UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

May 30, 2019

Kenneth A. Harris Jr.
State Oil and Gas Supervisor
Division of Oil, Gas, and Geothermal Resources
California Department of Conservation
801 K Street, MS 18-05
Sacramento, CA 95814-3530

Re: Approval of Aquifer Exemption for the Midway-Sunset Oil Field, Kern and San Luis Obispo Counties, California

Dear Mr. Harris:

Based on a thorough review of the supporting documents submitted by the California Department of Conservation, Division of Oil, Gas, and Geothermal Resources (DOGGR) and the State Water Resources Control Board (SWRCB), the U.S. Environmental Protection Agency (EPA) hereby approves the aquifer exemption request for portions of the Potter Sands, Spellacy Sands, Miocene Shales and Warson Sand, and the Lower Antelope Sands in the Midway-Sunset Oil Field in Kern and San Luis Obispo Counties, California.

In accordance with applicable regulations at 40 C.F.R. Parts 144, 145, and 146, we find that this aquifer exemption request is a non-substantial program revision, and the requested formations meet the following federal exemption criteria:

- The portion of the formations proposed for exemption in the field do not currently serve as sources of drinking water; and
- The portion of the formations proposed for exemption in the field have more than 3,000 milligrams per liter (mg/L) and less than 10,000 mg/L total dissolved solids content and are not reasonably expected to supply a public water system.

The approved aquifer exemption boundaries and depths, along with the EPA's analysis and rationale in support of the approval, are detailed in the enclosed Record of Decision. In addition, we are enclosing the application and other documents submitted by the DOGGR and SWRCB to the EPA that were considered in this approval decision. Due to the size of these additional enclosures, we are providing, via email, a link to an electronic folder containing all the remaining documents.

If you have any questions, or if you have any difficulty accessing the electronic folder, please contact David Albright, Manager of our Groundwater Protection Section, at (415) 972-3971.

Sincerely,

Tomas Torres
Director, Water Division

Enclosures: Aquifer Exemption Record of Decision for Midway-Sunset Oil Field
GIS Shape Files of Approved Aquifer Exemption
Final Midway-Sunset Exemption Application
Letter from Kenneth Harris to David Albright dated May 29, 2019

cc: Jonathan Bishop, Chief Deputy Director, State Water Resources Control Board

US Environmental Protection Agency Region 9
Underground Injection Control (UIC) Program

AQUIFER EXEMPTION RECORD OF DECISION

POTTER SANDS, SPELLACY SANDS, MIOCENE SHALES AND WARSON SAND, AND LOWER ANTELOPE SANDS – MIDWAY-SUNSET OIL FIELD

This Record of Decision (ROD) provides the United States Environmental Protection Agency's (EPA's) decision to approve an aquifer exemption (AE) for portions of the Potter Sands, Spellacy Sands, Miocene Shales and Warson Sand, and the Lower Antelope Sands in the Midway-Sunset Oil Field, background information concerning the AE request, and the basis for the AE decision.

Primacy Agency: California Division of Oil, Gas, & Geothermal Resources (DOGGR)

Date of Aquifer Exemption Request: April 15, 2019

Exemption Criteria: DOGGR requests this exemption because it has determined that it meets the criteria at 40 CFR § 146.4(a) and § 146.4(c).

Substantial or Non-Substantial Program Revision: Non-Substantial

Although the EPA must approve all revisions to EPA-approved state Underground Injection Control (UIC) programs, the process differs depending on whether the EPA finds the revision to be a substantial or non-substantial program revision. The EPA determined that this is a non-substantial program revision because it is associated with an active oil field and is not a state-wide programmatic change or a program revision with unique or significant implications for the State's UIC program. The decision to treat this AE request as a non-substantial program revision is also consistent with the EPA's "Guidance for Review and Approval of State Underground Injection Control Programs and Revisions to Approved State Programs" ("Guidance 34"), which explains that the determination of whether a program revision is substantial or non-substantial is made on a case-by-case basis.

Current Operators: More than 40 companies, including Aera Energy, Berry Petroleum, California Resources Corporation, Chalk Cliff Limited, Chevron Corporation, Crimson Resources, Holmes Western Oil, Seneca Resources, Sentinel Peak, and TRC Resources.[1]

[1] The complete list of operators, as follows: 25 Hill Prop. Inc.; Aera Energy, LLC; Amrich Energy, Inc.; Bruce A. Holmes; CFT Oil & Gas, LLC; Caleco, LLC; California Resources Corp.; Chevron Corp.; Commander Oil Co. Ltd.; Crimson Resource Management; Drilling & Production Co.; Dwayne's Engineering; E&B Natural Resources Management Corp; Emjayco, L.P.; Engineers Oil Co.; Sentinel Peak Resources; G.H. Preuitt; Holmes Western Oil Corp; J&K Operating Co., Inc; Jaco Production Co.; KB Oil & Gas; LDD Energy, LLC; Berry Petroleum Co.; MacPherson Oil Co.; McLenna Family Properties; Midway-Sunset Investors; Naftex Operating Co.; ND Petroleum LLC; NMT Oil Co., Inc.; O'Brien Sill; Paul M. Woodward; Petro Resources, Inc.; Pyramid Oil Co.; Ronald R. Brackon Opr.; Seneca Resources; Sunray Petroleum, Inc.; Target Drilling; Tetra Oil Co.; TRC Resources; Valley Water Management; Vaughn, LLC; Vintage Production California; and West American Energy, Corp.

Well/Project Name: The Potter Sands, Spellacy Sands, Miocene Shales and Warson Sand, and the Lower Antelope Sands in the Midway-Sunset Oil Field.

Well/Project Permit Number: There are currently approximately 8,213 Class II enhanced oil recovery (EOR) wells and 30 Class II water disposal wells in the Midway-Sunset Oil Field within the portions of the aquifer proposed for exemption. In the future, the State anticipates there will be additional Class II wells permitted to inject within the portions of the aquifer proposed for exemption.

Well/Project Location: The aquifer proposed for exemption includes formations which underlie the following Sections within the Midway-Sunset Oil Field. [Refer to Figure 1.]

- Potter Sands: Portions of Township 30S Range 22E Sections 10, 14, 15, 21-28, and 34-36; Township 30S Range 23E Sections 19, 29-32; Township 31S Range 22E Sections 1-3, 9-13, 16, 17, 20, 21, 24, 26-28, 35, and 36; Township 31S Range 23E Sections 5-8, 17-21, 28-30; Township 32S Range 22E Section 1; and Township 32S Range 23E Section 6, Mount Diablo Base and Meridian (MDB&M).
- Spellacy Sands: Portions of Township 31S Range 22E Sections 4, 8-10, 16, 17, 20, 21, 35, 36; Township 32S Range 22E Sections 1, 2, and 12; Township 32S Range 23E Sections 5-8, 16-22, 26, 27, 35, 36; Township 12N Range 24W Sections 28, 33, and 34; and Township 11N Range 24W Sections 1, 2, and 12, MDB&M.
- Miocene Shales and Warson Sands: Portions of Township 30S Range 22E Sections 20, 21, 27-29, 32-35; Township 31S Range 22E Sections 1-4, 9-12, 15, 16; and Township 32S Range 23E Sections 16-18, 20-22, 26-28, MDB&M.
- Lower Antelope Sands: Portions of Township 31S Range 22E Section 35; Township 32S Range 22E Sections 1, 2, 12; Township 32S Range 23E Sections 6-8, 17, 18, 21, 22, 27, 28; Township 12N Range 24W Section 34; Township 11N Range 24W Sections 3, 12, 13, 24; Township 11N Range 23W Sections 9, 10, 17-28; and Township 11N Range 22W Sections 19 and 30, MDB&M.

Counties: Kern and San Luis Obispo **State:** California

Current Well Class/Type: Class II EOR and produced water disposal.

DESCRIPTION OF PROPOSED AQUIFER EXEMPTION

Aquifer to be Exempted: Portions of the Potter Sands, Spellacy Sands, Miocene Shales and Warson Sand, and the Lower Antelope Sands in the Midway-Sunset Oil Field.

Areal Extent of Aquifer Exemption: The total areal extent of the existing AE and the proposed expansion in the Midway-Sunset Oil Field is approximately 61,187 acres (see the table below). This includes the oil-productive acres within the boundaries of the AE approved by the EPA at the time California received primacy to implement the Class II program in 1983 and the areas in which DOGGR proposes to expand the current exemption.

In the Potter Sands, DOGGR is requesting to expand the exempted area of the sands laterally beyond the 1983 AE boundaries. In the Spellacy Sands and Lower Antelope Sands, DOGGR requests to expand the lateral areas of portions of these formations beyond those approved in 1983, as well as expand the vertical extent of the previously exempted areas of some portions of

these sands; the vertical expansions are within the "overlap exemption areas" shown on the maps of the Spellacy Sands and Lower Antelope Sands on Figure 1. No portions of the Miocene Shales and Warson Sand were exempted in 1983; therefore, all the areas addressed in this ROD will be newly exempted.

DOGGR provided GIS shapefiles that delineate the AE boundaries, which are included in the administrative record for this ROD. Refer to Figures 2.1 through 2.4 for depictions of the proposed portions of the exempt formations.

A breakdown of the proposed and existing exempted areas, in acres, for each of the aquifers follows:

Aquifer	Existing Exempted Area	Proposed Vertical Expansion (incl. in the Existing area)	Proposed Lateral Expansion
Potter Sands	33,980	0	15,955
Spellacy Sands	33,980	10,684	4,313
Miocene Shales & Warson Sand	0	0	6,667
Lower Antelope Sands	33,980	3,688	4,211

Lithology, Total Dissolved Solids (TDS), Depth, Thickness, Porosity, and Permeability of the Aquifer: The following table presents the lithology, range of TDS levels, depth below ground surface (bgs), thickness, and average porosity and permeability information for the formations comprising the aquifer proposed for exemption.

Formation	*Lithology*	*TDS (mg/L)*	*Depth to Top (feet bgs)*	*Thickness (feet)*	*Average Porosity (%) and Permeability (millidarcy "mD")*
Potter Sands	Sandstones and conglomerates.	3,802 to 16,606 mg/L (average: 8,150 mg/L)	73 to 1,795	1 to 1,200	32% 2,000 mD
Spellacy Sands	Arkosic sands containing quartz, feldspars, and volcanic rock fragments.	1,200 to 13,155 mg/L (average: 4,849 mg/L)	392 to 1,268	1,000 to 5,500	30% 2,000 mD
Miocene Shales and Warson Sand	Biogenic, siliceous shales (diatomite) intermixed with discontinuous beds of terrigenous clays, sands, and silts.	5,750 to 26,628 mg/L (average: 18,937 mg/L)	400 to 5,000	0 to 2,000	41 to 60% (Miocene Shales) 26% (Warson Sand) 0.1 to 3.6 mD (Miocene Shales) 1,094 mD (Warson Sand)
Lower Antelope Sands	Fine grained sands.	4,827 to 28,063 mg/L (average: 14,571 mg/L)	460 to 2,394	70 to 1,539	18 to 47% 21 to 6,950 mD

Confining Zone(s): In the Midway-Sunset Oil Field, the portions of the formations proposed for exemption are confined above and below by low-permeability shales and silts. Lateral confinement is provided by sealing faults (for the Potter Sands); "pinch outs" due to erosional or depositional changes (for the Potter Sands and Spellacy Sands); encasement within impermeable shales (for the Warson Sand and the Lower Antelope Sands); and low permeability that impedes

fluid migration (for the Miocene Shales). In addition, there is an inward pressure gradient (for the Potter Sands and Spellacy Sands). See Figures 3.1 through 3.8.

BACKGROUND

On April 15, 2019, the EPA received a request from DOGGR for approval to exempt portions of the Potter Sands, Spellacy Sands, Miocene Shales and Warson Sand, and the Lower Antelope Sands in the Midway-Sunset Oil Field in Kern and San Luis Obispo Counties, California. DOGGR reviewed the operator's request and proposed this AE based on the criteria at 40 CFR §146.4(a): it does not currently serve as a source of drinking water; and at 40 CFR § 146.4(c): that the TDS content of the groundwater is more than 3,000 milligrams per liter (mg/L) and less than 10,000 mg/L, and it is not reasonably expected to supply a public water system. After the EPA's approval of the AE, the portions of the exempt formations would not be protected as "underground sources of drinking water" (USDWs) under the Safe Drinking Water Act (SDWA), and DOGGR would be authorized, subject to state regulatory requirements, to approve additional Class II injection into the identified portions of the formations.

The Midway-Sunset Oil Field has been producing oil since the late 1800's. Cyclic steam injection (or "steaming") was initiated in the field in the early 1960's to increase the amount of oil recovery. The oil field currently produces more than 29 million barrels (bbl) of oil per year from several oil-bearing horizons and has produced more than 3 billion bbl of oil through 2018. There are approximately 23,000 producing wells in the oil field. As noted above, Class II wells are currently permitted for injection into the portions of the formations proposed for exemption. Upon EPA's approval of the AE, injection into these wells will be into an exempt aquifer.

BASIS FOR DECISION

Regulatory Criteria under which the AE is Requested and Approved

40 CFR § 146.4(a) *It does not currently serve as a source of drinking water.*

State Water Resources Control Board (State Water Board) Concurrence: In their concurrence on this AE request, the State Water Board determined that the portions of the Potter Sands, Spellacy Sands, Miocene Shales and Warson Sand, and the Lower Antelope Sands proposed for exemption do not currently serve as a source of drinking water and are not hydraulically connected to any domestic or public water supply wells. The State Water Board based its determination on an evaluation of information about water supply wells in the area, groundwater flow patterns, and confinement of groundwater flow. These reviews demonstrate that the portions of the aquifer proposed for exemption do not currently serve as a source of drinking water because there are no existing drinking water supply wells, public or private, that currently or in the future would draw water from the portions of the aquifer that are proposed for exemption. In addition, the formations are vertically and laterally confined (i.e., separated) from other USDWs, and no aquifers that serve as sources of drinking water are hydraulically connected to the formations. Further, within the State's water well search area described more fully below, the portions of the formations that are proposed for exemption are not currently a source of drinking water.

Water Supply Wells: DOGGR's AE request included information about wells in the area proposed for exemption to establish that no drinking water wells draw from the portions of the

aquifer proposed for exemption. The operators searched well records in accordance with a request from the Central Valley Regional Water Quality Control Board to identify wells within a water supply well search area ("study area") that extended at least one mile beyond the proposed boundary of the area proposed for exemption.

The water well inventory was compiled based on data from the State Water Board's GeoTracker GAMA database, DOGGR's Well Finder database, Kern County Environmental Health Department data, Department of Water Resources data, the West Kern Water District (WKWD) 2011 Urban Water Management Plan, and well searches associated with AE proposals in nearby oil fields, including the Cymric, San Ardo, Kern River, Lost Hills, and McKittrick Oil Fields.

DOGGR's water well study identified 28 wells within the study area (see Table 1). One of the wells is a domestic drinking water well, which is screened in the Alluvium and hydraulically isolated from the formations proposed for exemption. The other well types include 4 agricultural/irrigation wells, 12 industrial wells, 1 monitoring well, and 10 wells with no information regarding their use. Seven of these 10 wells are screened in either the Alluvium or Tulare Formation (which are not proposed for exemption), and the 3 remaining wells are unlikely to serve as drinking water wells because there are no habitable structures within at least one-quarter mile of any of the wells based on DOGGR's review of aerial imagery. Due to the distance between the habitable structures and the 3 wells, DOGGR concluded that the habitable structures were not drawing drinking water from the wells.

The nearest municipal service company-owned drinking water well is operated by J. G. Boswell Company, which is located approximately 6.1 miles northeast of the Midway-Sunset Oil Field. Additionally, the WKWD operates 15 active drinking water supply wells that are more than 12 miles northeast of the Midway-Sunset Oil Field. These municipal water supply wells are screened in the Alluvium and are separated from the shallowest aquifer proposed for exemption (the Potter Sands) by approximately 2,500 to 6,000 vertical feet of multiple confining layers. None of the formations proposed for exemption are currently used as a source of drinking water.

Groundwater Flow Patterns: In the Potter Sands, fluid flow is estimated to be to the west, toward the EOR operations; this is based on modeling of injection operations. In the Spellacy Sands and Lower Antelope Sands, groundwater flow is restricted in every direction due to confinement above, below, and laterally (see the next section). Due to the limited permeability of the Miocene Shales, there is no groundwater flow since there is no steaming in the area.

Confinement of the Formations to Groundwater Flow: DOGGR's AE request included information about the vertical and lateral confinement of the Potter Sands, Spellacy Sands, Miocene Shales and Warson Sand, and the Lower Antelope Sands from drinking water sources. (See Figures 3.1 through 3.8.)

Potter Sands

The portion of the Potter Sands, which is the shallowest interval proposed for exemption in DOGGR's request, is present in one contiguous area within both the North Midway-Sunset Area and the Midway Valley area of the Midway-Sunset Oil Field. (See Figures 3.1 through 3.3.)

The Potter Sands are confined above by the Basal Tulare Shale, the Basal San Joaquin/ Etchegoin Shale, and the Miocene Shales. These confining shales are up to 250 to 1,000 feet

thick above the Potter Sands. The average permeability of the Basal Tulare Shale is 4.8 mD; the average permeability of the Basal San Joaquin/Etchegoin Shale is 1.0 mD; and the average permeability of the Miocene Shales is 1.8 mD to 10 mD, based on core data provided in the AE request. Additional evidence of upper confinement is demonstrated by the interpretation of the results of neutron density logs that show depleted oil above the confining layers, and observation well data showing that there is no connectivity between the Potter Sands and the overlying formations.

The Potter Sands are confined below by the impermeable marine Reef Ridge Shale. The average permeability of the Reef Ridge Shale is approximately 4.0 mD, based on core data provided in the AE request.

Lateral confinement on all sides of the portions of the Potter Sands that are proposed for exemption is provided by the Reef Ridge Shale, which encases the Potter Sands. The Reef Ridge Shale has an average permeability of approximately 4.0 mD based on core data provided in the AE request.

- *To the north, northeast, east, and southeast* of the North Midway-Sunset Area, the Potter Sands erode and "pinch out" into the low-permeability Reef Ridge Shale. This confinement is depicted on cross sections that are based on well log data, and maps in the AE request.
- *To the west* of the North Midway-Sunset Area, movement along the McKittrick Thrust Fault has juxtaposed Potter Sands against the impermeable Reef Ridge Shale. Evidence of this confinement is depicted on cross sections that are based on well log and core data provided in the AE request.
- *To the southwest and west* in the Midway Valley Area, the lateral boundary of the area proposed for exemption is defined by an inward pressure gradient caused by differences in the volumes of fluids injected versus fluids produced. DOGGR provided injection and production data showing that a total of 4,181,899,788 bbl of oil and water have been produced between 1920 and 2017. Over the same period, 2,354,460,886 bbl of steam have been injected for EOR, and 8,592,302 bbl of water have been injected for disposal. This results in a net withdrawal of 1,818,846,600 bbl from the Potter Sands within the Midway-Sunset Oil Field.

Spellacy Sands

The portions of the Spellacy Sands proposed for exemption are located in the northern and central areas of the Midway-Sunset Oil Field. (See Figures 3.4 through 3.6.)

In the northern area of the field, the Spellacy Sands are confined above and below by the Miocene Shales. In the central area of the field, the Spellacy Sands are confined above and below by the Basal San Joaquin/Etchegoin and Miocene Shales. These are the same formations that confine the Potter Sands (see above for information about the permeability of these layers). The Miocene Shales above the Spellacy Sands are approximately 100 to 1,800 feet thick and are 100 to several thousand feet thick where they underlie the Spellacy Sands. In the portion of the Midway-Sunset Oil Field where the Spellacy Sands is overlain by the Alluvium, the Alluvium is confined from the Spellacy Sands by a 100 to 1,000 foot-thick Basal Alluvial Clay that has an estimated permeability in the range of 0.15 to 0.58 mD, based on core studies in the nearby McKittrick Flats Oil Field, and corroborated by documented studies of the Basal Alluvial Clay.

Lateral confinement of the Spellacy Sands is provided by the erosional and depositional limits of the sands.

- *To the east:* the Spellacy Sands are laterally confined by the limit of their deposition. That is, the Spellacy Sands "pinch out" into the Miocene Shales, and are no longer present, such that fluid movement is confined by the low-permeability shales. This is depicted on cross sections that are based on well logs provided in the AE request.
- *To the west*: the Spellacy Sands are laterally confined by erosion and terminate at the low-permeability Miocene Shales. This is depicted on cross sections based on well logs and geologic maps in the AE request.
- *In portions of the western boundary* where the Spellacy Sands outcrop to the surface, a negative pressure gradient provides additional confinement of fluids. Injection and production data provided by four operators in the field (representing activity from the early 1900's through 2018) indicate that a total of 2,949,856,635 bbl of fluid have been produced from the Spellacy Sands. Over the same period, 1,723,687,547 bbl of steam have been injected for EOR and 52,459,219 bbl of water have been injected for disposal. This results in a net fluid withdrawal of 1,173,709,869 bbl from the Spellacy Sands within the Midway-Sunset Oil Field, and an inward pressure gradient.

Miocene Shales and Warson Sand

The Miocene Shales (also referred to as Diatomite productive areas) and Warson Sand are present in the northern and central areas of the Midway-Sunset Oil Field. (See Figures 3.7 and 3.8.) These formations are considered a single unit because there is not a clear separation between the formations.

The Warson Sand is contained vertically and laterally by the low-permeability Miocene Shales, as shown on cross sections in the AE request.

Vertical containment of fluids above the Miocene Shales is provided by the erosional limits of the shales, along with the low-permeability San Joaquin/Etchegoin shales and silts. This confinement is depicted on well log-based cross sections in the AE request.

Below the Miocene Shales, and laterally, the low permeability of the shales, and the presence of highly viscous oil in the Miocene Shales impedes fluid migration. This also limits any fluid movement into or out of any sands, including the Warson, Potter, and Spellacy Sands, that are contained (i.e., "embedded") within the Miocene Shales. Evidence for the low permeability of the Miocene Shales is provided by core data (which indicate an average permeability of 1.8 mD to 10 mD) and cross sections, based on well logs in the AE request.

Lower Antelope Sands

The Lower Antelope Sands, which are the deepest portions of the formation proposed for exemption, consist of about 12 discontinuous areas throughout the Midway-Sunset Oil Field. (See Figures 3.5 and 3.6.)

The Lower Antelope Sands are contained within, and therefore confined in all directions by the low-permeability silts and shales of the Miocene Shales. Evidence for the confining nature of these shales is demonstrated through core data provided in the AE request. The discontinuous

nature of the Lower Antelope Sands is illustrated in cross sections based on well logs provided in the AE request.

After reviewing information regarding the location and depth of the existing drinking water wells, groundwater flow within the Potter Sands, Spellacy Sands, Miocene Shales and Warson Sand, and the Lower Antelope Sands, and the lateral and vertical confinement of the formations as described in the AE request, the EPA concludes that the portions of the formations that are proposed for exemption are not currently sources of drinking water and are not hydraulically connected to any domestic or public drinking water supply wells. Therefore, the EPA has determined that the portions of the aquifer proposed for exemption meet the criteria at 40 CFR § 146.4(a).

40 CFR § 146.4(c) *The total dissolved solids content of the ground water is more than 3,000 and less than 10,000 mg/L and it is not reasonably expected to supply a public water system.*

DOGGR provided information on the TDS content of the portions of the four formations proposed for exemption within the Midway-Sunset Oil Field, along with supporting information such as analytical sampling data performed by certified laboratories and log-derived TDS data that support a demonstration that the TDS content of the Potter Sands, Spellacy Sands, Miocene Shales and Warson Sand, and the Lower Antelope Sands are between 3,000 and 10,000 mg/L.

- Potter Sands: 5 samples with measured TDS ranging from 3,802 to 16,606 mg/L (average TDS of 8,150 mg/L) taken from the area of the Potter Sands proposed for exemption were described in the AE request. Additional samples from inside the previously exempted area corroborate these TDS values.
- Spellacy Sands: 10 samples from the proposed exemption area and with measured TDS ranging from 1,200 to 13,155 mg/L (average TDS of 4,849 mg/L) were presented in the AE request. These values are corroborated by measured samples and log-derived values from samples throughout the Spellacy Sands. DOGGR asserted in the AE request, and the State Water Board concurred, that TDS concentrations below 3,000 mg/L are outliers that do not represent true formation water quality because they are freshened by steam injection operations, which involve the injection of steam generated using low-TDS water, prior to the sampling events.
- Miocene Shales and Warson Sand: measured TDS values from the Diatomite productive areas in the northern area (six samples, ranging from 5,750 to 26,628 mg/L, averaging 18,937 mg/L) and the central area (two samples with measured TDS content of 3,115 and 4,047 mg/L) of the Midway-Sunset Oil Field are presented in the AE request.
- Lower Antelope Sands: 35 measured TDS values from samples in some of the discontinuous areas that are proposed for exemption ranging from 4,827 to 28,063 mg/L (averaging 14,571 mg/L) are described in the AE request. According to DOGGR, and as concurred with by the State Water Board, the fact that all the sands in these discontinuous areas were deposited at approximately the same time makes it likely that they have similar fluid chemistry.

Information presented by DOGGR in the AE request indicates that the Potter Sands, Spellacy Sands, Miocene Shales and Warson Sand, and the Lower Antelope Sands are not reasonably expected to supply a public water system due to their poor water quality or limited volume.

- The quality of water in the Potter Sands, the Spellacy Sands, and the Lower Antelope Sands makes them impractical for use as a domestic drinking water supply due to the high TDS content, and the presence of boron, sodium, and chloride at levels that exceed the maximum contaminant level (MCL) in California's Title 22 primary or secondary drinking water standards. Average boron concentrations exceed state standards by 733% in the Potter Sands, by 763% in the Spellacy Sands, and by 1,886% in the Lower Antelope Sands. Average sodium concentrations exceed state standards by 2,306% in the Potter Sands, by 8,316% in the Spellacy Sands, and by 6,507% in the Lower Antelope Sands. Average chloride concentrations exceed state standards by 539% in the Potter Sands, by 3,260% in the Spellacy Sands, and by 2,499% the Lower Antelope Sands. The groundwater in these formations also contains hydrocarbons, rendering them unsuitable for domestic drinking water use.
- For the Miocene Shales and Warson Sand, DOGGR explains that the low permeability of these formations and the limited quantity of water that could be drawn from these impermeable shales, and the sands within them, makes drawing quantities of water for drinking water supply technically challenging and therefore economically infeasible, relative to shallow, more permeable formations.

DOGGR and the current operators compared potential water treatment costs to local utility data to demonstrate that treating the water from the portions of the formations proposed for exemption would be economically infeasible. The operators estimated the cost of treating groundwater to meet drinking water standards based on the TDS content and the concentrations of chloride and boron reported above. The AE request included the calculated costs of pumping groundwater from the formations, applying reverse osmosis treatment to remove TDS, chloride, and boron at the levels present, and delivering water to nearby communities. These cost estimates were based on the quality of groundwater in the Tulare Formation in the Midway-Sunset Oil Field and assumptions about water usage by nearby communities. DOGGR explained that these cost estimates are applicable to the Potter Sands, Spellacy Sands, and the Lower Antelope Sands due to the similar concentrations of the contaminants in these formations. Further, all the portions of the formations proposed for exemption are deeper than the Tulare Formation, which would result in higher pumping costs. As noted above, the low permeability of the Miocene Shales and Warson Sand makes drawing water from these formations for drinking water supply economically infeasible, relative to shallow, more permeable and higher quality formations.

The cost estimate concluded that treating this groundwater to meet drinking water standards could result in an annual water charge per household of $4,840, a nearly eight-fold increase in the current average annual household water cost of $600 in Kern County.

Although the WKWD experiences water shortages and reductions in supply due to current drought conditions, its supplies and entitlements are adequate to meet its current and long-term needs. Additionally, ample groundwater northeast of the area proposed for exemption is readily available to the WKWD, which can also acquire water from several nearby water districts. These waters are less costly to treat and are more readily available to meet present and future needs.

The AE request includes a letter from the WKWD to DOGGR stating that it does not own or lease any land in the areas proposed for exemption on which to construct water wells, water

transmission infrastructure, or water treatment facilities, and that no such construction activities are planned by the WKWD. The WKWD indicated that it has no plans to treat formation water in the Midway-Sunset Oil Field for municipal uses due to the significant costs of treatment, and the lack of demand for additional water resources beyond those that are available to the WKWD.

To meet future water supply needs, the WKWD stated that it plans to increase its production capacity by constructing new wells in the north well field, which was previously unavailable to the District. The new wells will nearly double WKWD's current capacity from 55,000 to up to 100,000 acre-feet/year of water. Although current demand is well below the production capacity, this highly industrialized region will be able to sustain its industrial and domestic demands more effectively with the new wells. WKWD states that it has sufficient supply and banked water that exceeds the production capacity. Based on their review of all information provided, including the WKWD's Urban Water Management Plan (UWMP), which evaluated the water supply's reliability and its ability to meet future water needs through the year 2040, DOGGR concluded that the WKWD has adequate supplies from currently developed groundwater-bearing zones to meet expected population growth.

Based on a review of the submitted information, the EPA has determined that the portions of the Potter Sands, Spellacy Sands, Miocene Shales and Warson Sand, and the Lower Antelope Sands proposed for exemption in the Midway-Sunset Oil Field contain between 3,000 mg/L and 10,000 mg/L TDS and are not reasonably expected to supply a public water system. As such, the EPA has determined that the aquifer proposed for exemption meets the criteria at 40 CFR § 146.4(c).

PUBLIC NOTICE AND COMMENT

DOGGR provided public notice of this proposed AE on November 6, 2018 and held a public hearing in Bakersfield, CA on December 6, 2018. The public comment period closed on December 6, 2018. DOGGR provided the EPA a summary of the single, written public comment it received, a copy of the written public comment, a transcript of the public hearing, DOGGR's acknowledgement of the oral comments made at the public hearing, and DOGGR's written responses to the written comment.

In making this decision, the EPA considered all the information submitted by the State, including the comments made during the public hearing, and the written comment submitted to the State during its public comment process. Specific responses not addressed by DOGGR are provided below.

The commenter (The Center for Biological Diversity) wrote to DOGGR and commented that the EPA should reject the aquifer exemption request before an environmental review has occurred under the National Environmental Policy Act (NEPA). The EPA believes that the public comment and hearing process afforded by DOGGR, the technical analysis to protect USDWs required in the aquifer exemption proposal process under the EPA's UIC regulations, and the enabling legislation in the SDWA provide a functionally equivalent environmental review for this decision.

The same commenter also raised concerns regarding protection of listed species and critical habitat under the federal Endangered Species Act (ESA). After consideration of this issue, the EPA has determined that ESA consultation is not required because the AE approval has no effect

on any listed threatened or endangered species or the designated critical habitat of such species. The EPA's conclusion is based on a number of considerations. First, the AE approval under the SDWA changes the jurisdictional status of a confined aquifer that is hundreds to thousands of feet underground. No species of concern are present in the subsurface portions of the aquifer considered in the EPA's approval action, and it is unclear or speculative whether any listed species or critical habitat overlaps with the surface-level activities. In addition, the EPA's approval of the AE is only one preliminary step in the process leading to potential fluid injection into the aquifer, with many additional steps (including state actions and decisions and actions by third party operators) that must occur prior to injection and prior to any potential effects to protected species or habitat at the surface. Thus, EPA would not be the legal cause of potential effects to listed species or designated critical habitat, if any.

Additionally, the commenter questioned whether the current AE criteria reflect changing climate conditions and modern water treatment technologies. In considering whether the aquifer proposed for exemption cannot now and will not in the future serve as a source of drinking water, the EPA reviewed data regarding the level of contaminants in the groundwater and information about the presence of ample high-quality shallow water that is available to meet current and future drinking water demand. As discussed above, even with the potential for improved treatment technology and higher demand for drinking water due to drought or scarcity, other nearby aquifers would continue to provide an adequate, economically feasible supply of higher quality water for public water systems. As a result, the EPA concluded the aquifer is not reasonably expected to supply a public water system.

CONCLUSION AND DECISION

Based on a review of the entire record, including all written and oral comments submitted to DOGGR during its public comment process, EPA finds that the exemption criteria at 40 CFR § 146.4(a) and § 146.4(c) have been met, and EPA approves the AE request as a non-substantial program revision.

Effective Date: May 30, 2019

Figure 1: Location of the Midway-Sunset Oil Field, Kern and San Luis Obispo Counties, California

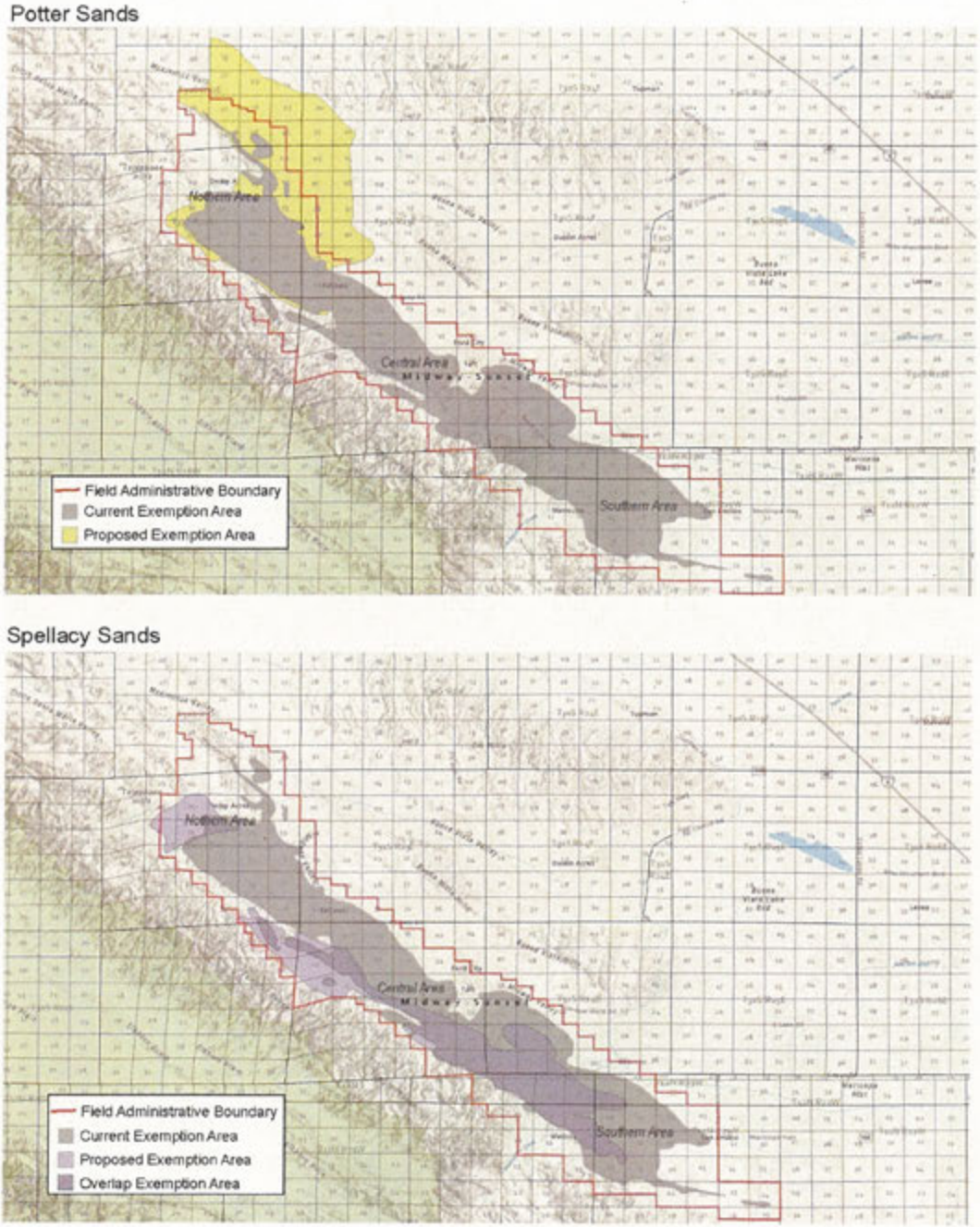
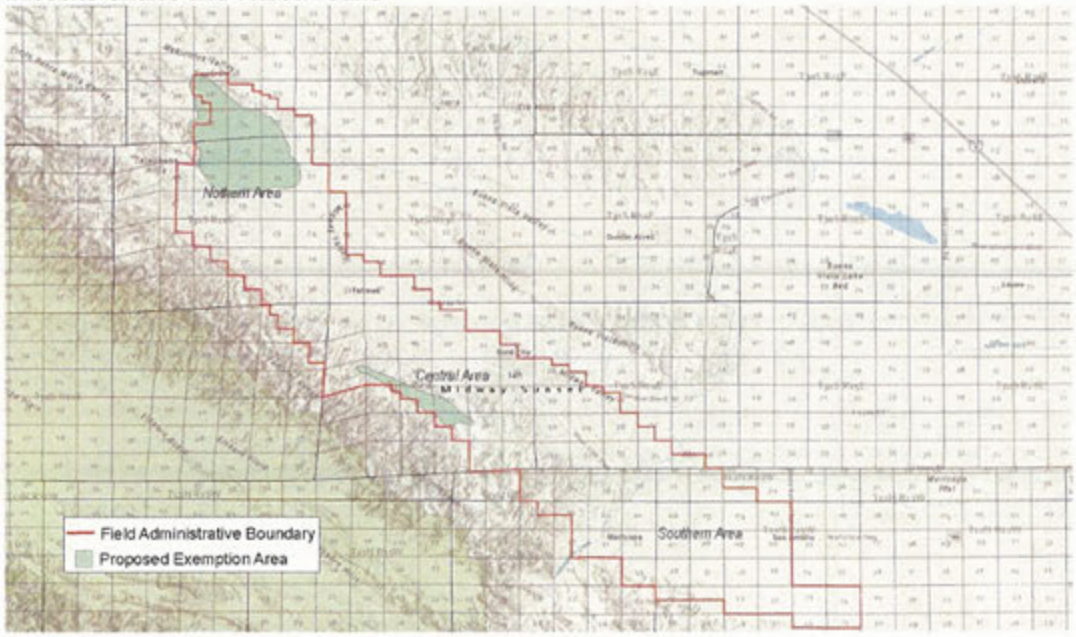
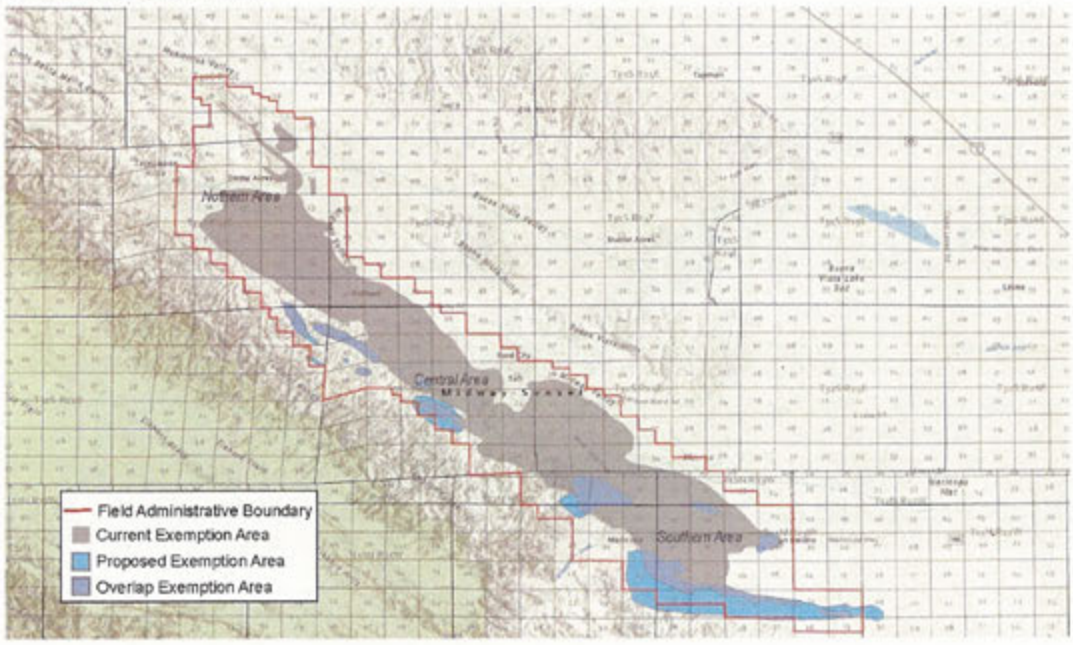


Figure 1: Location of the Midway-Sunset Oil Field, Kern and San Luis Obispo Counties, California (continued)

Miocene Shales and Warson Sand

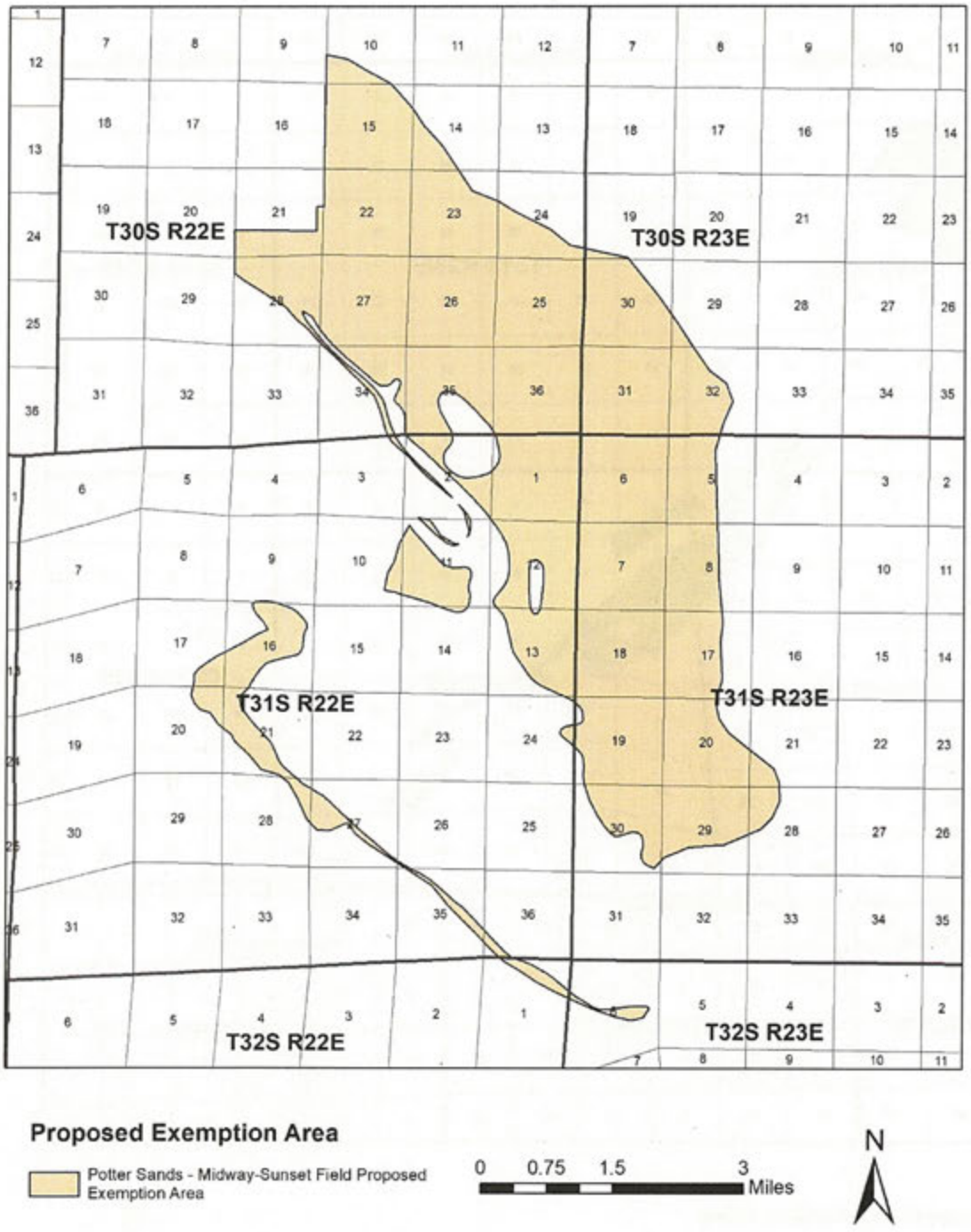


Lower Antelope Sands



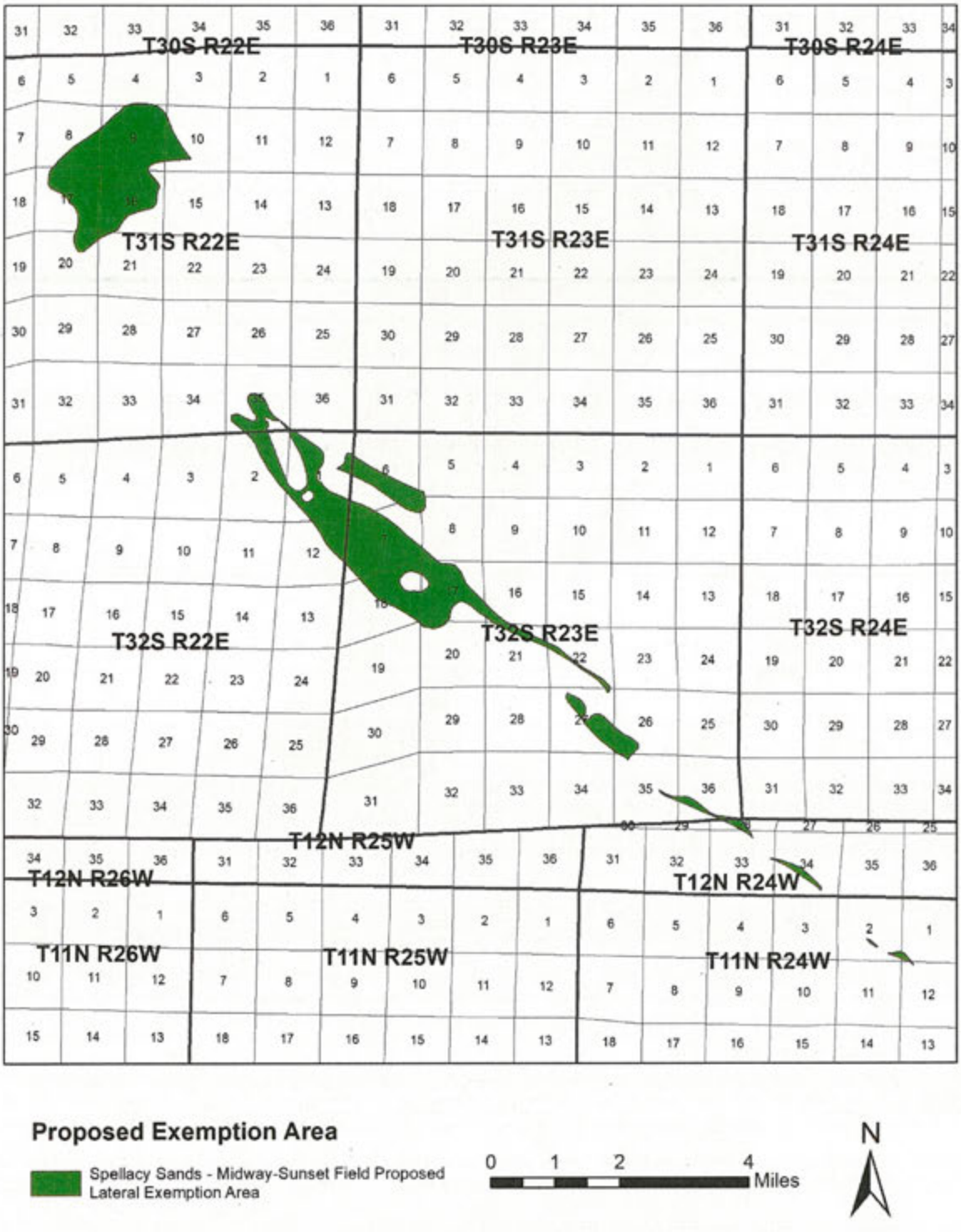
Source: DOGGR's Aquifer Exemption Application for the Midway-Sunset Oil Field

Figure 2.1: Potter Sands Aquifer Exemption Location Map, Midway-Sunset Oil Field, Kern and San Luis Obispo Counties, California



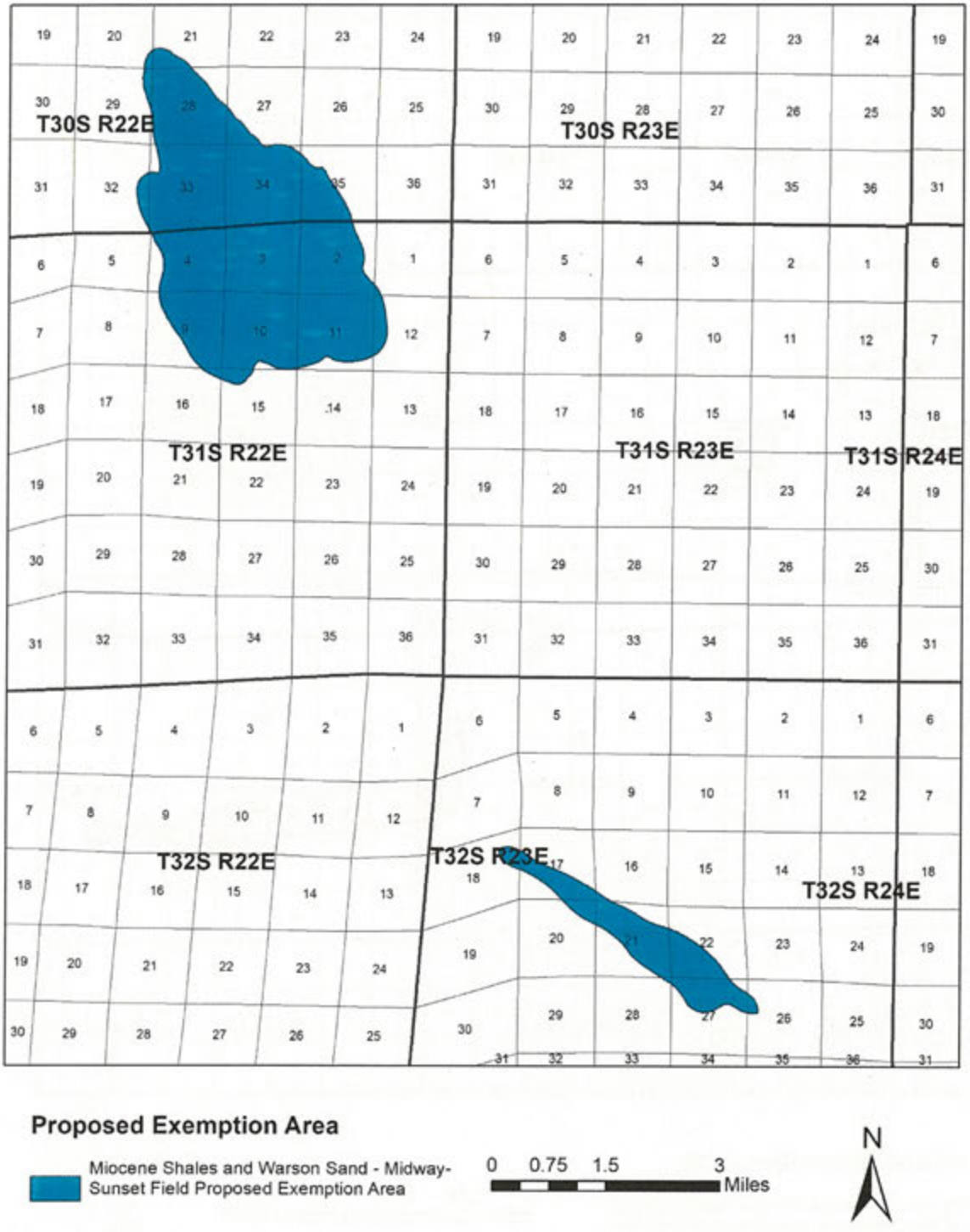
Source: DOGGR's Aquifer Exemption Application for the Midway-Sunset Oil Field

Figure 2.2: Spellacy Sands Aquifer Exemption Location Map, Midway-Sunset Oil Field, Kern and San Luis Obispo Counties, California



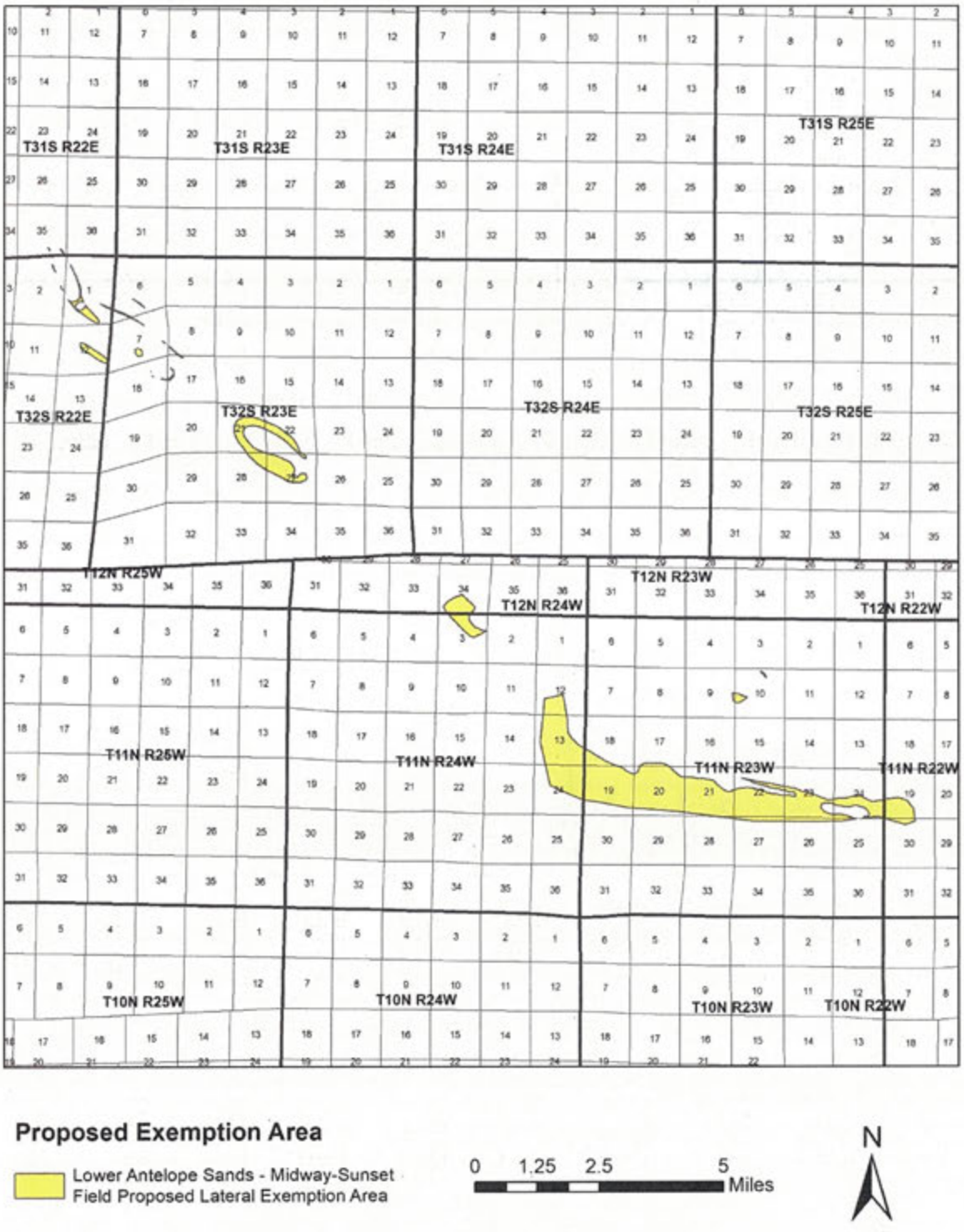
Source: DOGGR's Aquifer Exemption Application for the Midway-Sunset Oil Field

Figure 2.3: Miocene Shales and Warson Sands Aquifer Exemption Location Map, Midway-Sunset Oil Field, Kern and San Luis Obispo Counties, California



Source: DOGGR's Aquifer Exemption Application for the Midway-Sunset Oil Field

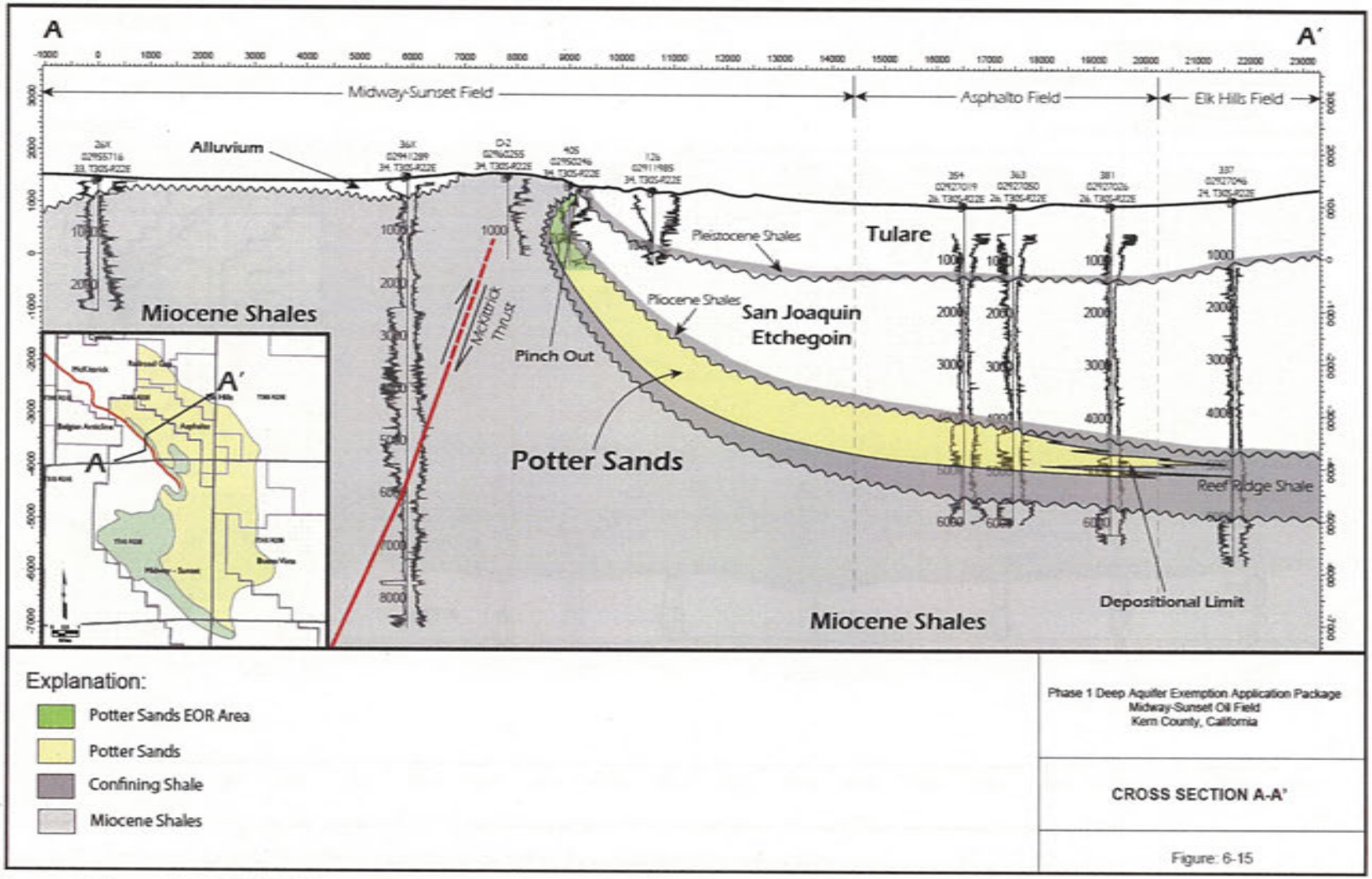
Figure 2.4: Lower Antelope Sands Aquifer Exemption Location Map, Midway-Sunset Oil Field, Kern and San Luis Obispo Counties, California



Source: DOGGR's Aquifer Exemption Application for the Midway-Sunset Oil Field

Figure 3.1: Cross Section A-A' across the Potter Sands Aquifer Exemption Area

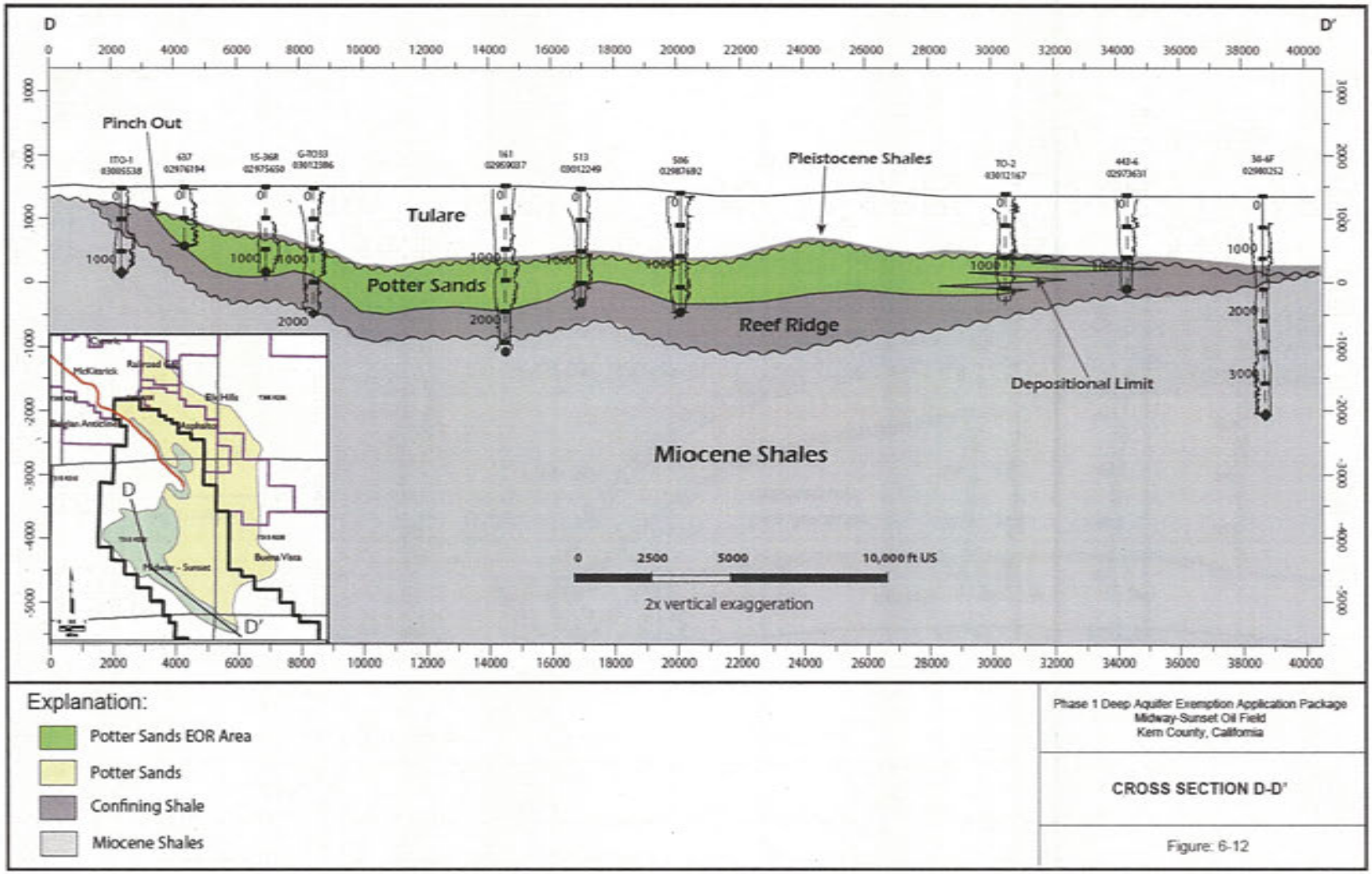
Midway-Sunset Oil Field, Kern and San Luis Obispo Counties, California



Source: Figure 6-15, DOGGR's Aquifer Exemption Application for the Midway-Sunset Oil Field

Figure 3.2: Cross Section D-D' across the Potter Sands Aquifer Exemption Area

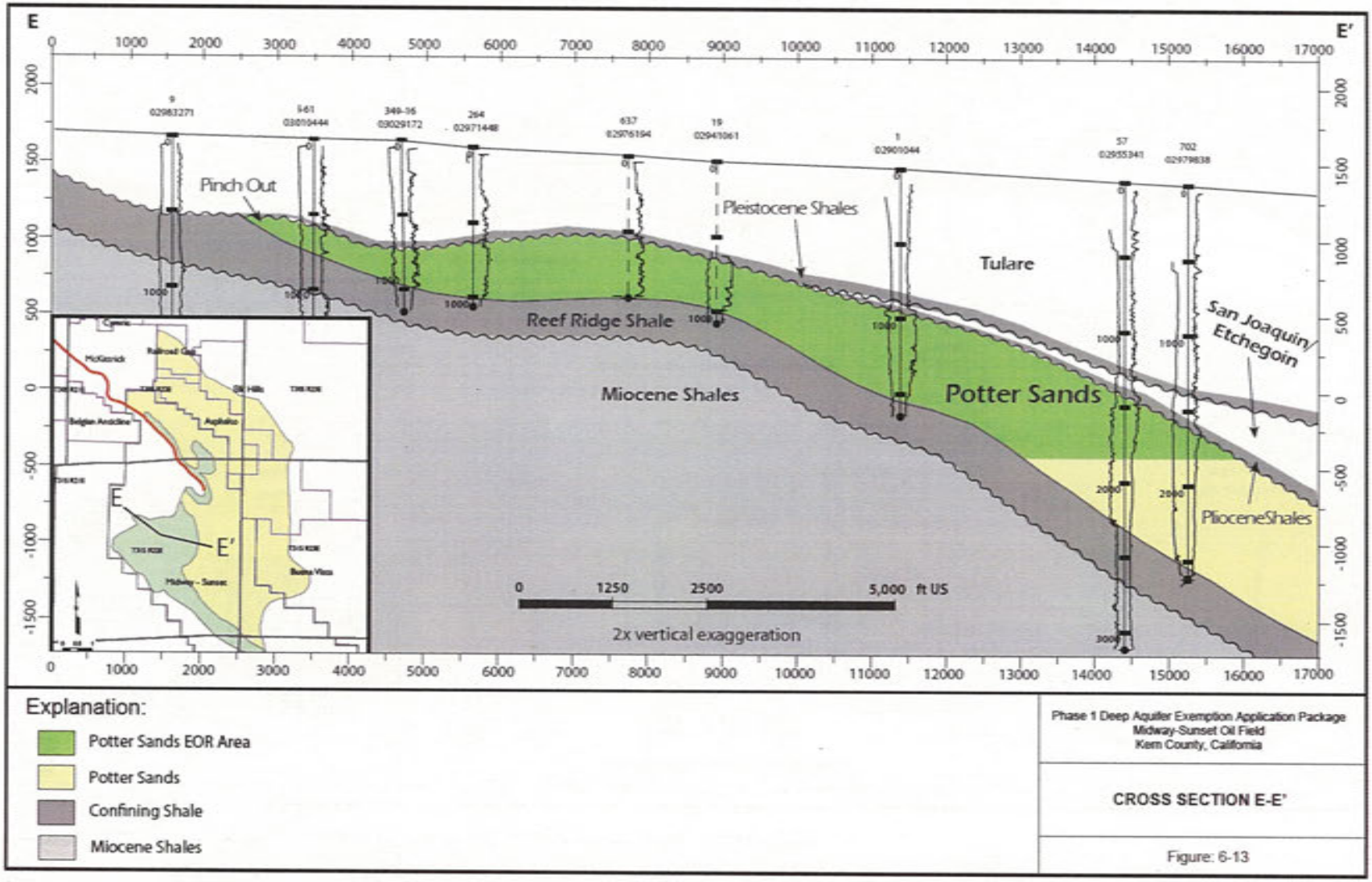
Midway-Sunset Oil Field, Kern and San Luis Obispo Counties, California



Source: Figure 6-12, DOGGR's Aquifer Exemption Application for the Midway-Sunset Oil Field

Figure 3.3: Cross Section E-E' across the Potter Sands Aquifer Exemption Area

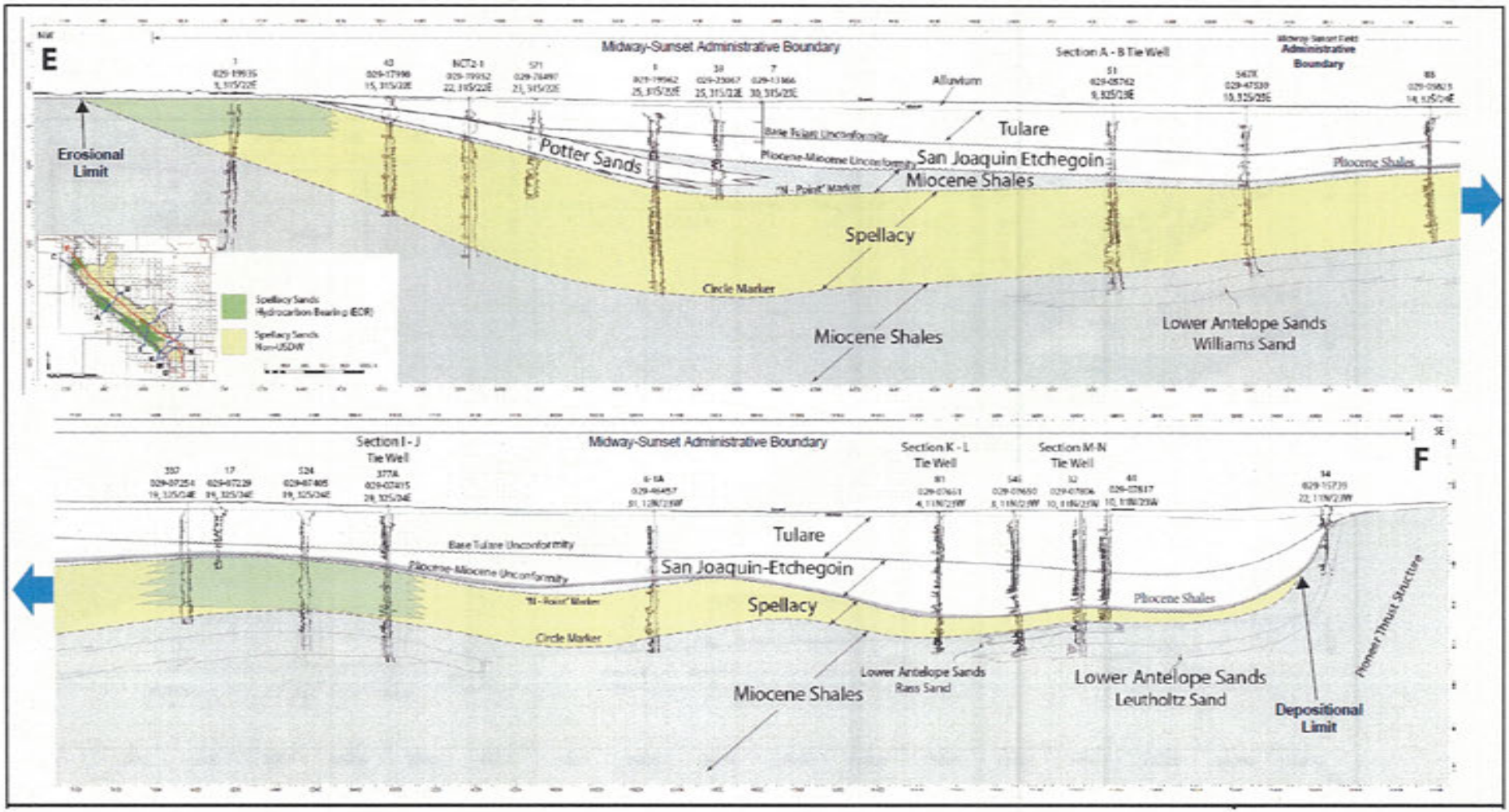
Midway-Sunset Oil Field, Kern and San Luis Obispo Counties, California



Source: Figure 6-13, DOGGR's Aquifer Exemption Application for the Midway-Sunset Oil Field

Figure 3.4: Cross Section E-F across the Spellacy Sands Aquifer Exemption Area

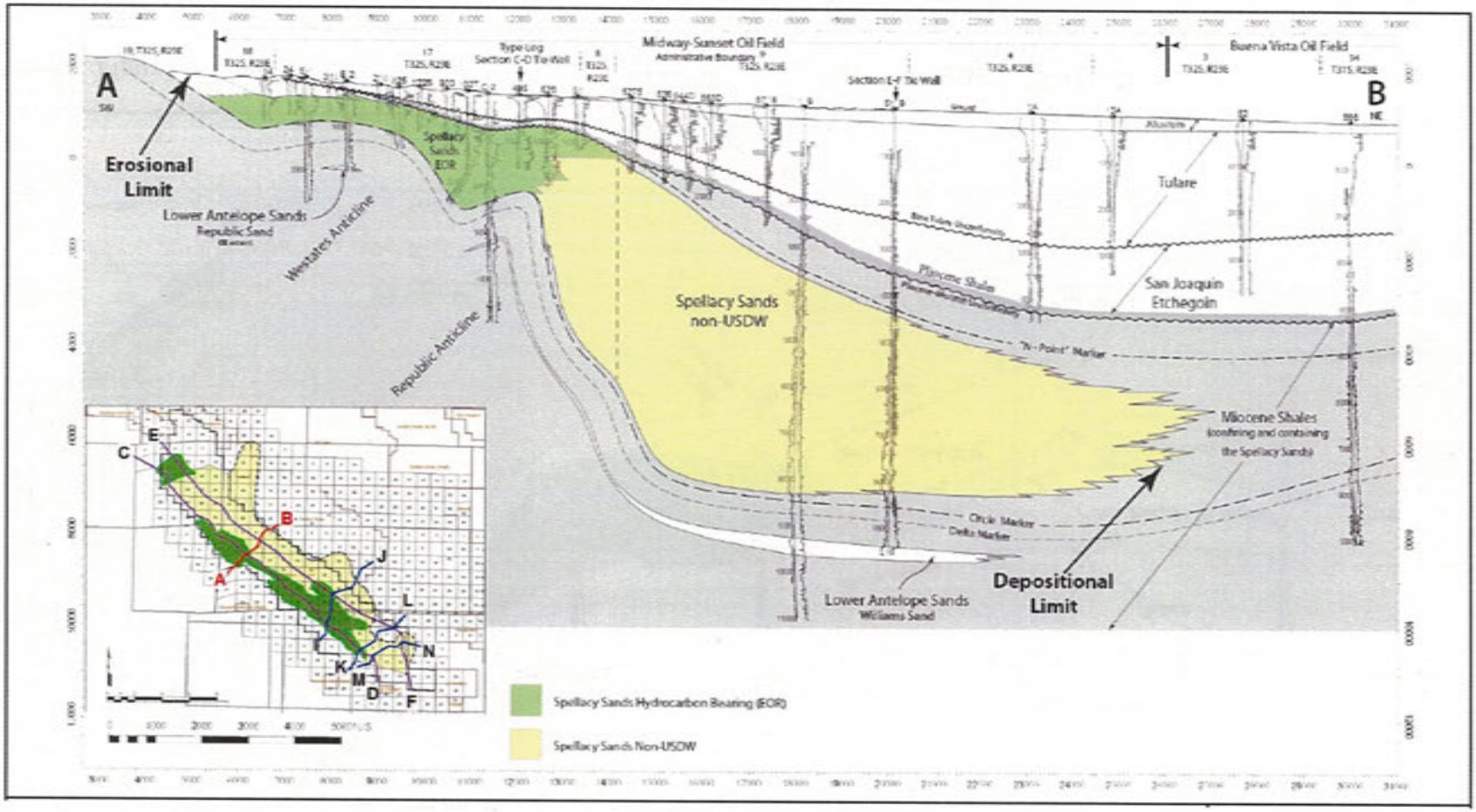
Midway-Sunset Oil Field, Kern and San Luis Obispo Counties, California



Source: Figure 7-8, DOGGR's Aquifer Exemption Application for the Midway-Sunset Oil Field

Figure 3.5: Cross Section A-B across the Spellacy Sands and Antelope Sands Aquifer Exemption Areas

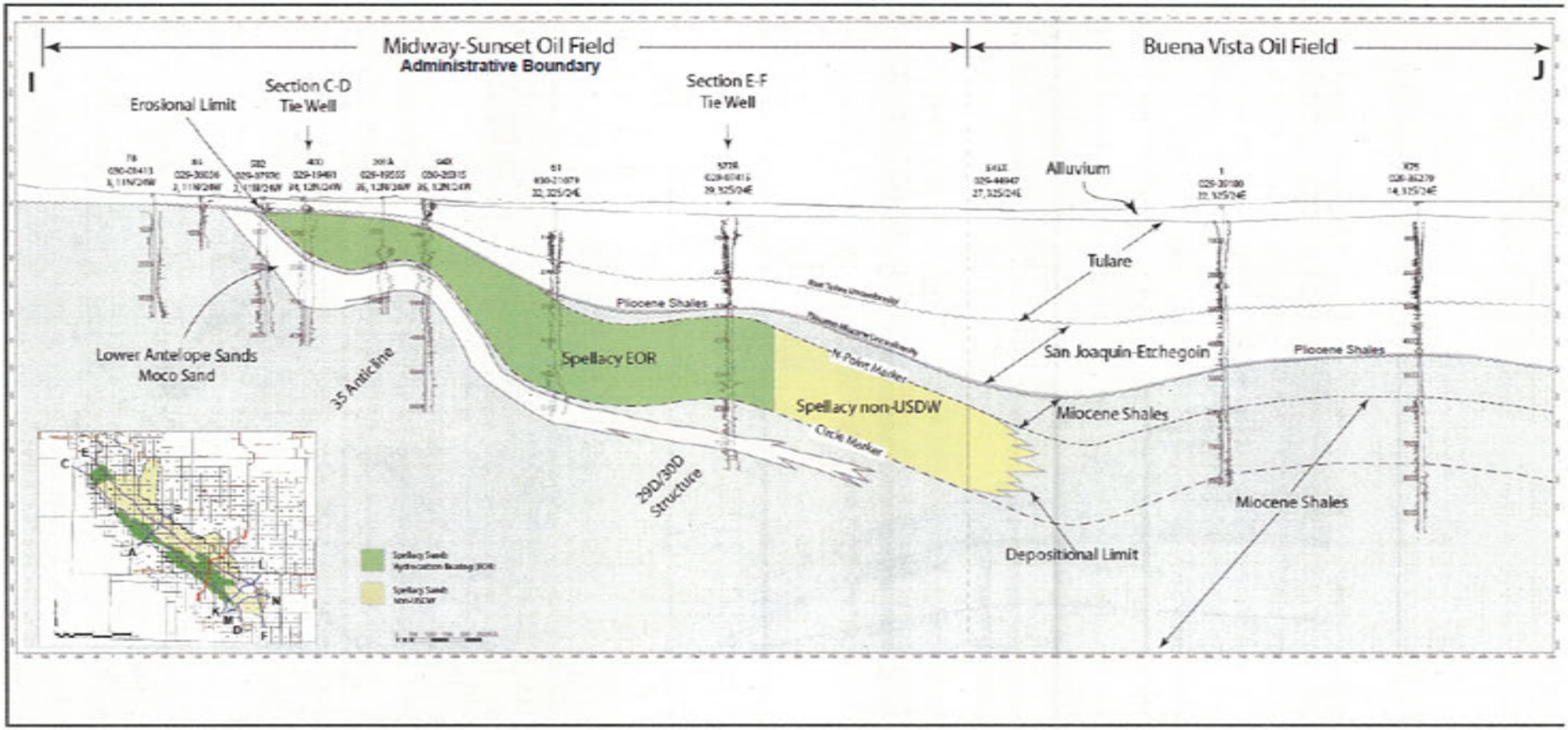
Midway-Sunset Oil Field, Kern and San Luis Obispo Counties, California



Source: Figure 7-6, DOGGR's Aquifer Exemption Application for the Midway-Sunset Oil Field

Figure 3.6: Cross Section I-J across the Spellacy Sands and Antelope Sands Aquifer Exemption Areas

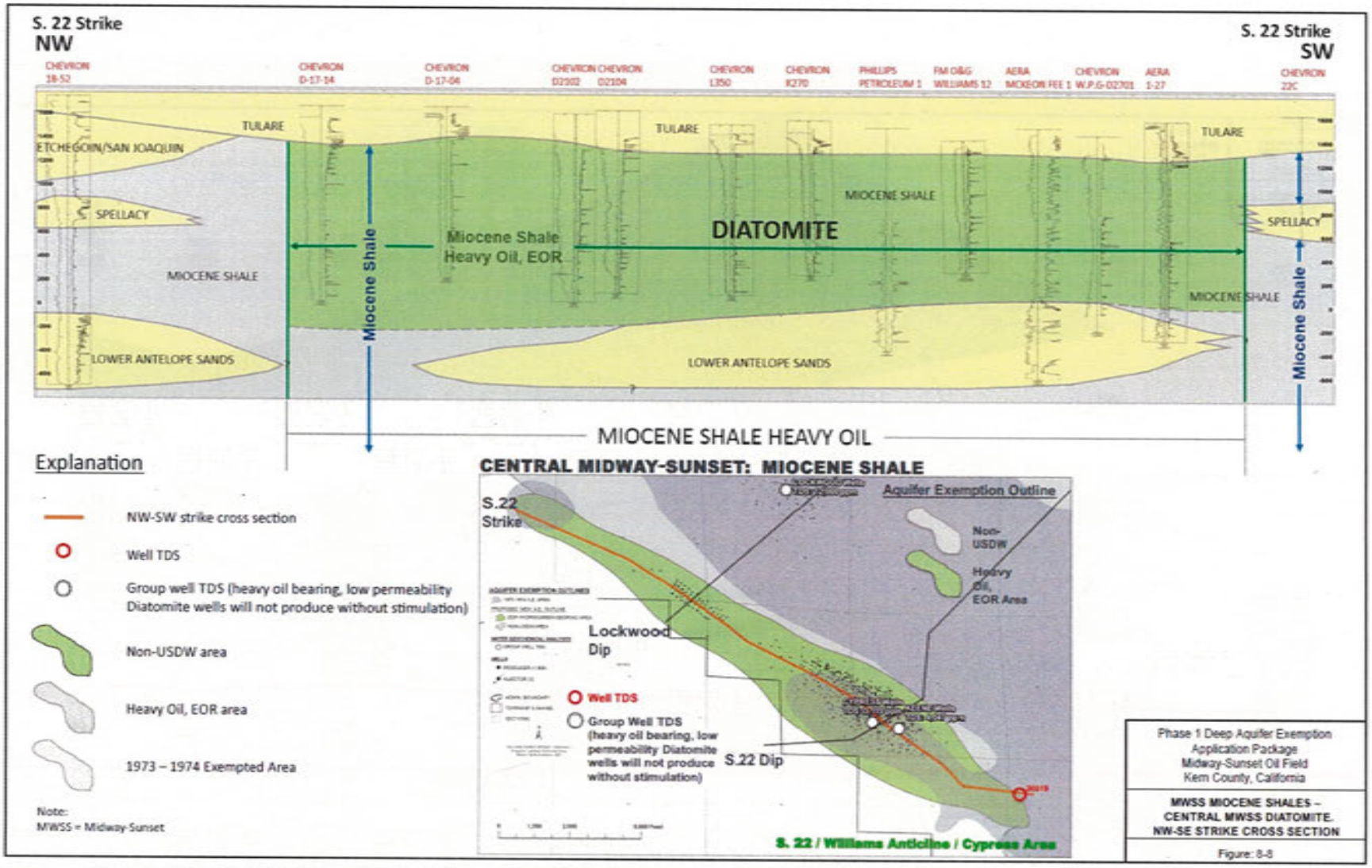
Midway-Sunset Oil Field, Kern and San Luis Obispo Counties, California



Source: Figure 7-9, DOGGR's Aquifer Exemption Application for the Midway-Sunset Oil Field

Figure 3.7: NW-SE Cross Section across the Miocene Shales Aquifer Exemption Area

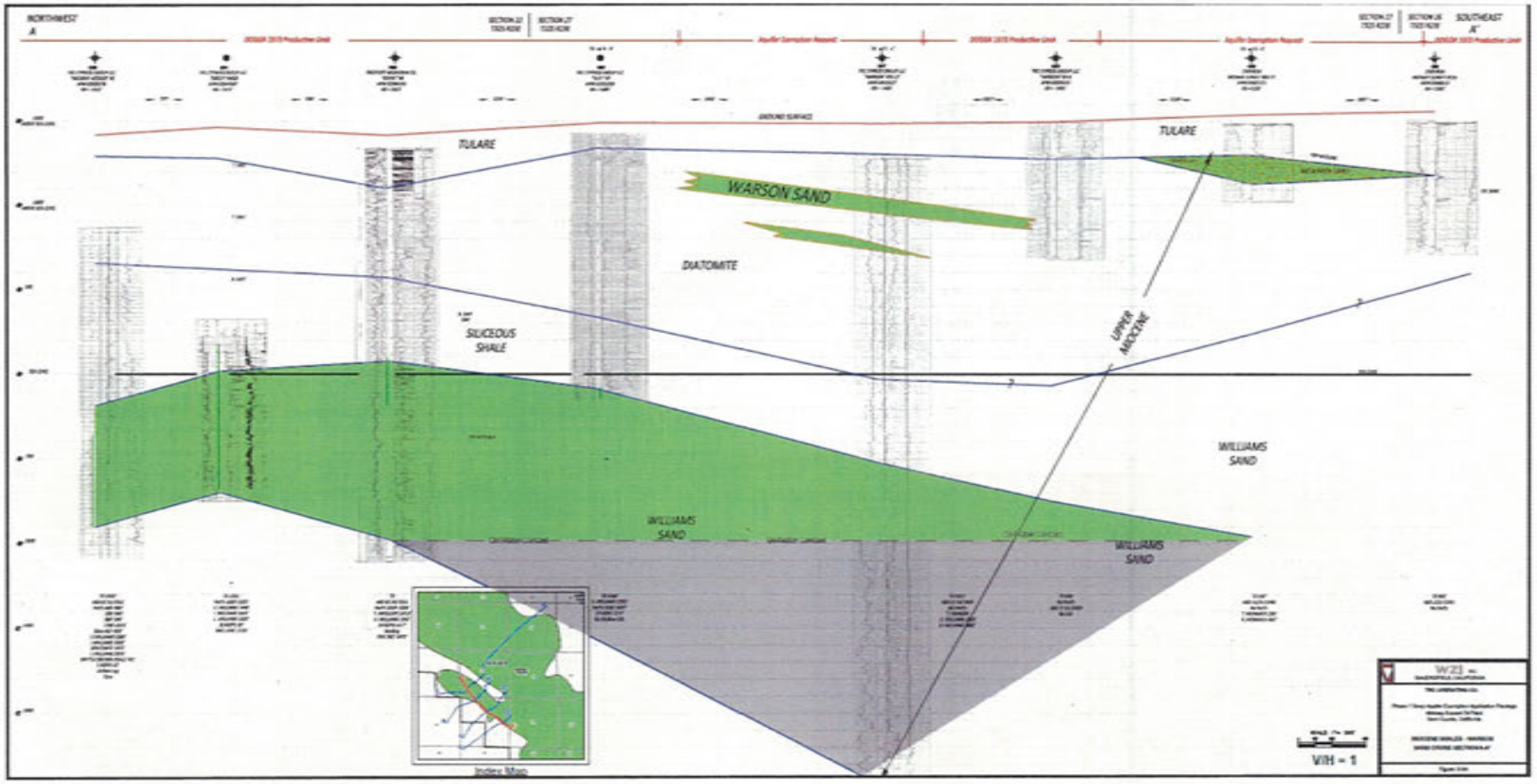
Midway-Sunset Oil Field, Kern and San Luis Obispo Counties, California



Source: Figure 8-8, DOGGR's Aquifer Exemption Application for the Midway-Sunset Oil Field

Figure 3.8: Cross Section A-A' across the Miocene Shales and Warson Sands Aquifer Exemption Area

Midway-Sunset Oil Field, Kern and San Luis Obispo Counties, California



Source: Figure 8-8A, DOGGR's Aquifer Exemption Application for the Midway-Sunset Oil Field

Table 1: List of Water Supply Wells

Well ID/ Name	Water Well Type	Distance from proposed area (feet)	Total Depth of Well (feet bgs)	Top of Well Screen (feet bgs)	Geologic Formation in Screen/Perf Interval[2]	Location					
						Township	Range	Section	Latitude	Longitude	Address (or Description) of Well
T11N/R22W-19D	Industrial	857				11N	22W	19D	35.029533	-119.27487	
011N022W19M0015; USGS 350129119162601	Unspecified	1,149	1,333	614	Tulare	11N	22W	19M	35.024722	-119.27389	2280' due north and 4422' due west from the southeast corner of Section; well name San Emidio A 25-19
WP10978	Domestic	1,094 from both field and AE boundaries	490	350	Alluvium	11N	23W	2	35.070621	-119.31012	150 feet east of Basic School Road and 135 feet north of southern fence line, 50 feet east of the mobile home at site, APN: 23913105; owner well # BSR-01-08
T12N/R23W-28; 28P1	Unspecified	1,801	702	280	Alluvium	12N	23W	28	35.091757	-119.34349	
EH-367-89	Industrial	Within	1,000	400	Tulare	12N	23W	31	35.089735	-119.37047	Replacement well of EH-366-89. ~2 miles east of HWY 33 and ~1mile north of Kerto Road. APN: 220-201-17
12N023W31A0015; USGS 350528119221101; API 02932908	Industrial	Within	760	490	Tulare	12N	23W	31B	35.090426	-119.37205	1.5 miles east of highway 33, 0.5 north of Kerto Road
T12N/R23W-31B	Industrial	Within	740	500	Tulare	12N	23W	31B	35.089033	-119.37375	
API 02932908	Industrial	Within	775		Tulare	12N	23W	31E	35.090426	-119.37205	1465' westerly along Sec line & 220' Southerly at 90 degrees from NE corner
API 02932907	Industrial	Within	770	500	Tulare	12N	23W	31E	35.090754	-119.37199	1450' westerly along section line, and 100' southerly at R/A, from NE corner section; well WW2
API 02932906	Industrial	Within	1225	650	Tulare	12N	23W	31E	35.090141	-119.36864	WW #1; 300' south and 450' west at 90 degrees from northeast corner sec. 31E

Table 1: List of Water Supply Wells (continued)

Well ID/ Name	Water Well Type	Distance from proposed area (feet)	Total Depth of Well (feet bgs)	Top of Well Screen (feet bgs)	Geologic Formation in Screen/Perf Interval[1]	Location					
						Township	Range	Section	Latitude	Longitude	Address (or Description) of Well
300668-T32S/R23E-14	Industrial	Within	300	NA	Tulare	32S	23E	14	35.146765	-119.47913	Somewhere in West of Hwy33 and ~250 feet south of Wade Ave. near 1441 Wade Ave. Taft, CA
T32S/R24E-26C1	Unspecified	4,240		550	Tulare	32S	24E	26C	35.119142	-119.37098	NE 1/4 of Sec. 26
T32S/R24E-26Q1	Unspecified	2,907			unknown	32S	24E	26Q	35.109234	-119.36374	unreadable
USGS-350640119223001	Monitoring[2]	979	699		Alluvium/Tulare Undifferentiated	32S	24E	27	35.111054	-119.37646	
API 02938541	Industrial	Within			unknown	32S	24E	28	35.111304	-119.41142	Pyramid Oil Company well #6; production well
API 02968654	Industrial	Within	1,050	550	Tulare	32S	24E	35D	35.094148	-119.37197	Chevron well #1; 1300 ft easterly along section line and 100 feet northerly at right angles to said line from the southwest corner of section 35D
T32S/R24E-35N2	Industrial	Within	928	509-913	Tulare	32S	24E	35N	35.096158	-119.37412	
T32S/R24E-35N; USGS 350539119221501	Industrial	Within	784	484	Tulare	32S	24E	35N	35.095216	-119.37455	Well 35D1 is located SW corner of Section 35; 3.5 miles east of hwy 33, 1/4 south of Cadet road
T32S/R24E-36A1	Unspecified	4,505	752	452	Alluvium	32S	24E	36A	35.105381	-119.34359	0.35 miles NW from Gardner Field Rd., 100' NE of Taft Rd.
T32S/R24E-36A2	Unspecified	4,463	750	256	Alluvium	32S	24E	36A	35.105377	-119.344	
T32S/R24E-36A1	Agriculture	4,463	1000		Alluvium	32S	24E	36A	35.105377	-119.344	APN #22005026
T32S/R25E-31L1	Irrigation	4,723	956	397	Alluvium	32S	25E	31L	35.099518	-119.33534	
32S25E31L001M	Irrigation	4,723	804		Alluvium	32S	25E	31L	35.099518	-119.33534	300' south of Gardner Field Rd. 7.6 miles east of US 399
T32S/R25E-31N1	Unspecified	5,022			unknown	32S	25E	31N	35.0948	-119.32188	
T32S/R25E-31P1	Unspecified	4,411	665		Alluvium	32S	25E	31P	35.096593	-119.33517	
T32S/R25E-31R1	Unspecified	5,001			unknown	32S	25E	31R	35.096225	-119.32507	
T32S/R25E-32N1	Unspecified	3,393	1010		Alluvium	32S	25E	32N	35.095983	-119.33856	
T32S/R25E-32N2	Irrigation	3,393	952	450	Alluvium	32S	25E	32N	35.095983	-119.33856	

[1] Interpreted from total depth of well and, where available, top of well screen; unknown = insufficient information.

[2] This well is assumed to be a monitoring well, based on aerial imagry data and its association to the USGS.

Source: DOGGR's Aquifer Exemption Application for the Midway-Sunset Oil Field