tulare (ft.)
27S21E24P002M	< 1	E	27S	21E	24	N	(unknown)	(unknown)	1120	(unknown)
27S22E31N002M	< 1,	E	27S	21E	36	R	(unknown)	(unknown)	1090	(unknown)
Van Sicklen 45	1-2	SE	27S	21E	1	G	Abandoned	(unknown)	760	(unknown)
27S22E09D001M	2-3	NE	27S	22E	8	B	Irrigation	500	1780	1280
27S22E17P001M	2-3	E	27S	22E	17	N	Irrigation	500	1560	1060
27S22E20R001M	2-3	E	27S	22E	20	R	Irrigation	870	1600	730
27S22E29P002M	2-3	E	27S	22E	29	N	Irrigation	624	1380	756
47D-12	2-3	SE	27S	22E	12	P	Abandoned	(unknown)	750	(unknown)
27S22E04N001M	3-4	NE	27S	22E	4	N	Irrigation	504	1880	1376
27S22E16A001M	3-4	E	27S	22E	16	A	Irrigation	400	1890	1490
27S22E21P001M	3-4	E	27S	22E	21	P	USGS	700	1680	980
27S22E21P002M	3-4	E	27S	22E	21	N	Irrigation	420	1620	1200
27S22E28G002M	3-4	E	27S	22E	28	G	Irrigation	708	1690	982

State Well ID Number	Approx. Distance from Project Area (miles)	Direction from Project Area	Town-ship	Range	Section	Tract	Use	Bottom of Screen (ft. bgs.)	Top of Lower Tulare Member (ft. bgs)	Distance Between Bottom of Screen to Top of Lower Tulare (ft.)
27S22E33L001M	3-4	SE	27S	22E	33	K	Irrigation	501	1260	759
28S22E04G001M	3-4	SE	27S	22E	4	F	Irrigation	800	1160	360
28S22E04Q001M	3-4	SE	27S	22E	4	P	Irrigation	460	1120	660
28S22E09D002M	3-4	SE	27S	22E	9	D	Domestic	522	1080	558
Belridge 12	3-4	SE	27S	22E	8	B	Irrigation	(unknown)	980	(unknown)
Belridge 13	3-4	SE	27S	22E	8	J	Irrigation	(unknown)	960	(unknown)
27S22E11C001M	4-5	NE	27S	22E	10	C	Industrial	500	2150	1650
27S22E11L002M	4-5	E	27S	22E	10	H	Irrigation	540	2120	1580
27S22E14E001M	4-5	E	27S	22E	15	G	(unknown)	(unknown)	2020	(unknown)
28S22E10D002M	4-5	SE	27S	22E	9	A	Irrigation	420	1230	810
Belridge 9	4-5	SE	27S	22E	17	A	Irrigation	(unknown)	950	(unknown)
27S22E23D003M	> 5	E	27S	22E	23	D	Irrigation	510	2050	1540
27S22E23E001M	> 5	E	27S	22E	23	E	(unknown)	91	2000	1909

Table 1-2 Notes:

1. See Figure 1-11 for well locations on map.

2. Well uses and screen depths are based on drillers logs (where available).

3 Estimates for top of Lower Tulare Member are based on structure contours from Lost Hills Oilfield and Wildcat wells,

4. For “Distance Between Bottom of Screen to Top of Lower Tulare,” a positive value indicates that the well is screened above the Lower Tulare Member.

1.2.6 Surface Features

Developments in the Project Area consist only of scattered oil-field related facilities including pump jacks, tank batteries, pipelines, utilities, and access roads. Lost Hills Road (County Road 298) occupies a 60-foot right of way that transects the middle of the Project Area from north to south.

The Belridge Canal transects the west side of Section 27 flowing from north to south. The California Aqueduct transects the east sides of Section 14 and Section 23 flowing from north to south.

Cultivated farmlands are present in most of Section 27 and in the portions of Section 14 and Section 23 that are east of the California Aqueduct.

1.2.7 Cities and Communities

No cities or communities are located in the Project Area. The nearest community to the Project Area is the City of Lost Hills, which is located 2 miles to the north. 2010 census data indicate the City of Lost Hills has a population of 2,412 people, and has undergone 24.5 percent growth since 2000 (www.city-data.com/city/Lost-Hills-California.html). State well records do not identify any local municipal wells that would be associated with water supply for the City of Lost Hills.

The Lost Hills Oilfield and the City of Lost Hills are located in the Lost Hills Water District, which is a State Water Project Member Unit of the Kern County Water Agency. Based on the Lost Hills Water District's 2012 Agricultural Water Management Plan, water supplies are generally obtained as surface water from the State Water Project. The water is delivered to the District through the California Aqueduct pursuant to a contract signed with the Kern County Water Agency. The District's annual entitlement of State Water Project water is 119,110 acre-feet per year (LHWD, 2013). In addition, the District reportedly extracts approximately 19,000 acre-feet per year of water from the Barrenda Mesa and Pioneer groundwater banking projects, but the District does not own or operate any municipal wells (LHWD, 2013). The Plan indicates that the District drilled a test well in 1992 in Service Area 6 (east of Interstate 5) to a depth of 900 feet, but the well was unsuccessful in finding water of sufficient quality to supplement the surface water supply. The Plan identifies no groundwater supplies for the reported water year 2012, and none in the planning for water years 2013 through 2017 (LHWD, 2013).

1.3 Regulatory Authority and Mandates for Basin Plan Amendments

In enacting the Porter-Cologne Water Quality Control Act (Porter-Cologne Act), Water Code section 13000 et seq., the Legislature found and declared that activities and factors which may affect the quality of the waters of the State shall be regulated to attain the highest water quality which is reasonable, considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible.

The State Water Board and each of the nine Regional Water Quality Control Boards (Regional Boards) (collectively, Water Boards) are the State agencies with primary responsibility for coordination and control of water quality. (Wat. Code, §§ 13100, 13200, 13225.) Each Regional Board, including the Central Valley Water Board, is required to adopt a water quality control plan, or "basin plan," which provides the basis for regulatory actions to protect water quality. (*Id*., § 13240.) These "basin plans" designate beneficial uses of water; water quality objectives (WQOs) to protect such uses; and a program of implementation to achieve the objectives. (*Id*., §§ 13241-13242.) Once adopted, "basin plans" must be periodically reviewed and may be revised. (*Id*., § 13240.)

Under the federal Clean Water Act (33 U.S.C. § 1251 et seq.), states are required to adopt water quality standards for surface waters. Water quality standards, as defined in Clean Water Act section 303(c), consist of the designated beneficial uses (e.g., swimming, fishing, municipal drinking water supply, etc.) of a water body and water quality criteria necessary to protect the beneficial uses. A difference between the state and federal programs is that California's "basin plans" establish beneficial uses and WQOs for ground waters in addition to surface waters. Accordingly, "basin plans" contain designated beneficial uses and protective WQOs for groundwater.

Regional Boards adopt and amend "basin plans" through a structured process involving scientific peer review, public participation, and environmental review. This process is referred to as a Basin Plan Amendment. In undertaking this process, Regional Boards are required to comply with the California Environmental Quality Act (CEQA) (Pub. Resources Code, § 21000 et seq.).

Although the Secretary of Natural Resources has certified the basin planning process as "exempt" from the CEQA requirement to prepare an environmental impact report (EIR) or other appropriate environmental document (*Id*., § 21080.5; Cal. Code Regs., tit. 14, § 15251, subd. (g)), State Water Board regulations on its exempt regulatory programs require the Regional Boards to prepare a written report and an accompanying CEQA Environmental Checklist and Determination with respect to Significant Environmental Impacts (CEQA Checklist) (Cal. Code Regs., tit. 23, § 3775 et seq.).

Basin Plan Amendments are not effective until they are approved by the State Water Board and the regulatory provisions are approved by the State Office of Administrative Law (OAL).

Although United States Environmental Protection Agency (USEPA) review and approval is required for Basin Plan Amendments that add or modify water quality standards for certain surface waters (i.e., jurisdictional waters of the United States), this particular Basin Plan Amendment is strictly limited to groundwater. Accordingly, USEPA review and approval will not be required.

Section 2: Laws, Plans and Policies Relevant to Basin Planning

The Project Alternatives presented in **Section 4** encompass potential changes to the Basin Plan in the areas of Beneficial Uses, WQOs, and Implementation. Therefore, State laws, plans, or policies pertaining to these three areas of the Basin Plan are described below. The preferred alternative is evaluated for consistency with relevant laws, plans, and policies in **Section 6** (Consistency with Laws, Plans, and Policies).

2.1 Regulations that Apply to Beneficial Uses

2.1.1 Federal Regulations and Guidance

Federal regulations require the protection of designated uses in all (surface) waters of the United States as specified by the Clean Water Act (CWA). Federal regulations establish special protections for the uses specified in section 101(a)(2) (33 U.S.C. § 1251). However, Section 101(a)(2) only pertains to surface waters, and, since the current project is only concerned with potential impacts to groundwater, these federal regulations do not apply.

The federal Safe Drinking Water Act (42 U.S.C. § 300f et seq.) was originally passed by Congress in 1974 to protect public health by regulating the nation's public drinking water supply (EPA, 2004). The law was amended in 1986 and 1996 and requires action to protect drinking water sources including rivers, lakes, reservoirs, springs, and groundwater wells. The Act authorizes the EPA to set national health-based standards for drinking water to protect against both naturally occurring and man-made contaminants. Among the water quality criteria that have been established under the Act, groundwater may be considered an Underground Source of Drinking Water (USDW) if its Total Dissolved Solids (TDS) concentration is below 10,000 mg/L. Groundwaters with TDS in excess of 10,000 mg/L are considered non-USDWs.

2.1.2 State Regulations and Guidance

The Water Code includes designation of beneficial uses in both basin plans and statewide plans. Section 13050, subdivision (j) of the Water Code defines beneficial uses of water as including, but not limited to the following examples:

- Domestic, municipal, agricultural, and industrial supply
- Power generation
- Recreation
- Aesthetic enjoyment
- Navigation
- Preservation and enhancement of fish, wildlife, and other aquatic resources or preserves.

Basin Plan Table 2-1 specifies the beneficial uses for surface water, whereas Basin Plan Table 2-2 specifies the beneficial uses of groundwater—the latter of which is affected by this proposed Basin Plan Amendment.

The potential beneficial uses of groundwater are:

- Municipal and Domestic Supply (MUN)
- Agricultural Supply (AGR)
- Industrial Service Supply (IND)
- Industrial Process Supply (PRO)
- Water Contact Recreation (REC-1)
- Non-Contact Water Recreation (REC-2)
- Wildlife Habitat (WILD)

By default, all ground waters are considered suitable or potentially suitable, at a minimum, for agricultural supply (AGR), industrial supply (IND), and industrial process supply (PRO). (Basin Plan, § 2 [p. 2-3].) Groundwater areas exempted from MUN are footnoted in Basin Plan Table 2-2. (Basin Plan, § 2 [p. 2-7].)

The Project Area for the proposed Basin Plan Amendment is located in Detailed Analysis Unit (DAU) number 259 of the Kern County Basin Hydrologic Unit of the Tulare Lake Basin. Based on Table 2-2 of the Basin Plan, beneficial uses designated for Detailed Analysis Unit 259 include MUN, AGR, and IND.

2.2 Sources of Drinking Water Policy, State Water Board Resolution 88-63

Adopted by the State Water Board via Resolution 88-63, the *Sources of Drinking Water Policy* establishes State policy that, subject to certain exceptions, all waters are considered suitable or potentially suitable to support the MUN beneficial use.

When it incorporated the State Water Board's *Sources of Drinking Water Policy* into the Basin Plan, the Central Valley Water Board made a blanket designation that all groundwaters support the MUN beneficial use by default. The Board may only exempt waterbodies from MUN beneficial use designations by amending the Basin Plans. However, the *Sources of Drinking Water Policy* also identifies exception criteria that the Board may use to de-designate the MUN beneficial use from waterbodies that were subject to the blanket MUN designation.

The *Sources of Drinking Water Policy* identifies the following exceptions that may be used to de-designate MUN beneficial use:

1. Where waters contain total dissolved solids (TDS) exceeding 3,000 mg/L (5,000 μS/cm, electrical conductivity [EC]), and are not reasonably expected by Regional Boards to supply a public water system;

2. Where waters contain contamination that cannot reasonably be treated for domestic use;

3. Where there is insufficient water supply for a single well to provide an average, sustained yield of 200 gallons per day [gpd]; or

4. Where the aquifer is regulated as a geothermal energy producing source or has been exempted administratively for the purpose of underground injection of fluids associated with the production of hydrocarbon or geothermal energy.

The *Sources of Drinking Water Policy* only addresses the designation of water as a drinking water source; it does not establish WQOs for constituents that are protective of MUN beneficial uses.

2.3 Regulations that Apply to Water Quality Objectives (WQOs)

2.3.1 Federal Regulations and Guidance

Federal regulations require States to adopt narrative or numeric water quality criteria to protect designated beneficial uses of surface waters within federal jurisdiction. (40 C.F.R. § 131.11(a)(1).) As noted above, this Basin Plan Amendment does not apply to any surface waters.

2.3.2 State Statute, Regulations and Guidance

WQOs are defined as the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area. (Wat. Code, § 13050, subd. (h).)

Pursuant to Water Code section 13241, when establishing WQOs, the Regional Boards are required to consider the following:

a. Past, present, and probable future beneficial uses of water.

b. Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto.

c. Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area.

d. Economic considerations.

e. The need for developing housing within the region.

f. The need to develop and use recycled water.

g. The Program of Implementation per Water Code section 13242.

2.4 Regulations to Establish an Implementation Program

2.4.1 Federal Regulations and Guidance

Section 402 of the Clean Water Act (33 U.S.C. § 1342) establishes the National Pollutant Discharge Elimination System (NPDES), a permitting system for surface waters. USEPA regulations for the NPDES are codified in title 40, part 122 of Code of Federal Regulations. The State's regulations pertaining to NPDES permits must be consistent with the federal regulations. However, the Project Area does not currently receive discharges subject to the NPDES. Accordingly, these federal regulations are not applicable to the proposed Basin Plan Amendment.

2.4.2 State Statute, Regulations and Guidance

2.4.2.1 Wat. Code 13050

Pursuant to Water Code section 13050, subdivision (j)(3), a Basin Plan Amendment must include an implementation program to achieve water quality objectives. Water Code section 13242 prescribes the program of implementation for achieving water quality objectives, which include the following:

- A description of the nature of actions which are necessary to achieve the water quality objectives, including recommendations for appropriate action by an entity, public or private;
- A time schedule for the actions to be taken; and
- A description of a monitoring and surveillance program to determine compliance with water quality objectives.

Since this Basin Plan Amendment is de-designating MUN and AGR use and any associated water quality objectives developed to protect those beneficial uses, no implementation plan is required.

2.4.2.2 Monitoring Program (*Sources of Drinking Water Policy*)

Per the *Sources of Drinking Water Policy*, monitoring is required for application of Exception 2b. Since the proposed project does not seek to de-designate MUN beneficial uses in the proposed MUN de-designation boundary based on Exception 2b, the project is exempt from the monitoring required when seeking MUN de-designation.

2.4.2.3 Human Right to Water (Wat. Code, § 106.3)

As codified in Water Code section 106.3, it is the policy of the State of California that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes. As the Project Area is not zoned for residential, nor anticipated to be zoned residential in the future and

existing groundwater quality within the Project Zone does not support MUN use and MUN use is being de-designated through Exception 1a of the *Sources of Drinking Water Policy*, this water code is not applicable.

Section 3: MUN Evaluation of the Upper and Lower Members of the Tulare Formation

3.1 Characteristics of the Tulare Formation

As discussed in **Section 1.2**, the Project Zone proposed for MUN beneficial use de-designation comprises the non-USDW portions of the lower Tulare and Etchegoin Formations within six square miles including Sections 14, 15, 22, 23, 26, and 27 of T27S/R21E, and is entirely contained within the administrative boundary of the Lost Hills Oilfield. The Project Zone is located in DAU 259 (Antelope Plain) of the Kern County Basin. Designated beneficial uses in the Basin Plan for DAU 259 currently include MUN, AGR, and IND.

As described in **Section 1.2.2.2**, west of Lost Hills, the Tulare Formation consists of poorly sorted alluvial sandy mudstones and fluvial sandstones that interfinger with coastal plain fine-grained sandstones, mudstones, and gypsum cemented mudstones of delta marsh origin. At the crest of the anticline the alluvial/fluvial facies become interbedded with fine-grained facies associated with coastal plain (marshland and delta) and lacustrine shoreline deposits from the pre-historic Lake Clyde and historic Tulare Lake (Harden, 2004). On the east flank of the field, fine-grained sandstones pinch out eastward into lacustrine mudstones.

The Tulare Formation is divided into two member units – the Upper Tulare Member and the Lower Tulare Member, each consisting of interbedded layers of mudstone, siltstone, and sandstone. The sandstone is poorly consolidated, and poorly sorted (very fine, fine, medium to coarse grained, with moderate amounts of clay and silt-sized grains); and has an average porosity of approximately 35 percent, and permeabilities that range from 200 to 5,000 millidarcies (mD). Productive reservoirs typically comprise porosities of 36 to 42 percent and permeabilities ranging between 1,000 and 2,000 mD.

The Tulare Formation contains individual sandstone intervals ranging from 5 to 25 feet thick that are separated by numerous low-permeability mudstones. The sandy intervals are characterized by blocky resistivity log signatures and lack of well-developed upward-coarsening successions. The isochore maps of the Tulare Formation and Lower Tulare Member (Figures 1-7 and 1-8) indicate both thicken to the east-northeast, east and southeast. The distribution of interbedded mudstones between sandstone layers influences fluid distribution and affects fluid migration within the reservoir.

The Upper and Lower Members of the Tulare Formations are separated by a regionally traceable clay- and silt-rich mudstone, referred to here as the Mid-Tulare Shale or Mid-Tulare Mudstone (Figure 1-10), which acts as a hydraulic barrier to vertical flow. The Mid-Tulare Shale is a 10-to 50-foot thick, low permeability, high clay and silt mudstone layer that is persistent across the southern portion of the Lost Hills area as depicted on Cross Sections A-A’ and B-B’ (Figures 1-11, 1-12 and 1-13) and present throughout the Project Area. The Mid-Tulare Shale is the basal member of a clay-rich zone (CRZ) that comprises the lower portion of the Upper Tulare Member. The CRZ is a sequence of

low-permeability mudstones, shales, and shaly-sandstones that is regionally traceable and ranges in thickness from 50 feet to over 400 feet. As described below, the Mid-Tulare Shale is the marker for the top of the non-USDW Lower Tulare Member in the Southern Lost Hills area.

3.2 Past, Present and Future MUN and AGR Uses

Copies of Kern County Assessors Map Nos. 69-12 and 69-14 are presented in **Appendix D**. These maps show that the six square-mile Project Area comprises 30 severed parcels. Twenty of the parcels retain rights to the surface, and ten of the parcels retain rights to the minerals. **Table 3-1** below provides a summary of each parcel from the Kern County Assessor's Office website. The surface parcels range in size from 1.25 acres to 636.36 acres. County land-use codes for the 20 surface parcels include the following:

- Irrigated land (4300), 11 parcels
- Refineries (3206), one parcel
- Grazing or dry farmland (4400), four parcels
- Almond orchard (4120), two parcels
- Undeveloped land >20 acres (4000), one parcel
- Oil multiple uses (8209), one parcel.

None of the parcels in the Project Area have use codes for residential (0000- through 0700-series), agricultural with residential (4390 or 5000-series), private domestic water well (6309), or public or private water concerns (8300-series), which would indicate the presence of a domestic or municipal water well. As a result, there is no evidence that the groundwater in the Project Area is being used for the MUN beneficial use.

Lands in the Project Area used for agriculture are owned and operated by a single entity called Wonderful Nut Orchards, formerly known as Paramount Land Company. Based on personal communications with Wonderful Nut Orchards personnel, the grower uses almost exclusively State water managed by the Belridge Water Storage District to irrigate the orchards located in the Project Area, as well as adjacent sections to the east and south. Wonderful Nut Orchards does not own or operate any wells in the six sections that make up the Project Area.

In 2016, Wonderful Nut Orchards installed four wells in Section 30, Township 27S, Range 22E to a maximum depth of 650 feet below ground surface. These wells are located approximately 2 miles east (downgradient) of the Project Area. As indicated previously, Wonderful Nut Orchards indicated that the water produced by these wells is of such poor quality with EC at 4,000 µS/cm (TDS 2,560 mg/L) that they must blend it with surface water at a 4:1 or 5:1 ratio of fresh water to groundwater to make it usable. Based on Cross Section C on Figure 18 of the Technical Report, the top of the Lower Tulare Member occurs at approximately 1,200 feet below ground surface at the location where these wells were installed. Thus, the water extracted by these wells occurs in the Upper Tulare Member.

Wonderful Nut Orchards also drilled a test well west of the California Aqueduct and approximately three miles south of the Project Area to a depth of 600 feet below ground surface. Water produced from the test well was found to have an EC at 12,000 µS/cm (TDS 7,680). Wonderful Nut Orchards considers groundwater west of the California Aqueduct to be of such poor quality as to be unusable. Wonderful Nut Orchards indicated that they have no plans to drill additional wells west of the California Aqueduct or in the Project Area and have no interest in water sourced from deeper Formations (i.e., the Lower Tulare Member). The information gained from Wonderful Nut Orchards indicates that they have no intended use of groundwater from the Upper or Lower Tulare Member in the vicinity of the Project Area in the foreseeable future.

A review of public well records with the California Department of Water Resources for the six sections that make up the Project Area indicates that three wells are located in Section 26, Township 27S, Range 21E. A review of logs for these three wells indicate that they were installed in 1989 for cathodic protection and are not used to produce groundwater. No wells are identified for the other five sections (14, 15, 22, 23, 27) of the same Township and Range. Based on the findings of the well search, there is no State record of wells installed in any of the six sections of the Project Area for groundwater use of any kind.

In general, there is no evidence that water is being produced from the Tulare Formation (Upper or Lower Member) for MUN or AGR beneficial uses in the Project Zone.

Given the extremely poor quality of groundwater in the Project Zone and the limited availability of surface water in the area, blending with higher quality surface water does not appear to be a feasible possibility.

Table 3-1. Kern County Assessor Information for the Project Area

Township 27S, Range 21E, Section	Assessor's Parcel No.	Acreage	Comment	Land Use Code	Current Owner
15	069-120-001	80	Surface	4300 (Irrigated Land)	Chevron U.S.A., Inc.
15	069-120-022	0	Minerals	8201 (Productive Mineral Rights)	--
15	069-120-033	14.96	Surface	3206 (Refineries)	Aera Energy
15	069-120-025	0	Minerals	8201 (Productive Mineral Rights)	--
15	069-120-034	541	Surface	4300 (Irrigated Land)	Aera Energy
14	069-120-012	96.63	Surface	4300 (Irrigated Land)	Aera Energy
14	069-120-013	45.3	Surface	4300 (Irrigated Land)	Paramount Land Co. LLC
14	069-120-021	0	Minerals	8201 (Productive Mineral Rights)	--
14	069-120-031	128.43	Surface	4300 (Irrigated Land)	Aera Energy
14	069-120-017	138	Surface	4300 (Irrigated Land)	Paramount Land Co. LLC
14	069-120-032	160	Surface	4300 (Irrigated Land)	Aera Energy
14	069-120-026	0	Minerals	8201 (Productive Mineral Rights)	--

Township 27S, Range 21E, Section	Assessor's Parcel No.	Acreage	Comment	Land Use Code	Current Owner
22	069-120-011	0	Minerals	8201 (Productive Mineral Rights)	--
22	069-120-030	636.36	Surface	4300 (Irrigated Land)	Aera Energy
23	069-120-014	129.01	Surface	4300 (Irrigated Land)	Chevron U.S.A., Inc.
23	069-120-023	0	Minerals	8201 (Productive Mineral Rights)	--
23	069-120-010	474.87	Surface	4300 (Irrigated Land)	Aera Energy
23	069-120-029	0	Minerals	8201 (Productive Mineral Rights)	--
23	069-120-015	8.47	Surface	4300 (Irrigated Land)	Paramount Land Co. LLC
27	069-140-002	0	Minerals	8201 (Productive Mineral Rights)	--
27	069-140-010	1.25	Surface	4400 (Grazing or Dry Farm Land)	Paramount Land Co. LLC
27	069-140-011	1.25	Surface	4400 (Grazing or Dry Farm Land)	Paramount Land Co. LLC
27	069-140-012	1.25	Surface	4400 (Grazing or Dry Farm Land)	Paramount Land Co. LLC
27	069-140-018	1.25	Surface	4400 (Grazing or Dry Farm Land)	Paramount Land Co. LLC

Township 27S, Range 21E, Section	Assessor's Parcel No.	Acreage	Comment	Land Use Code	Current Owner
27	069-140-020	316.36	Surface	4120 (Almond)	Paramount Land Co. LLC
27	069-140-019	315	Surface	4120 (Almond)	Paramount Land Co. LLC
27	069-140-024	0	Minerals	8201 (Productive Mineral Rights)	--
26	069-140-038	616.56	Surface	4000 (Undeveloped Land > 20 Acres)	Paramount Land Co. LLC
26	069-140-037	20	Surface	8209 (Oil Multiple Uses)	Seneca Resources Corp.
26	069-140-026	0	Minerals	8201 (Productive Mineral Rights)	--

3.3 Evaluation of the Groundwater Quality in the Southern Lost Hills Oilfield

As discussed in **Section 1.2.5.2**, water quality data from groundwater sampling is generally sparse due to a lack of water wells in the southern part of the Lost Hills Oilfield, but the existing data do show consistent water quality relationships between the Upper and Lower Members of the Tulare Formation. The available groundwater quality data are summarized in **Table 1-1** and well locations are illustrated on Figure 1-17. Water quality information is based on the results of laboratory analysis of water samples and on interpretation of well resistivity logs shown on Figures 1-12 and 1-13.

3.3.1 Upper Tulare Member

Groundwater samples collected from the Upper Tulare Member contain TDS in concentrations ranging from 3,400 to 7,400 mg/L (**Table 1-1**). Wireline logs show resistivity in the Upper Tulare Member fluctuating about and above 3 ohm-m, indicating that TDS levels are below 10,000 mg/L (Figures 1-12 and 1-13).

3.3.2 Lower Tulare Member

Groundwater samples collected from the Lower Tulare Member, below the Mid-Tulare Shale, contain TDS in concentrations ranging from 16,100 to 18,960 mg/L (Table 1-1). Wireline logs show resistivity consistently remains below 3 ohm-m below the Mid-Tulare Shale in the Lower Tulare Member, indicating that TDS levels are above 10,000 mg/L (Figures 1-12 and 1-13).

3.3.3 Etchegoin Formation

Groundwater samples collected from the Etchegoin Formation contain TDS in concentrations ranging from 21,488 to 45,207 mg/L (**Table 1-1**). Wireline logs show resistivity consistently remains below 3 ohm-m in the Etchegoin Formation, indicating that TDS levels are above 10,000 mg/L (Figures 1-12 and 1-13).

3.3.4 Horizontal and Vertical Gradients

The gradient and flow direction are based on a review of groundwater contour maps for groundwater in the Tulare Formation in the central portion of the Lost Hills oilfield, as well as the structure of the Tulare Formation throughout the Lost Hills Oilfield and generalized groundwater flow direction towards the center of the San Joaquin Valley. Well control for the Lower Tulare Member is generally stronger to the north and northwest of the Project Area. Calculations indicate a generally east-northeastward groundwater flow direction with a gradient of 0.02 feet/foot.

Vertical gradients within the Project Area are based on observations at the Mackessy well as described in **Section 1.2.3.2**. A comparison of water levels from the screen in the Upper Tulare Member to levels from the Lower Tulare Member indicate a strongly

negative, or downward, vertical gradient (**Figure 1-23**). However, regionally, the vertical gradient is not determined.

3.3.5 Supply Well Pumpage

The only known use of the Tulare Formation groundwater in the Lost Hills Oilfield is industrial (IND) by oilfield operators. These operators extract water from the Upper Tulare Member using wells located northwest of the Project Area. The extracted water is generally converted to steam and is used for EOR in the northern portion of the oilfield.

There is no record of MUN or AGR use of groundwater in the Project Area. Groundwater within the Tulare Formation has generally not been developed for municipal or agricultural use because of the poor mineral quality and depth of the resource. As indicated previously, the nearest municipal water source well is located approximately 9.4 miles east of the Lost Hills Oilfield.

3.4 Proposed Horizontal and Vertical MUN De-Designation Boundaries

As described in **Section 1.2.3.1**, Kennedy/Jenks modeled the flow path of water injected into the four wells over a 100-year time-frame (the anticipated life of UIC operations for these wells) and projected that information onto a regional map (Figure 1-16). These flow path projections were generated using MODFLOW. Input parameters used to generate the model include a generalized east-northeastward groundwater flow direction, a horizontal gradient of 0.02 feet/foot, an effective porosity of 35 percent, and the permitted flow limits for each injection well. The model also assumes the receiving Formation is homogeneous, isotropic and of uniform thickness. A summary of the MODFLOW modeling is provided in Appendix C.

The six sections 14, 15, 22, 23, 26, and 27 of T27S/R21E, shown on Figure 1-16, constitute a Project Area that encompasses the 100-year injection plumes from the four UIC wells, and a buffer zone that allows for uncertainties in the groundwater flow direction, heterogeneities in the aquifer parameters that were used to generate the modeled injection plumes, potential cumulative effects, and the displacement of existing groundwater in the Formation as water is injected into the four UIC wells.

The vertical definition of the MUN De-Designation is shown in the cross sections on **Figures 1-18 and 1-19**. As depicted, the area proposed for de-designation extends from the base of the Mid-Tulare Shale, down through the Lower Tulare Member and into the Etchegoin Formation as far as the perforation intervals for Tisdale wells 51WD-22 and 53WD-22.

The effectiveness of the Mid-Tulare Shale as a confining unit that separates groundwater within the Lower Tulare Member from groundwater within the Upper Tulare Member has been demonstrated using the following multiple lines of evidence:

- Contrasting water levels in shallow versus deep perforated intervals in Mackessy Well WD1-25 (as explained in Section 1.2.3.2 water levels were measured when the Mackessy well was screened in the Lower Tulare Member and again after the perforations were plugged and the well was perforated in the Upper Tulare Member).
- Contrasting water TDS values in groundwater samples collected from shallow versus deep perforated intervals in Mackessy Well WD1-25.
- Consistent resistivity values below 3 ohm-m in Formations below the Mid-Tulare Shale, observed in wireline logs of wells throughout and outside the Project Area.
- The positive pressure response in well 83WD-22 during the injection test into the Lower Tulare Member in well 81WD-22.
- Plausible correlation of the Mid-Tulare Shale with the Corcoran Clay, which is a well-known confining unit in the Tulare Formation.

3.5 Stakeholder Identification

Information available from the Kern County Assessor's Office indicates that the six sections that overlie the Project Area comprise 30 parcels, of which 20 parcels provide surface rights and 10 provide mineral rights (Table 3, Appendix D). Among the 20 surface parcels, County Land Use Codes include irrigated land (11), grazing or dry farmland (4), almond orchard (2), various oil and gas (2), and undeveloped (1). The surface property owners in the Project Area include three oil and gas operators and one agricultural concern as listed below:

- Aera Energy LLC – 2052 acres, most of Section 15, portions of Section 14 west of the California Aqueduct, all of Section 22, most of Section 23.
- Chevron U.S.A. Inc. – 209 acres, North ½ of the NW ¼ of Section 15, North ½ of N ½ of Section 23.
- Wonderful Nut Orchards (formerly Paramount Land Co., LLC and Paramount Orchards) – 1445 acres, portions of Section 14 and 23 east of the California Aqueduct, all but 20 acres of Section 26, all of Section 27.
- Seneca Resources Corp. – 20 Acres in Section 26.

The County records do not identify any municipal or domestic use of any of the properties. Furthermore, the Project Area comprises confined aquifers that begin 700 to 1200 feet below the ground surface. As a result, surface landowners would not constitute stakeholders for this proposed Basin Plan Amendment.

As described in **Section 3.2**, Wonderful Nut Orchards uses surface water from the Belridge Water Storage District to irrigate the orchards in the Project Area. Wonderful Nut Orchards does not own or operate groundwater wells in the Project Area and has

no intention of extracting the poor-quality groundwater from the Upper and Lower Tulare Members or the Etchegoin Formation.

The remaining potential stakeholders for this project would consist of the oilfield operators that depend on continued operation of the Tisdale disposal wells to inject produced water at the Lost Hills Oilfield. Based on records maintained by CalGEM, the current operators at the Lost Hills Oilfield include the following:

Table 3-2. Current Operators in Lost Hills Oilfield

Operator Name	Operating in Project Area	Whole Field Well Counts	Project Area Well Counts
Aera Energy LLC	Yes	Active: 1,914 Idle: 143 Total: 2,057	Active: 61 Idle: 4 Total: 65
California Resources Production Co.	No	Active: 1,176 Idle: 135 Total: 1,311	(None)
Chevron U.S.A. Inc.	Yes	Active: 2,171 Idle: 49 Total: 2,122	Active: 6 Idle: 5 Total: 11
Crimson Resource Management Corp.	No	Active: 0 Idle: 1 Total: 1	(None)
General Production Oil LLC	No	Active: 0 Idle: 4 Total: 4	(None)
Pyramid Oil Co.	No	Active: 3 Idle: 2 Total: 5	(None)
Reserve Petroleum California, Inc.	No	Active: 0 Idle: 1 Total: 1	(None)

Operator Name	Operating in Project Area	Whole Field Well Counts	Project Area Well Counts
Seneca Resources Corp.	Yes	Active: 513 Idle: 17 Total: 530	Active: 109 Idle: 3 Total: 112
James Sherman & Dennis Weese	No	Active: 0 Idle: 1 Total: 1	(None)

Aera Energy, Chevron U.S.A., and Seneca Resources Corporation (Seneca) are the only operators in the Project Area. Seneca Resources Corporation operates the four Tisdale wells that inject produced water from the Lost Hills Oilfield into the Lower Tulare Member and upper Etchegoin Formation in the Project Area. The injection wells receive produced water only from Seneca production operations. Produced waters generated by Aera and Chevron operations are routed to their own injection wells that are located 1 to 2 miles northwest of the Project Area. As a result, Seneca represents the sole stakeholder for this proposed Basin Plan Amendment.

Section 4: Project Alternatives

The technical and regulatory analysis considered information relevant to the proposed de-designation of MUN and AGR beneficial use in groundwater in a portion of the Lower Tulare Member and the Etchegoin Formation in the southern Lost Hills Oilfield. The information evaluated included subsurface geologic conditions, the location of existing water supply wells, groundwater movement, and groundwater quality. The findings of the evaluation provided a basis for recommending specific horizontal and vertical boundaries for de-designation of the MUN and the AGR irrigation supply and the AGR livestock watering beneficial uses.

4.1 MUN Beneficial Use Alternatives, Evaluation and Recommendation

Stakeholders and Board staff identified the following four project alternatives pertaining to the MUN beneficial use designation for a portion of the Lower Tulare Member and Etchegoin Formation in the southern Lost Hills Oilfield:

Alternative 1: No Action

Alternative 2: De-designate MUN beneficial use for all groundwater in Project Area (no vertical boundaries; includes Upper Tulare Member).

Alternative 3: De-designate MUN within vertically-delimited “Project Zone” (Lower Tulare Member and the Etchegoin Formation in Project Area)

Alternative 4: Develop MUN site-specific salinity objectives within vertically-delimited “Project Zone” (Lower Tulare Member and the Etchegoin Formation in Project Area)

General components of each of the MUN regulatory project alternatives are shown in **Table 4-1**. Detailed descriptions of each alternative are provided in **Sections 4.1.1 through 4.1.4**.

Table 4-1. Project Alternatives: MUN Use Designation in Groundwater in the Southern Lost Hills Oilfield

Project Alternatives	Beneficial Use Designation Components	Water Quality Objective (WQO) Components	Implementation Program Components	Monitoring/ Surveillance (M/S) Components
Alternative 1: No Action	No Change in MUN Beneficial Use Designation	No New WQOs	No New Implementation Program	No New Monitoring and Surveillance Program
Alternative 2: De-designate MUN beneficial use for all groundwater in Project Area (no vertical boundaries; includes Upper Tulare Member)	Use technical and regulatory analyses in Revised Technical Report to support de-designation of MUN beneficial use	MUN WQOs will no longer apply to groundwater within a specific area of the Southern Lost Hills Oilfield horizontally defined by Sections 14, 15, 22, 23, 26 or 27 of Township 27S, Range 21E	Existing Regulatory Programs to Implement	Monitoring Utilizing Current Existing Regulatory Programs to Fill Data Gaps
Alternative 3: De-designate MUN within Project Zone (Lower Tulare and Etchegoin Formations)	Use *Sources of Drinking Water Policy* "Exception 1a" and supporting evidence to de-designate MUN beneficial use	MUN WQOs no longer apply to groundwater in specific area of Southern Lost Hills Oilfield having groundwater salinity concentration levels greater than 3,000 mg/L TDS (EC of 5,000 µS/cm) as defined by proposed de-designation boundaries identified in Revised Technical Report	Existing Regulatory Programs to Implement	Monitoring Utilizing Current Existing Regulatory Programs to Fill Data Gaps
Alternative 4: Development of MUN Site-Specific Salinity Objectives in Project Zone (Lower Tulare and Etchegoin Formations)	Re-designate Beneficial Use as Limited-MUN	Develop Individual Site-Specific Objectives (SSOs) that maintain existing ambient concentrations	Existing Regulatory Programs to Implement	Adjust Existing Regulatory Programs to Account for New Objectives

4.1.1 MUN Alternative 1: No Action

Under MUN Alternative 1 (No Action), the Basin Plan would not be amended, and the groundwater of the Lower Tulare Member and the Etchegoin Formation would retain the MUN beneficial use designations. Injection of the produced water to these Formations through the four injection wells will continue according to the UIC permits and regulations. However, under this scenario Seneca would retain an undue responsibility under the Basin Plan to protect ground water that is already considered non-Underground Source(s) of Drinking Water (non-USDW) under the federal Safe Drinking Water Act.

4.1.2 MUN Alternative 2: De-Designation in Project Area without Vertical Boundaries (including Upper Tulare Member)

Under MUN Alternative 2, the MUN beneficial use would be de-designated over the entire six-sections in the Project Area from the surface down, with no vertical delineation. Notably, this alternative would encompass the Upper Tulare Member in addition to the Project Zone (i.e., Lower Tulare Member and the Etchegoin Formation).

The *Sources of Drinking Water Policy* contains an exception (1a) for surface and ground waters where “the total dissolved solids (TDS) exceed 3,000 mg/L (5,000 µS/cm, electrical conductivity [EC]) and is not reasonably expected by Regional Boards to supply a public water system.” The portion of the Southern Lost Hills Oilfield features groundwater EC levels greater than 5,000 µS/cm and is thus eligible for MUN de-designation under this exception.

Groundwater quality in the Upper Tulare Member is currently poor, such that it satisfies “Exception 1a” of the *Sources of Drinking Water Policy* for de-designation of MUN (TDS > 3,000 mg/L) and its TDS levels exceed the narrative Chemical Constituents WQO. In addition, and as summarized in **Section 3.2**, local stakeholders have not relied upon the groundwater within the proposed MUN de-designation boundary to support the MUN beneficial use in the past, are not currently relying on this area to support the use, and do not expect the area to support the use in the foreseeable future. Moreover, the proposed vertical de-designation boundary was developed to include a buffer area between active wells and the proposed de-designation boundary based on a modeled 100-year groundwater travel time.

As a result of this alternative, injection of the produced water to these formations through the four injection wells will continue according to the UIC permits and regulations. In addition, Seneca will be relieved of an undue responsibility under the Basin Plan to protect MUN use in ground water that is already considered non-USDW under the federal Safe Drinking Water Act.

However, since there is sufficient evidence that groundwater within the Lower Tulare Member is a confined aquifer, Seneca does not need a more expansive de-designation

and therefore de-designation of the MUN beneficial use from groundwater within the Upper Tulare Member is unnecessary.

4.1.3 MUN Alternative 3: De-Designation Only in Project Zone (Lower Tulare Member and the Etchegoin Formation)

Alternative 3 is a more limited version of Alternative 2 where the MUN beneficial use would only be de-designated from groundwater within the Project Zone (as depicted on **Figures 1-11, 1-18 and 1-19**) in accordance with "Exception 1a" of the Sources of Drinking Water Policy. Specifically, the MUN beneficial use is to be de-designated from groundwater situated below the Mid-Tulare Shale, within the Lower Tulare Member and the Etchegoin Formation, within the horizontal area defined by the proposed six sections. Shallow groundwater in the Upper Tulare Member within the Project Area, and any groundwater outside the Project Area would retain the MUN designation. Again, this vertically-delimited space within the Project Area is referred to as the Project Zone.

The groundwater quality evaluation performed as part of the Revised Technical Report found that groundwater EC levels exceed 10,000 mg/L TDS within the proposed MUN de-designation boundary within the Lower Tulare and Etchegoin Formations and thus, meet and/or exceed the criteria for "Exception 1a" under the *Sources of Drinking Water Policy*. As such, the groundwater in this area would not reasonably be expected to supply a public water system. In addition, as summarized in **Section 3.2**, local stakeholders have not relied upon the groundwater within the proposed MUN de-designation boundary to support the MUN beneficial use in the past, are not currently relying on this area to support the use, and do not expect the area to support the use in the foreseeable future. Moreover, the proposed MUN de-designation boundary was developed to include a buffer area between active wells and the proposed de-designation boundary based on a modeled 100-year groundwater travel time.

As a result of this alternative, injection of the produced water to these Formations through the four injection wells will continue according to the UIC permits and regulations. In addition, Seneca Resources will be relieved of the undue responsibility under the Basin Plan to protect ground water that is already considered non-USDW under the federal Sources of Drinking Water Act.

4.1.4 MUN Alternative 4: Site-Specific Objectives (SSOs) for Salinity for All Groundwater within Project Zone (Lower Tulare and Etchegoin Formations)

MUN Alternative 4 would involve changes to the Basin Plan pertaining to beneficial uses and WQOs for groundwater in the Southern Lost Hills Oilfield. This alternative would involve a change in the beneficial use designation of groundwater in the Southern Lost Hills Oilfield from MUN to a new "Limited-MUN" designation. The development of site-specific objectives (SSOs) for constituents of concern for the groundwater would be developed based on existing ambient groundwater concentrations. Where groundwater

currently does not meet MUN and MUN-related WQOs due to naturally occurring background concentrations, controllable factors, such as agriculture operations, would not be allowed to further degrade existing water quality under this alternative. Groundwater designated as having a "Limited-MUN" beneficial use would need to be treated or blended prior to use as municipal and domestic supply. Existing regulatory programs would be responsible for implementing the monitoring and surveillance program needed to assure that waste discharges do not further degrade existing ambient groundwater concentrations in a site-specific area, including the maximum average annual increase in EC allowed by the Basin Plan.

4.1.5 Evaluation of Project Alternatives

The above-described MUN Basin Plan Amendment alternatives were evaluated based on their ability to meet the following nine selection criteria (additional information describing a criterion is included where it was thought to be helpful):

1. Consistency with Applicable Federal and State Statutes and Regulations[9] for Protection of Water Quality (e.g., *Sources of Drinking Water Policy*, *Antidegradation Policy*, etc.)

2. Applicability of Exception(s) in *Sources of Drinking Water Policy*

3. Protection of Existing and Future Potential Beneficial Uses

4. Maintenance of Agricultural Production in Project Area (i.e., whether alternative has the potential to allow agricultural production in Project Area to be in compliance with water quality objectives)

5. Support for Proactive Control and Management of Salt for Application or Disposal in Western Portion of Basin, Toward Drainage Trough of Valley (i.e., whether alternative has the potential in the future to allow the de-designated area to accept salts from outside of the Project Zrea on a case-by-case basis, subject to appropriate environmental review).

6. Technical Feasibility, Economic Viability, and Reasonableness of Action

7. Scientific Support with Existing Data

8. Support for Socioeconomic Wellbeing of Project Area

9. Ease of Implementation

[9] Water Quality Control Plans and State Policy For Water Quality Control have the same legal effect as regulations. (See Gov. Code, § 11353; Wat. Code, §§ 13140 et seq., 13241 et seq.)

Each MUN project alternative was evaluated with regard to how well it satisfies each criterion. A scale of “low”, “medium”, and “high” was used to rank how well an alternative meets a criterion. The low, medium, and high rankings are characterized as follows:

Low	Alternative largely does not satisfy criterion
Medium	Alternative satisfies criterion, in part
High	Alternative largely satisfies criterion

A ranking of each proposed MUN project alternative with respect to the nine criteria is provided in **Table 4-2**. A description of the assumptions and rationale used when ranking each MUN project alternative is provided in Appendix E.

Table 4-2. MUN Designation in Southern Lost Hills Oilfield Groundwater: Evaluation of Project Alternatives

MUN Project Alternatives	Criterion 1: Consistent w/ Fed/State Laws	Criterion 2: Exception 1a Applies	Criterion 3: Protects Beneficial Uses	Criterion 4: Maintains Ag Production in Project Area	Criterion 5: Supports Salt Control/ Mgmt.	Criterion 6: Tech. Feasibility, Econ. Viability, Reasonable Action	Criterion 7: Scientific Support	Criterion 8: Socio-economic Wellbeing	Criterion 9: Ease to implement
Alternative 1: No Action	High	Low	High	High	Low	Low	Low	Low	High
Alternative 2: De-Designate MUN in Project Area w/o Vertical Boundaries (includes Upper Tulare Member)	Low[1]	Low[1]	Low[1]	High	Med	Med[1]	Low[1]	Med	Med
Alternative 3: De-Designate MUN within Project Zone (Lower Tulare and Etchegoin Formations)	High	High	High	High	High	High	High	High	High
Alternative 4: Site-Specific Salinity Objectives in Project Zone (Lower Tulare and Etchegoin Formations)	High	Low	High	Low	Low	Low	Low	Low	Low

[1]Absence of vertical limit to de-designation boundary could deny certain geographic areas a beneficial use that is currently supported by existing water quality at some vertical depth (e.g. shallow groundwater near a leaking surface water channel or ditch)

4.1.6 Staff Recommendation: MUN Alternative 3

Based on analysis of the four alternatives discussed above, Central Valley Water Board staff recommends implementation of **MUN Alternative 3**, wherein MUN beneficial uses shall be de-designated for groundwater of the Project Zone only—i.e., the Lower Tulare Member and the Etchegoin Formation within the horizontal and vertical boundaries of the Project Area as identified in **Sections 1.2.3 and 3**, and as depicted on **Figures 1-11**, **1-18 and 1-19**.

MUN Alternative 3 best satisfies the selection criteria listed in Section 4.1.5. A more limited de-designation within the three-dimensional Project Zone—constrained to the Lower Tulare Member and the Etchegoin Formation—would:

1. Be consistent with both federal and state water quality laws and policies. Notably, the area proposed for MUN de-designation meets the criteria for "Exception 1a" under the *Sources of Drinking Water Policy*. (See Staff Report, § 4.1.3.)

2. Be the appropriate protection for the groundwater in the area proposed for MUN de-designation. The proposed de-designation area has no past, current, or planned future use for municipal or domestic supply due to high background salinity of the groundwater and therefore, need not be protected for the MUN use. (See Staff Report, § 4.1.3.)

3. Ensure that existing and future potential beneficial uses of groundwater resources outside (upgradient and beneath) the proposed MUN de-designation boundary have been accounted for.

4. Be the most beneficial and cost effective measure because it does not require extensive scientific review and development of SSOs or additional costly measures to avoid groundwater quality degradation and/or meet MUN-related WQOs in an area with no potential to sustainably supply a municipal or domestic water supply.

5. Find it appropriate that agriculture or other regulated entities in the project area not be required to implement new treatment processes or other control measures to avoid groundwater quality degradation and/or meet MUN-related discharge limitations in Waste Discharge Requirements (WDRs) when no such use currently exists or is anticipated to exist for groundwater in the area proposed for MUN de-designation.

Implementation of MUN Alternative 1 (No Action) is **not recommended** for the following reasons:

1. Nonaction would be inconsistent with the enumerated exceptions under the Sources of Drinking Water Policy, which contemplate de-designation where existing water quality is clearly does not support MUN beneficial uses.

2. Nonaction would result in costly treatment or other control measures for agriculture and other regulated entities beyond those currently required to avoid groundwater quality degradation and/or meet MUN-specific WQOs where water quality does not support MUN use.

Implementation of MUN Alternative 2 (de-designation in Project Area without vertical boundaries) is also **not recommended** for the following reasons:

1. This alternative would de-designate the MUN beneficial use in the unconfined, upper aquifer above the confining clay layer that separate the upper and lower aquifers, allowing potential degradation of the upper aquifer within the project area which could migrate, in the absence of a confining layer, and potentially impact offsite beneficial MUN uses downgradient.

2. The technical findings of the Revised Technical Report showed that while groundwater quality above the mid Tulare Shale in the Project Study Area features EC above 5,000 µS/cm (3,000 mg/L TDS) , the de-designation of MUN use within the Upper Tulare Member would not add any additional benefit or improvement to the overall effectiveness of implementing Alternative 3. Due to the relatively impermeable nature of the Mid Tulare Shale confining layer, Seneca's injection waters are prevented from migrating into the upper aquifer where it could potentially move downgradient and offsite into better quality groundwater where MUN use may be present. Use of the groundwater in the upper aquifer would not be protected under MUN Alternative 2 and because it does not feature the vertical boundaries identified in MUN Alternative 3, there is no confining layer present within the upper aquifer that would prevent offsite migration. Because this alternative is viewed as unnecessarily limiting beneficial use protection in the project area and does not add any additional benefit over Alternative 3, it is eliminated from further consideration and no specific environmental, antidegradation, or economic analyses are conducted for it.

Implementation of MUN Alternative 4 (Development of MUN site-specific objectives within the proposed MUN de-designation boundary) is **not recommended** for the following reason:

1. Implementation would be inconsistent with the intent of the Sources of Drinking Water Policy Exception 1a in that groundwater EC levels exceed 5,000 µS/cm in the proposed MUN de designation boundary. Unlike MUN Alternative 3, SSOs do not address the primary question of what the appropriate MUN beneficial use protection is for the Southern Lost Hills Oilfield.

2. Since the MUN use is not existing in the area, SSOs would only be possible to support a "limited MUN" use, whereby waters would need to be treated or blended prior to use. A rational basis for a Limited-MUN SSO would be existing ambient water quality. This alternative would then be similar to MUN Alternative 1 (No Action), which allows only limited degradation of groundwater quality. However, as described in Section 4.1.3.1, because the degree of MUN use of the groundwater contained in the proposed de designation area is no MUN use, developing SSOs for another degree of use is not a reasonable alternative. As such, SSOs for the protection of the MUN beneficial use are eliminated from further consideration and specific environmental, antidegradation, or economic analyses are conducted on this alternative.

Recommendations for the Monitoring and Surveillance component of MUN Alternative 3 are discussed further in Section 5, Program of Implementation.

4.2 AGR Beneficial Use Alternatives, Evaluation and Staff Recommendation

The various project alternatives pertaining to the designation of the AGR beneficial use in groundwater in a portion of the Southern Lost Hills Oilfield are described below. Stakeholders also identified the following four project alternatives pertaining to the AGR beneficial use designation for a portion of the Southern Lost Hills Oilfield:

Alternative 1: No Action

Alternative 2: De-designate AGR beneficial use for all groundwater within Project Area (no vertical boundaries; includes Upper Tulare Member)

Alternative 3: De-designate AGR within vertically-delimited Project Zone (Lower Tulare Member and the Etchegoin Formation)

Alternative 4: Develop AGR site-specific salinity objectives within Project Zone (Lower Tulare Member and the Etchegoin Formation)

General components of each of the AGR regulatory project alternatives are shown in **Table 4-3**Error! Not a valid bookmark self-reference.. Detailed descriptions of each alternative are provided in **Section 4.2**.

Table 4-3. AGR Use Designation in Groundwater in the Southern Lost Hills Oilfield: Project Alternatives

Project Alternatives	Beneficial Use Designation Components	Water Quality Objective (WQO) Components	Implementation Program Components	Monitoring/ Surveillance (M/S) Components
Alternative 1: No Action	No Change in AGR Beneficial Use Designation	No New WQOs	No New Implementation Program	No New Monitoring and Surveillance Program
Alternative 2: De-designate AGR for all groundwater in Project Area (no vertical limitations; includes Upper Tulare Member)	Use technical and regulatory analyses in Revised Technical Report to support de-designation of AGR beneficial use	AGR WQOs will no longer apply to groundwater within a specific area of the Southern Lost Hills Oilfield defined by proposed de-designation boundaries identified in Revised Technical Report	Existing Regulatory Programs to Implement	Monitoring Utilizing Current Existing Regulatory Programs to Fill Data Gaps
Alternative 3: De-designate AGR within vertically-delimited Project Zone (Lower Tulare, Etchegoin Formations)	Use technical and regulatory analyses in Beneficial Use Evaluation Report to support de-designation of AGR beneficial use	AGR WQOs will no longer apply to groundwater within specific area of the Southern Lost Hills Oilfield defined by proposed de-designation boundaries identified in Revised Technical Report	Existing Regulatory Programs to Implement	Monitoring Utilizing Current Existing Regulatory Programs to Fill Data Gaps
Alternative 4: Develop AGR site-specific salinity objectives within Project Zone (Lower Tulare, Etchegoin Formations)	No Change in AGR Beneficial Use Designation	Develop Individual Site-Specific Objectives (SSOs) that maintain existing ambient concentrations	Existing Regulatory Programs to Implement	Adjust Existing Regulatory Programs to Account for New Objectives

4.2.1 AGR Alternative 1: No Action

AGR Alternative 1 would not amend the Basin Plan; rather it would continue to maintain the current AGR beneficial use designation for the Tulare Lake Basin (DAUs 238, 241, 246). Accordingly, for areas that currently do not meet AGR-related WQOs due to naturally occurring background concentrations, controllable factors, such as agriculture operations, would not be allowed to further degrade existing water quality under the No Action Alternative. However, since no agricultural operations discharge to the proposed de-designation area, due to its depth and the presence of the Mid Tulare Shale, the No Action Alternative would results in no change to current ag operations, as they would still have to protect AGR beneficial use of groundwater within the Upper Tulare Member, situated above the Project Zone. In addition, no new implementation provisions or monitoring and surveillance programs would be initiated.

4.2.2 AGR Alternative 2: De-Designation in Project Area without Vertical Boundaries (including Upper Tulare Member)

AGR Alternative 2 would de-designate AGR as a beneficial use for all groundwater within the Project Area (i.e., with no vertical boundaries) based on an upper salinity threshold of 5,000 mg/L TDS for livestock watering (1974 NRC). The six sections comprising the Project Area within the Southern Lost Hills Oilfield has groundwater with salinity exceeding this threshold. The rationale for selecting this salinity threshold is discussed in Section 1.

The proposed AGR de-designation boundaries were developed to preclude areas where active irrigation wells and stock wells are located, including a buffer area between the proposed de-designation boundary and the boundary of the oilfield.

Discussions with the landowner in the Project Area revealed that no one carries out livestock operations on their lands, and irrigation water used for orchard crops present in portions of the proposed de-designation area is imported from outside the Project Area (water is delivered via either earthen ditches, water trucks, or pipelines; see the irrigation and stock watering outreach study provided in **Appendix F**).

4.2.3 AGR Alternative 3: De-Designation Only in Project Zone (Lower Tulare and Etchegoin Formations)

AGR Alternative 3 is similar to AGR Alternative 2, except that AGR de-designation would be limited to the Project Zone—i.e., the Lower Tulare Member and the Etchegoin Formation within the Project Area.[10] The Lower Tulare Member and the Etchegoin Formation have variable vertical depths represented in **Figures 1-11, 1-18 and 1-19**. The minimum variable depths shown in **Figures 1-18 and 1-19** represent the depth at

[10] The Project Zone is the same for AGR Alternative 3 and MUN Alternative 3.

which the Mid Tulare Shale is first encountered within the boundary area proposed for AGR de-designation (top of the Project Zone). Because the Mid Tulare Shale in this area is of variable thickness, the de-designation of the AGR beneficial use would extend to the bottom of the clay layer along the outside surface of the de-designation boundary. The selection of AGR Alternative 3 would result in the same de-designation boundary for both the MUN and AGR beneficial uses in groundwater in a portion of the Southern Lost Hills Oilfield because the MUN de-designation boundary and AGR de-designation boundary are identical. No changes will be made to other beneficial uses.

The proposed AGR de-designation boundary (**Figure 1-11**) was developed to preclude areas where active irrigation or stock watering wells are located, and includes a buffer area between any active agricultural supply wells and the proposed de-designation boundary based on a thorough ground level reconnaissance of all irrigation supply wells within the proposed Project Area. Additionally, groundwater salinity levels within the AGR de-designation Project Zone exceed 10,000 mg/L TDS, which means they significantly exceed the upper salinity limit of 5,000 mg/L TDS.

Discussions with the landowner in the Project Area revealed that no one carries out livestock operations on their lands, and irrigation water used for orchard crops present in portions of the proposed de-designation area is imported from outside the Project Area (water is delivered via either earthen ditches, water trucks, or pipelines; see the irrigation and stock watering outreach study provided in **Appendix F**).

4.2.4 AGR Alternative 4: Site-Specific Objectives (SSOs) for Salinity for All Groundwater within Project Zone (Lower Tulare and Etchegoin Formations)

AGR Alternative 4 would involve changes to the Basin Plan pertaining to water quality objectives for groundwater in the Project Area within the Southern Lost Hills Oilfield. The development of SSOs for constituents of concern for the groundwater would be developed based on existing ambient groundwater concentrations. Where groundwater quality (measured as TDS) currently does not support the irrigation supply or the livestock watering beneficial uses due to naturally occurring background concentrations (e.g., ambient salinity is 10,000 mg/L TDS), controllable factors, such as agriculture, would not be allowed to further degrade existing water quality under this alternative. Existing regulatory programs would be responsible for implementing the monitoring and surveillance program needed to assure that waste discharges do not further degrade existing ambient groundwater concentrations in a site-specific area.

4.2.5 Evaluation of Project Alternatives

Similar to the process used to evaluate MUN alternatives, the above-described AGR Basin Plan Amendment alternatives were evaluated based on their ability to meet 8 of the 9 selection criteria described in Section 4.2. Selection criterion 2, “Meet exception(s) to *Sources of Drinking Water Policy*”, is not applicable to the AGR beneficial use. Each AGR project alternative was evaluated with regard to how well it satisfies each criterion. As with the MUN Alternatives,

this evaluation employs a scale of “low”, ‘medium”, and “high” in ranking extent to which each alternative meets a given criterion. Definitions of these rankings are provided in Section 4.1.5. A description of the assumptions and rationale used when ranking each AGR project alternative is provided in **Appendix G**.

Table 4-4. AGR Designation in Southern Lost Hills Oilfield Groundwater: Evaluation of Project Alternatives

AGR Project Alternatives	Criterion 1: Consistent w/ Fed/State Laws	Criterion 2: Protects Beneficial Uses	Criterion 3: Maintains Ag Production in Project Area	Criterion 4: Supports Salt Control/ Mgmt.	Criterion 5: Tech. Feasibility, Econ. Viability, Reasonable Action	Criterion 6: Scientific Support	Criterion 7: Socio-economic Wellbeing	Criterion 8: Ease to implement
Alternative 1: No Action	High	High	High	Low	Low	Low	Low	Low
Alternative 2: De-Designate AGR in Project Area w/o Vertical Boundaries (includes Upper Tulare Member)	Low	Low[1]	High	Med	Med[1]	Low[1]	Med	Med
Alternative 3: De-Designate AGR within Project Zone (Lower Tulare and Etchegoin Formations)	High	High	High	High	High	High	High	High
Alternative 4: Site-Specific Salinity Objectives in Project Zone (Lower Tulare and Etchegoin Formations)	High	High	Low	Low	Low	Low	Low	Low

4.2.6 Staff Recommendation: AGR Alternative 3

Based on the analysis of the four alternatives discussed above, Central Valley Water Board staff recommends AGR Alternative 3, which is to de-designate the AGR beneficial use from the portion of the Southern Lost Hills Oilfield for groundwater of the Lower Tulare Member and the Etchegoin Formation, as represented in **Figures 1-11**, 1**-18** and **1-19,** based on an salinity groundwater quality threshold of 5,000 mg/L TDS that is supported by the findings of the Beneficial Use Evaluation Report and the literature review prepared for CV-SALTS by Kennedy/Jenks Consultants and Texas A&M Agrilife Research (CV-SALTS, 2013). Additionally, the 5,000 mg/L TDS salinity threshold has previously been used to de-designate AGR beneficial use from groundwater during the 2018 Royal Mountain King Mine project and has undergone scientific peer review and found to be reasonable.

AGR Alternative 3 best satisfies the selection criteria since the action would:

1. Be consistent with both federal and state water quality laws and policies.

2. Be the appropriate protection for the groundwater in the area proposed for AGR de-designation. Section 4.4.3.1 demonstrates that the proposed de-designation area has no past, current, or potential future use for agricultural supply (irrigation supply and livestock watering) due to high background salinity of the groundwater.

3. Ensure that all existing and future potential groundwater beneficial uses are protected.

4. Be the most beneficial and cost effective measure because it does not require extensive scientific review and development of SSOs or additional costly measures to avoid groundwater quality degradation and/or meet salinity levels generally considered to support AGR beneficial uses: 2,000 mg/L TDS for irrigation and 5,000 mg/L TDS for livestock watering.

5. Find it appropriate that agriculture in the project area not be required to implement new treatment processes or other control measures to avoid groundwater quality degradation and/or meet AGR-related discharge limitations in WDRs when no such use currently exists or is anticipated to exist for groundwater in the zone proposed for AGR de-designation.

6. Result in better protection of groundwater beneficial uses downgradient from the de-designation area, as the Mid Tulare Shale would reasonably contain the injection water within the de-designation area.

Implementation of AGR Alternative 1 (No Action) would not satisfy the selection criteria because it would not lead to the improvement of salinity management within the Project Area and is not supported by existing scientific data and conditions. Additionally, implementation of AGR Alternative 1 would not result in additional costly treatment or

other control measures for regulated entities beyond those currently required to avoid groundwater quality degradation and/or meet AGR water quality concentration limit thresholds, as AGR beneficial use would be maintained in groundwater within the Upper Tulare Member regardless.

Implementation of AGR Alternative 2 (AGR de-designation without vertical limits) would not satisfy the selection criteria because it would de-designate the AGR beneficial use in the unconfined, upper aquifer, where groundwater does not exceed the salinity threshold. The technical findings of the Revised Technical Report showed that groundwater quality above the mid Tulare Shale in the Project Area features salinity levels both above and below 5,000 mg/L TDS, therefore, not all of the groundwater within the Upper Tulare Member that falls within the proposed Project Area exceeds the 5,000 mg/L TDS salinity threshold and therefore AGR cannot be de-designated using this criteria. Use of the groundwater in the upper aquifer would not be protected under AGR Alternative 2 because it would not protect groundwater that has a salinity concentration slightly below the 5,000 mg/L TDS threshold that could potentially be used for livestock watering in the future. Because this alternative is viewed as unnecessarily limiting beneficial use protection in the project area, it is eliminated from further consideration and no specific environmental, antidegradation, or economic analyses are conducted for it.

Implementation of AGR Alternative 4 (Site-Specific Objectives within the proposed de-designation boundaries for irrigation supply and livestock watering) would not satisfy the selection criteria because it would also act to reduce agricultural production in the project area, would not lead to the improvement of salinity management within the project area, and has the potential to cause socioeconomic impacts in the project area. Unlike AGR Alternatives 2 and 3, SSOs do not address the primary question of what the appropriate AGR beneficial use protection is for the Southern Lost Hills Oilfield. Since the AGR use is not existing in the area, SSOs would only be possible to support a “limited AGR” use, whereby waters would need to be substantially treated or blended prior to use. A rational basis for a Limited-AGR SSO would be existing ambient water quality. This alternative would then be similar to AGR Alternative1 (No Action), which allows limited degradation of groundwater quality. However, as described in Sections 4.4.2.1 and 4.4.3.1, because the degree of AGR use of the groundwater contained in the proposed de-designation area is no AGR use, developing SSOs for another degree of use is not a reasonable alternative. As such, SSOs for the protection of AGR beneficial uses are eliminated from further consideration and no environmental, antidegradation, or economic analyses are conducted on this alternative. However, as noted in the assumptions and rationale used when ranking the AGR project alternatives (see **Appendix G**), implementation of SSOs for the protection of AGR beneficial uses would require agriculture to implement additional treatment and control of its discharge to reduce its impact on groundwater or would lead to reduced agricultural production in the area through land fallowing. Implementation of these measures would produce unwarranted adverse socioeconomic impacts in the project area.

Recommendations for the Monitoring and Surveillance component of AGR Alternative 3 are discussed further in Section 5, Program of Implementation.

Section 5: Program Implementation

Control and monitoring of this program has already been implemented through the monitoring and reporting requirements and limits imposed by the Underground Injection Control (UIC) permits under which the injection wells operate. CalGEM administers the UIC permits, and the operators are responsible for monitoring and reporting injection flows, injection day counts, and surface injection pressure readings on a monthly basis, and limiting injection flows as required by the permits. In addition, the operators are required to perform annual testing to demonstrate the integrity of the tubing and casing seals, and to notify CalGEM if the injection wells are to be shut in for a period of time for workovers or other maintenance activities. As a result, implementation of this program will proceed as follows with Seneca Resources as the operator and CalGEM as the agency providing oversight:

Seneca will continue with produced water injections at the four wells that are identified as permitted under the CalGEM UIC program.

Seneca has no plans to expand or alter the injection well network, nor will the currently UIC-permitted injection volumes be exceeded.

Section 6: Consistency with Laws, Plan and Policies

The following state and federal laws, plans, and policies were reviewed for this Basin Plan Amendment.

6.1 Federal and State Laws

Federal agencies have adopted regulations implementing federal laws to which Central Valley Water Board actions must conform. The following federal laws were evaluated for this proposed Basin Plan Amendment:

- Clean Water Act
- Federal Endangered Species Act (16 U.S.C. § 15331 et seq.) and California Endangered Species Act (Fish & Game Code, § 2050 et seq.)

These laws and their relevance to the proposed Basin Plan Amendment are described in the following sections in addition to State law.

6.1.1 Federal Clean Water Act

Requirements for Avoiding Wetlands Loss

Under Clean Water Act section 404 and the Rivers and Harbors Act of 1899 Section 10, alteration of waterways, including wetlands that affect navigable water requires a permit from the federal government and assurance that impacts will be avoided or mitigated. The U.S. Army Corps of Engineers (USACE) operates the 404 permitting program with a goal of achieving a “no net loss” of wetlands. For projects proposing unavoidable impacts on wetlands, compensatory mitigation in the form of replacing the lost aquatic functions is generally required. Under authority of Clean Water Act section 401, the State also reviews projects affecting water bodies. The State may require compensatory mitigation for wetlands impacts not under the jurisdiction of the federal government (e.g., for wetlands not contiguous with navigable waters).

The proposed Basin Plan Amendment will not adversely affect or have net loss to current wetlands. Therefore, these laws and regulations pertaining to wetland loss are not applicable to the proposed Basin Plan Amendment.

6.1.2 Federal and State Endangered Species Acts

The federal Endangered Species Act of 1973 (16 U.S.C. § 1531 et seq.) was established to identify, protect, and recover imperiled species and the ecosystems upon which they depend. It is administered by the Interior Department’s U.S. Fish and Wildlife Service (USFWS) and the Department of Commerce’s National Oceanic and Atmospheric Administration’s National Marine Fisheries Service (NMFS). The USFWS has primary responsibility for terrestrial and freshwater organisms, while the NMFS has primary responsibility for marine species such as salmon and whales. In addition, the

State of California enacted the California Endangered Species Act (Fish & G. Code, § 2050 et seq.), which is administered by the California Department of Fish and Wildlife (CDFW) and similarly maintains State lists of rare, threatened and endangered species.

The proposed Basin Plan Amendment is not expected to affect fish and wildlife as it only de-designates MUN and AGR beneficial uses in groundwater. Therefore, the Endangered Species Act is not applicable to the proposed Basin Plan Amendment.

6.1.3 Underground Injection Control (UIC) Regulatory Program

Seneca operates four injection wells in the Project Area under a CalGEM UIC Class II Permit and will continue to operate the wells under the permit requirements should the Basin Plan Amendment be adopted. Therefore, the proposed Basin Plan Amendment is not expected to modify Seneca's operations or their permit requirement under this program.

6.1.4 Human Right to Water (Wat. Code, § 106.3)

Water Code section 106.3 outlines the State of California policy that every human being shall have the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes. The statute provides as follows:

> (a) It is hereby declared to be the established policy of the State that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes.
>
> (b) All relevant State agencies, including the department, the State Board, and the State Department of Public Health, shall consider this State policy when revising, adopting, or establishing policies, regulations, and grant criteria when those policies, regulations, and criteria are pertinent to the uses of water described in this section.
>
> (c) This section does not expand any obligation of the State to provide water or to require the expenditure of additional resources to develop water infrastructure beyond those obligations that may exist pursuant to subdivision (b).
>
> (d) This section shall not apply to water supplies for new development.
>
> (d) The implementation of this section shall not infringe on the rights or responsibilities of any public water system.

As explained in this Staff Report, the Project Zone does not contain groundwater that is suitable for municipal and domestic beneficial uses—including the specific applications outlined in Water Code section 106.3 (i.e., consumption, cooking and sanitary purposes). Rather, the Project Zone is saline, with groundwater TDS levels exceeding

10,000 mg/L. Further, the groundwater proposed for de-designation meets the criteria for "Exception 1a" under the *Sources of Drinking Water Policy*. Accordingly, the proposed Basin Plan Amendment is consistent with California's Human Right to Water Policy established under Water Code section 106.3.

6.1.5 Assembly Bill 32 – California Global Warming Solutions Act (Health & Saf. Code, § 38500 et seq.)

The California Global Warming Solutions Act of 2006, Health & Safety Code section 38500 et seq., which is better known as "Assembly Bill 32" or "AB 32," establishes a comprehensive program to reduce greenhouse gas (GHG) emissions from all sources throughout California. The Water Boards are committed to the adoption and implementation of effective actions to mitigate GHG emissions and adaptation of our policies and programs to the environmental conditions resulting from climate change.

The proposed Basin Plan Amendment is not expected to affect climate change because its adoption is not anticipated to produce a measurable change in existing GHG emissions in the Project Area. The proposed project may include the use of GHG-generating equipment or machinery for monitoring well installation. However, equipment used in monitoring well installation is comparable to equipment used in existing oil-field and agricultural operations that are authorized pursuant to the land use designations in the project area. Therefore, the proposed Basin Plan Amendment is consistent with the California Global Warming Solutions Act.

6.2 State Water Board Polices

The State Water Board is authorized to adopt State policy for water quality control. (Wat. Code, § 13140.) State Water Board water quality control plans supersede any regional water quality control plans for the same waters to the extent of any conflict. (Water Code § 13170.) The following are the State Water Board policies potentially relevant to the proposed Basin Plan Amendment:

- *Statement of Policy with Respect to Maintaining the High Quality of Water in California*, State Water Board Resolution 68-16 (*Antidegradation Policy*)
- *Sources of Drinking Water Policy*, State Water Board Resolution 88-63 (*Sources of Drinking Water Policy*)

6.2.1 *Statement of Policy with Respect to Maintaining High Quality of Water in California*, State Water Board Resolution 68-16 (*Antidegradation Policy*)

A Basin Plan Amendment must be consistent with the State Water Board's *Statement of Policy with Respect to Maintaining High Quality of Waters in California*, Resolution 68-16 (*Antidegradation Policy*), which is also incorporated as part of the

Basin Plan itself.[11] Adopted in October 1968, the *Antidegradation Policy* effectively limits the Central Valley Water Board's discretion to authorize degradation of so-called "high quality waters," defined as those waters whose quality is sufficient to support designated beneficial uses. Determinations as to "high quality" status are typically made on a constituent-by-constituent basis.

The *Antidegradation Policy* sets forth a "two-part process" for the Board to authorize degradation of high-quality waters:

a. Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water, and will not result in water quality less than that prescribed in the policies.

b. Any activity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to discharge to existing high quality waters will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assume that (a) a pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained."

As a threshold matter, this Basin Plan Amendment does not trigger the State Water Board's *Antidegradation Policy*, as it does not involve the degradation of "high quality waters." The Project Zone groundwater subject to potential de-designation has been demonstrated to be entirely unsuitable for MUN and AGR beneficial uses. The groundwater is not being applied, has not been applied, and is not expected to ever be applied, for MUN and AGR beneficial uses. De-designation for MUN beneficial uses is also consistent with "Exception 1a" of the *Sources of Drinking Water Policy*. The groundwater is also too poor to meet the Chemical Constituents Narrative WQO for AGR beneficial use..

Accordingly, the proposed Bain Plan Amendment is consistent with the State Water Board's *Antidegradation Policy.*

[11] Although there is also a *Federal Antidegradation Policy* (40 C.F.R. § 131.12), it does not apply to groundwater or non-jurisdictional surface waters (i.e., not subject to the Clean Water Act).

6.2.2 *Sources of Drinking Water Policy*, State Water Board Resolution 88-63

The State Water Board's *Sources of Drinking Water Policy* has already been discussed at length in **Section 2.2** and many others. As previously explained, the "Exception 1a" in the policy categorically exempts from the blanket MUN designation those waters with TDS exceeding 3,000 mg/L (equivalent to 5,000 μS/cm EC). Because groundwater within the Project Area indisputably meets the criteria of "Exception 1a," MUN de-designation is consistent with the *Sources of Drinking Water Policy*.[12]

[12] The *Sources of Drinking Water Policy* pertains only to MUN beneficial use designations; it has no applicability to AGR beneficial uses.

Section 7: Environmental Review

7.1 Background and Proposed "Project"

Although it constitutes a "project" under the California Environmental Quality Act (CEQA), Public Resources Code section 21000 et seq., this Basin Plan Amendment is a "certified regulatory program" that has been categorically exempted from the requirement for preparation of an Environmental Impact Report (EIR). (Pub. Resources Code, § 21080.5; Cal. Code Regs., tit. 14, 1251, subd. (g).) Basin Plan Amendments must instead comply with the procedural requirements set forth in California Code of Regulations, title 23, section 3775 et seq. This Staff Report and its associated Environmental Checklist (**Appendix H**) constitute the Substitute Environmental Document (SED) that is required per California Code of Regulations, title 23, sections 3777 and 3779.5.

Although other alternatives were evaluated as part of the selection process (Staff Report, § 4), the Central Valley Water Board's environmental review in this Section is limited to the staff-recommended alternatives: **MUN Alternative 3** (§ 4.1.3) and **AGR Alternative 3** (§ 4.2.3). Together, these alternatives (i.e., the Project) would de-designate MUN and AGR as beneficial uses of groundwater within the Project Zone, as identified in **Figures 1-11, 1-12 and 1-13**; the area proposed for de-designation is referred to in two-dimensional terms as the "Project Area" (horizontal delineation) and in three-dimensional terms as the "Project Zone" (horizontal and vertical delineation).

7.2 Project Setting/Baseline

The baseline against which the proposed Basin Plan Amendment (Project) is assessed includes the following characteristics:

- Existing groundwater characteristics, hydrology, and uses of groundwater
- Existing agricultural operations
- Existing regulatory programs and policies

The Revised Technical Report (Seneca et al, 2018) characterized the various components of groundwater and groundwater uses listed above in the Project Area. Current groundwater quality was determined through review of United States Geologic Survey (USGS) reports, groundwater monitoring data measured within the Southern Lost Hills Oilfield and E-logs from wells within the Project Area. The current and anticipated future uses of local groundwater supplies in the Project Area were determined through outreach to municipalities and landowners within and just outside of the Project Area.

The primary discharge to groundwater in the Project Zone comes from injection of produced water directly into the aquifers of the Lower Tulare Member and the Etchegoin Formations (i.e., Project Zone) and from irrigated agriculture into the Upper Tulare Member. The area receives little precipitation, with the neighboring City of Lost Hills

averaging 7.55 inches per year,[13] which is substantially less than the statewide annual average rainfall (24.71 inches). The salinity of groundwater within the Project Zone exceeds10,000 mg/L TDS. Within the proposed de-designation boundaries (Project Area), there are no entities using the groundwater for MUN or AGR uses. Agricultural operations use surface water imported from outside the Project Area.

Existing regulatory programs and policies regulate the current produced water injection and agricultural and storm water discharges and groundwater quality within and outside of the Project Area. These programs and policies include, but are not limited to, CalGEM's Underground Injection Control (UIC) Regulatory Program, the Irrigated Lands Regulatory Program (ILRP), which is intended to ensure that agricultural discharges do not adversely affect beneficial uses, Phase II Small Municipal Separate Storm Sewer Systems (MS4s), Storm Water General Permit programs for construction and industrial activities, Water Quality Certification program for dredge and fill activities, and the State Water Board's *Sources of Drinking Water Policy* and *Antidegradation Policy*.

7.3 Environmental Impact Analysis (No Significant Effects)

As a SED, this Staff Report must contain "[a]n identification of any significant or potentially significant adverse environmental impacts of the proposed [Basin Plan Amendment]," as well as an analysis of any impacts associated with reasonably foreseeable methods of compliance with the amendment. (See Cal. Code Regs., tit. 23, § 3777, subds. (b)(2), (4).)

7.3.1 Project-Specific Impacts

The proposed Basin Plan Amendment would remove the MUN and AGR beneficial use designation in the groundwater within a horizontally and vertically delineated zone underlying a portion of the Southern Lost Hills Oilfield (i.e., the Project Zone). The MUN use is not an existing use in the groundwater and cannot feasibly be attained due to the high salinity of the ambient groundwater. Similarly, the AGR use, which includes applications for irrigation supply and livestock watering, is not an existing use (for the same reason noted above).

With respect to MUN beneficial uses, the proposed Basin Plan Amendment must be based on an enumerated "exception" under the *Sources of Drinking Water Policy*. A Basin Plan Amendment must also be adopted to de-designate the AGR beneficial use in the Project Zone, which would remove the applicability of all narrative WQOs in place to protect the AGR use in groundwater within the de-designation boundary. The proposed Basin Plan Amendment would not require additional implementation actions by dischargers to the groundwater within the Project Area to meet MUN or AGR-related WQOs. Because the preferred MUN and AGR de-designation alternatives use the same beneficial use de-designation boundary (i.e., the boundaries shown in **Figures 1-11**, **1-**

[13] https://www.usclimatedata.com/climate/corcoran/california/united-states/usca0250

18 and **1-19** are identical in both proposed MUN and AGR use de-designation alternatives), there exists only a single three-dimensional (3D) space in which both beneficial uses would be de-designated.

Adoption of the proposed Basin Plan Amendment would not have any significant effect on the existing physical environment because the amendment would not change any factors significantly affecting existing groundwater quality or hydrology within the three-dimensional Project Zone , or impart any changes to groundwater outside the Project Zone (e.g., upgradient or beneath). As indicated in **Section 1.2.3.1**, Seneca modeled the flow path of water injected into the four wells over a 100-year timeframe (the anticipated life of UIC operations for these wells) and projected that information onto a regional map (**Figure 1-16**). As depicted on **Figure 1-16**, the modeled flow paths emanating from each well have arrows that mark the projected progress of the plumes for each decade up to 100 years and a buffer zone was placed around the modeled injection flow paths to provide added assurance that the Project Zone will contain these plumes and therefore remain appropriate for the projected 100-year modeling period. The buffer zone allows for uncertainties in the groundwater flow direction, heterogeneities in the aquifer parameters that were used to generate the modeled injection plumes, potential cumulative effects, and the displacement of existing groundwater in the Project Zone as water is injected into the four UIC wells. With the addition of the buffer as described, the entire area that could be affected within the 100-year horizon is still within the six sections contained within the administrative boundaries of the Lost Hills Oilfield (Project Area).

All active municipal and domestic supply wells identified through the thorough ground-level well reconnaissance effort carried out as part of this Project either exist at distances sufficiently far away from the Project Area so as to have no potential to draw water from within the Project Zone.

The proposed Basin Plan Amendment simply recognizes that MUN and AGR are not existing or attainable uses within the Project Zone, formally applies the exceptions identified in the *Sources of Drinking Water Policy* with regard to the MUN beneficial use, and enables the Central Valley Water Board to regulate waste discharges and irrigated agriculture within the proposed de-designation boundary and make impairment assessments based on appropriate beneficial use designations, consistent with state and federal policies. The proposed Basin Plan Amendment would not cause any potentially significant environmental impacts and, therefore, there are no mitigation measures or alternatives that could reduce or avoid significant impacts. These conclusions are reflected in the Environmental Checklist provided in **Appendix H** for the proposed Basin Plan Amendment.

7.3.2 Foreseeable Means of Compliance

A SED must include a “[a]n environmental analysis of the reasonably foreseeable methods of compliance…,” which includes the following:

(A) An identification of the reasonably foreseeable methods of compliance with the project;

(B) An analysis of any reasonably foreseeable significant adverse environmental impacts associated with those methods of compliance;

(C) An analysis of reasonably foreseeable alternative methods of compliance that would have less significant adverse environmental impacts; and

(D) An analysis of reasonably foreseeable mitigation measures that would minimize any unavoidable significant adverse environmental impacts of the reasonably foreseeable methods of compliance.

(Cal. Code Regs., tit. 23, § 3777, subd. (b)(4).)

This environmental analysis must "take into account a reasonable range of environmental, economic, and technical factors, population and geographic areas, and specific sites," though the Central Valley Water Board is not required engage in a "a site-specific project level analysis of the methods of compliance, which CEQA may otherwise require of those agencies who are responsible for complying with the plan or policy when they determine the manner in which they will comply."[14] (*Id*., § 3777, subd. (c); cf. Pub. Resources Code, § 21159, subds. (c)-(d).)

In this instance, the proposed Basin Plan Amendment merely involves a de-designation of MUN and AGR beneficial uses within the three-dimensional Project Zone, thereby obviating altogether any need for compliance with WQOs associated with such beneficial uses. Accordingly, no further analysis of means of compliance is required at this time.

7.3.3 Cumulative Impacts

"Cumulative impacts" are defined as "two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts." (Cal. Code Regs., tit. 14, § 15355.) These effects may be changes resulting from a single project, or multiple separate projects. (*Id*., § 15355, subd. (a).)

[14] A similar analysis is also required when the Central Valley Water Board adopts a regulation (i.e., Basin Plan Amendment) requiring installation of pollution control equipment, or a performance standard or treatment requirement. (Pub. Resources Code, §§ 21159(a), 21159.4(a)(4).)

With respect to analyzing the cumulative impacts from multiple projects, the CEQA Guidelines further advise as follows:

> The cumulative impact from several projects is the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time.

(*Id*., § 15355, subd. (b).)

In this context, reasonably foreseeable future projects include the Board's revision of WDRs (permit requirements) for regulated entities that discharge agricultural drainage to groundwater within the Project Area; such revisions would still require compliance with WQOs or criteria developed for the protection of MUN and AGR uses in the groundwater within the Upper Tulare Member. The Central Valley Water Board would still be obligated to protect MUN and AGR beneficial uses in groundwater within the Project Area but above the Project Zone (i.e., within the Upper Tulare Member). However, agricultural discharges will not have a cumulative impact on groundwater within the Project Zone due to the lack of hydraulic connectivity between the aquifers within the Upper Tulare Member and aquifers within the Lower Tulare Member and the Etchegoin Formation. Any future projects that may involve injection of production water into the Project Zone, would not need to comply with criteria developed to protect MUN and AGR beneficial use, but would still need to comply with UIC permitting requirements. Central Valley Water Board staff anticipate that the regulated entities whose permits may be revised by the Board subsequent to the adoption of the proposed Basin Plan Amendment may include agricultural and gas and oilfield operations.

The Central Valley Water Board has issued ILRP General Orders to third-party coalitions (representatives of agricultural growers), including the Westside Water Quality Coalition that operates in the Project Area, that require the coalitions to develop regional water quality management plans for areas where irrigated agriculture may be contributing to water quality problems. The ILRP General Orders require growers to conduct evaluations of their management practices to ensure they are protecting groundwater and surface water and require coordinated monitoring at specified monitoring points that have been determined to be representative of water quality within the watershed. Because the ILRP General Orders issued to the Westside Water Quality Coalition only generally specify that the management plan that it develops and implements must ensure the protection of beneficial uses in all water bodies affected by agricultural return flows, revisions to the ILRP General Orders would likely not be required as the de-designation of the MUN and AGR uses in the groundwater within the Project Area does not apply to the shallow groundwater within the Upper Tulare Member, and as such, ILRP requirements would still be in effect within the Project Area.

Furthermore, the continued agricultural activities that discharge to groundwater within the area of the proposed Basin Plan Amendment are not anticipated to impact the

groundwater within the Project Zone due to the confining nature of the Mid Tulare Shale. Nonetheless, these agricultural activities will all be required to comply with regulatory limits developed to protect the still-designated MUN and AGR beneficial uses that will continue to exist in the groundwater above and outside of the Project Zone. When a potential permittee proposes a new or expanded discharge (which includes changes to existing discharge drainage patterns), they must submit a new report of waste discharge to the Central Valley Water Board, and the Board will be required to conduct a new antidegradation analysis and ensure that the beneficial uses that may be affected by the discharge, including those areas where the MUN and AGR beneficial uses will not be de-designated, will be protected, before the Board can issue WDRs. In this manner, the Board will continue to ensure that beneficial uses outside of the Project Zone will continue to be protected.

Lastly, this basin planning effort is one part of a region-wide effort that the Board is undertaking to evaluate the appropriate beneficial use protection, WQOs, and implementation and monitoring requirements for the MUN beneficial use in various water bodies throughout the Central Valley. It is possible that other ground waters in the Central Valley may have their MUN beneficial use removed in the future if they meet one or more of the exception criteria in the *Sources of Drinking Water*. Similarly, other ground waters in the Central Valley also may have their AGR beneficial use removed in the future if it is demonstrated that existing ambient salinity levels do not support the use of the water for irrigated agriculture and livestock watering and no such current use of the water is found to exist.

Based on the foregoing, the Central Valley Water Board has determined that there exists no “fair argument” that either the proposed Basin Plan Amendment, or the reasonably foreseeable methods of compliance therewith, will result in any significant environmental impacts, either individually or cumulatively.

7.4 Alternative Analysis (Not Required)

Ordinarily, a SED must contain “[a]n analysis of reasonable alternatives to the project and mitigation measures to avoid or reduce any significant or potentially significant adverse environmental impacts.” (Cal. Code Regs., tit. 23, § 3777, subd. (b)(3).) However, where the Central Valley Water Board has determined that there exists no “fair argument” that the Basin Plan Amendment may result in any reasonably foreseeable significant adverse environmental impacts, the SED (i.e., this Staff Report) need only include a finding to that effect. (*Id.*, § 3777, subd. (e).)

Section 8: Economic Analysis (Not Required)

For the purposes of this Section, the Basin Plan Amendment (Project) shall be strictly limited to the staff-recommended alternatives: **MUN Alternative 3** (§ 4.1.3) and **AGR Alternative 3** (§ 4.2.3). Together, these alternatives would de-designate MUN and AGR as beneficial uses of groundwater within the Project Zone—i.e., the horizontally and vertically-delineated space in the Project Area, as identified in **Figures 1-11, 1-12 and 1-13**.

There are three conditions under which economic considerations must be considered in the context of a Basin Plan Amendment. None of these conditions are present in the instant Project.

First, WQOs established under the Basin Plan must account for economic considerations. (Wat. Code, § 13241, subd. (d).) Because the Project will not involve the establishment or modification of WQOs, this requirement does not apply.[15]

Second, prior to the Central Valley Water Board's implementation of an agricultural water quality control program, the Basin Plan must include "an estimate of the total cost of such a program, together with an identification of potential sources of financing…." (Wat. Code, § 13141.) This requirement is also inapplicable because: (1) the proposed Project does not involve the implementation of an agricultural water quality control program; (2) such a program already exists in the form of the Irrigated Lands Regulatory Program (ILRP); and (3) the Board has already complied with this statutory mandate in connection with the ILRP. (See Basin Plan, § 4.1.2, pp. 4-2, 4-3.)

Third, economic considerations must be taken into account by the SED when analyzing impacts of reasonably foreseeable means of compliance with a new requirement or obligation imposed under the Basin Plan. (See Cal. Code Regs., tit. 23, § 3777, subds. (b)(4), (c).) As explained in **Section 7.3.2**, the de-designation of beneficial uses obviates any obligation to comply with WQOs associated with such uses. In other words, the Project does not result in any new means of compliance. No further analysis is required at this time.

[15] MUN Alternative 4 and AGR Alternative 4, both of which would involve the establishment of site-specific WQOs (i.e., Site-Specific Objectives or SSOs), are eliminated from consideration.

Section 9: References

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