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

June 7, 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 North Belridge Oil Field, Kern County, 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 Tulare Formation in the North Belridge Oil Field in Kern County, 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 portions of the formations proposed for exemption in the field do not currently serve as sources of drinking water; and
- The portions of the formations proposed for exemption in the field cannot now and will not in the future serve as sources of drinking water because they are commercially hydrocarbon-producing.

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,

June 7, 2019

Tomás Torres
Director, Water Division

Enclosures: Aquifer Exemption Record of Decision for North Belridge Oil Field
GIS Shape Files of Approved Aquifer Exemption
Final North Belridge Exemption Application
Letter from Kenneth Harris to David Albright dated June 6, 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

NORTH BELRIDGE OIL FIELD – TULARE FORMATION

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 Tulare Formation in the North Belridge 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: November 13, 2018

Exemption Criteria: DOGGR requests this exemption because it has determined that it meets the criteria at 40 CFR § 146.4(a) and § 146.4(b)(1).

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: Aera Energy LLC and Greka Oil & Gas Inc.

Well/Project Name: The Tulare Formation in the North Belridge Oil Field.

Well/Project Permit Number: There are currently 3 Class II enhanced oil recovery (EOR) wells in the area proposed for exemption in the North Belridge Oil Field. 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 underlies Township 27 South, Range 20 East, Sections 25, 26, 35, and 36; Township 28 South, Range 20 East, Sections 1 and 2; and Township 28 South, Range 21 East, Section 6, Mount Diablo Base and Meridian (MDB&M). [Refer to Figure 1.]

County: Kern **State:** California

Current Well Class/Type: Class II EOR.

DESCRIPTION OF PROPOSED AQUIFER EXEMPTION

Aquifer to be Exempted: Portions of the Tulare Formation within the North Belridge Oil Field.

Areal Extent of Aquifer Exemption: The areal extent of the existing AE and the proposed expansion in the North Belridge Oil Field is approximately 2,998 acres. This acreage includes 2,666 oil-productive acres that EPA exempted at the time California received primacy in 1983, and approximately 332 acres comprising the oil producing area outside the existing exemption boundaries. DOGGR provided GIS shape files that delineate the AE boundaries, which are included in the administrative record for this ROD. See Figure 2 for a depiction of the portions of the formation that are proposed for exemption.

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

Formation	Tulare Formation.
Lithology	Sands interbedded with low-permeability clay layers.
TDS (mg/L)	6,055 to 22,540 mg/L.
Depth to Top	Ranges from 0 to 300 feet below ground surface (bgs) from -30 to -300 feet relative to mean sea level (MSL).
Thickness (feet)	350 to 1,200 feet.
Porosity and Permeability	Porosity ranges from 30% to 40%. Permeability ranges from 35 to 4,000 millidarcies (mD).

Confining Zone(s): In the North Belridge Oil Field, the Tulare Formation is confined above by the low-permeability clays of the Upper Tulare Formation and below by the low-permeability Etchegoin Formation and Upper Diatomite Zone. Lateral confinement in the area proposed for exemption is provided by geologic structural controls and an inward pressure gradient (i.e., a "pressure sink" caused by the withdrawal of fluids). See Figures 3.1 through 3.4.

BACKGROUND

On November 13, 2018, the EPA received a request from DOGGR to exempt portions of the Tulare Formation of the North Belridge Oil Field, in Kern County, 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(b)(1): it cannot now and will not in the future serve as a source of drinking water because it is mineral, hydrocarbon, or geothermal energy-producing, or can be demonstrated by a permit applicant as part of a permit application for a Class II or III operation to contain minerals or hydrocarbons that considering their quantity and location are expected to be commercially producible. After the EPA's approval of the AE, the exempt formation would not be protected as an "underground source of drinking water" (USDW) under the Safe Drinking Water Act (SDWA) and DOGGR would be authorized, subject to state regulatory requirements, to approve Class II injection into the identified formation.

As noted above, 3 Class II EOR wells are currently permitted for injection into the expanded portions of the formation 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 Tulare Formation that are 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's determination was based 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 Tulare Formation proposed for exemption. In addition, the formation is 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 formation. Further, within the State's water well search area (described more fully below), the portions of the Tulare Formation that are proposed for exemption are not currently a source of drinking water.

Water Supply Wells: DOGGR's AE request included information about the state's efforts to identify wells in the area proposed for exemption to establish that no drinking water wells draw water from the portions of the aquifer proposed for exemption. The applicant searched for wells within a water supply well search area ("study area") that extended 1 mile beyond the boundary of the area proposed for exemption. This area was selected to expand upon the one-quarter mile review area recommended in EPA's Guidance 34 to ensure that a complete review of all water wells was performed.

The water supply well search, which did not locate any wells, involved reviewing water well data from the State Water Board, Kern County Environmental Health Department, and the California Department of Water Resources. In addition to the data searches, DOGGR staff field verified that there were no water supply wells within the one-mile study area.

The Spicer City Water System's wells, which are the nearest municipal water supply wells, are approximately 11 miles east of the field. The Spicer City wells are completed below the Corcoran Clay at an approximate depth of 535 to 650 feet bgs. The Corcoran Clay is immediately above the Tulare Formation; however, DOGGR has determined that, based on their distance from the North Belridge Oil Field, the results of a radius of influence calculation, and the induced pressure sink created by oil production in the Tulare Formation, injected fluids will not affect the Spicer City wells.

Finally, DOGGR contacted the local water districts (Lost Hills and Belridge Water Storage Districts) and state staff met with the nearby Buttonwillow County Water District regarding the

North Belridge proposed AE to confirm that neither the districts nor any individual growers operate wells within 1 mile of the proposed AE boundary.

Groundwater Flow Patterns: Fluid flow in the portions of the Tulare Formation proposed for exemption is toward the producing wells in the center of the field (i.e., from high to low pressure) and away from the boundaries of the area proposed for exemption. This is because in the North Belridge field more fluid is withdrawn from the aquifer than is injected, as shown by injection and production data and an evaluation of fluid level data in idle wells.

Confinement of the Formation to Groundwater Flow: Confinement above the portions of the Tulare Formation that are proposed for exemption is provided by the regionally extensive, discontinuous, overlapping low-permeability clays of the Upper Tulare Formation. While the clays are not continuous throughout the area proposed for exemption, they are continuous over short distances and range from 2 to 30 feet thick. Evidence of the confining nature of the clays is a lack of oil seeps in the North Belridge Oil Field, and the trapping of oil over geologic time, as well as the trapping of steam that is injected to recover oil. Samples from Upper Tulare Formation clays in the nearby South Belridge Oil Field have permeabilities that range from 0.006 to 0.272 mD. These samples are representative of the North Belridge Oil Field based on their geologic proximity and similar depositional environment; furthermore, these permeability values are corroborated by log data from three injection wells in the North Belridge Oil Field.

Below the Tulare Formation, confinement is provided by the low-permeability Etchegoin Formation and the Upper Diatomite Zone. The permeabilities of these lower confining layers range from less than 10 to less than 50 mD in the Etchegoin, and 0.8 to 7.3 mD in the Upper Diatomite Zone. This is based on evaluations of samples taken during drilling of wells in the field.

Lateral confinement is provided by a combination of structural controls and an inward pressure gradient (i.e., a "pressure sink" caused by the withdrawal of fluids). See Figures 3.1 through 3.4.

Geologically, the North Belridge Oil Field is on the eastern side of a series of folded rock layers that form a dome (known as an anticline) that traps the oil within the field. Within the steeply dipping structure of the dome, confinement is provided by an inward pressure gradient that is created by the withdrawal of fluids from the Tulare Formation. Fluid balance data provided in the AE package indicates that more fluid has been withdrawn from the formation than has been injected. Between 1977 and 2016, 99,260,499 bbls of oil and water have been produced from the Tulare Formation in the North Belridge Oil Field and 72, 957,429 bbls of water and steam have been injected, for a net withdrawal of 26,303,070 bbls of fluid. This withdrawal causes the fluids within the proposed AE area to move toward the producing wells, and away from the boundary of the area proposed for exemption. Additional evidence of this pressure sink is provided by evaluations of historic water level data from wells in the field.

After reviewing information regarding the location of existing drinking water supply wells, groundwater flow within the Tulare Formation, and the lateral and vertical confinement of the formation as described above, the EPA concludes that the portions of the Tulare Formation that are proposed for exemption are not currently a source 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(b)(1) *It cannot now and will not in the future serve as a source of drinking water because it is mineral, hydrocarbon, or geothermal energy producing, or can be demonstrated by a permit applicant as part of a permit application for a Class II or III operation to contain minerals or hydrocarbons that considering their quantity and location are expected to be commercially producible.*

DOGGR provided information on hydrocarbon production in the area proposed for exemption along with supporting documentation such as historic production data, the locations of current producing wells, well logs, and sidewall core sample data to demonstrate the presence of commercially producible quantities of oil in the Tulare Formation within the North Belridge Oil Field.

Oil production in the North Belridge Oil Field began in 1912 in the Reef Ridge-Monterey Formations. Oil production from the Tulare Formation began in 1917. EOR operations in the Tulare Formation using steam injection (i.e., steaming) began in the 1960's; this has continued as the primary means of oil production from the Tulare Formation within the field. Steaming operations were halted in 2015 to repair a pipeline that supplies water to the steam generators but are expected to resume. Since the 1970s, produced water has been re-injected into the Tulare Formation for disposal. The North Belridge Oil Field has produced 14,216,325 bbls of oil and 351,191 million cubic feet of gas between 1977 and 2016.

Figure 4 shows the location of the 33 Aera Energy and Greka Oil & Gas wells that currently produce from the Tulare Formation in the North Belridge Oil Field. Production data for Greka's wells are provided in the AE request; these wells have cumulatively produced up to 218,000 bbls of oil per well, with average cumulative production of about 82,000 bbls per well.

The presence of hydrocarbons in the Tulare Formation is demonstrated through historic production data, evaluation of well logs, and the physical properties (including the presence of oil) in samples that were collected when wells in the oil field were drilled. The average oil saturation of the Tulare Formation within the North Belridge Oil Field is 37.5%, with values ranging up to 62%.

Based on a review of information such as well logs, production data, the history of oil production, and the implementation of enhanced recovery techniques such as steaming that have the potential to increase the productivity of the Tulare Formation, the EPA has determined that the portions of the aquifer proposed for exemption meet the criteria at 40 CFR § 146.4(b)(1).

PUBLIC NOTICE AND COMMENT

DOGGR provided public notice of this proposed AE on May 18, 2018 and held a public hearing on June 19, 2018 in Bakersfield, CA. The public comment period closed on June 19, 2018. DOGGR provided the EPA a summary of the public comments, the written public comments, a transcript of the public hearing, and DOGGR's written responses to the written and oral comments.

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.

One commenter (The Center for Biological Diversity) wrote to DOGGR and commented that the EPA should reject the request before an environmental review has occurred under the National Environmental Policy Act (NEPA). NEPA review is not required because 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 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 approval of the aquifer exemption would not be the legal cause of potential effects to listed species or designated critical habitat, if any.

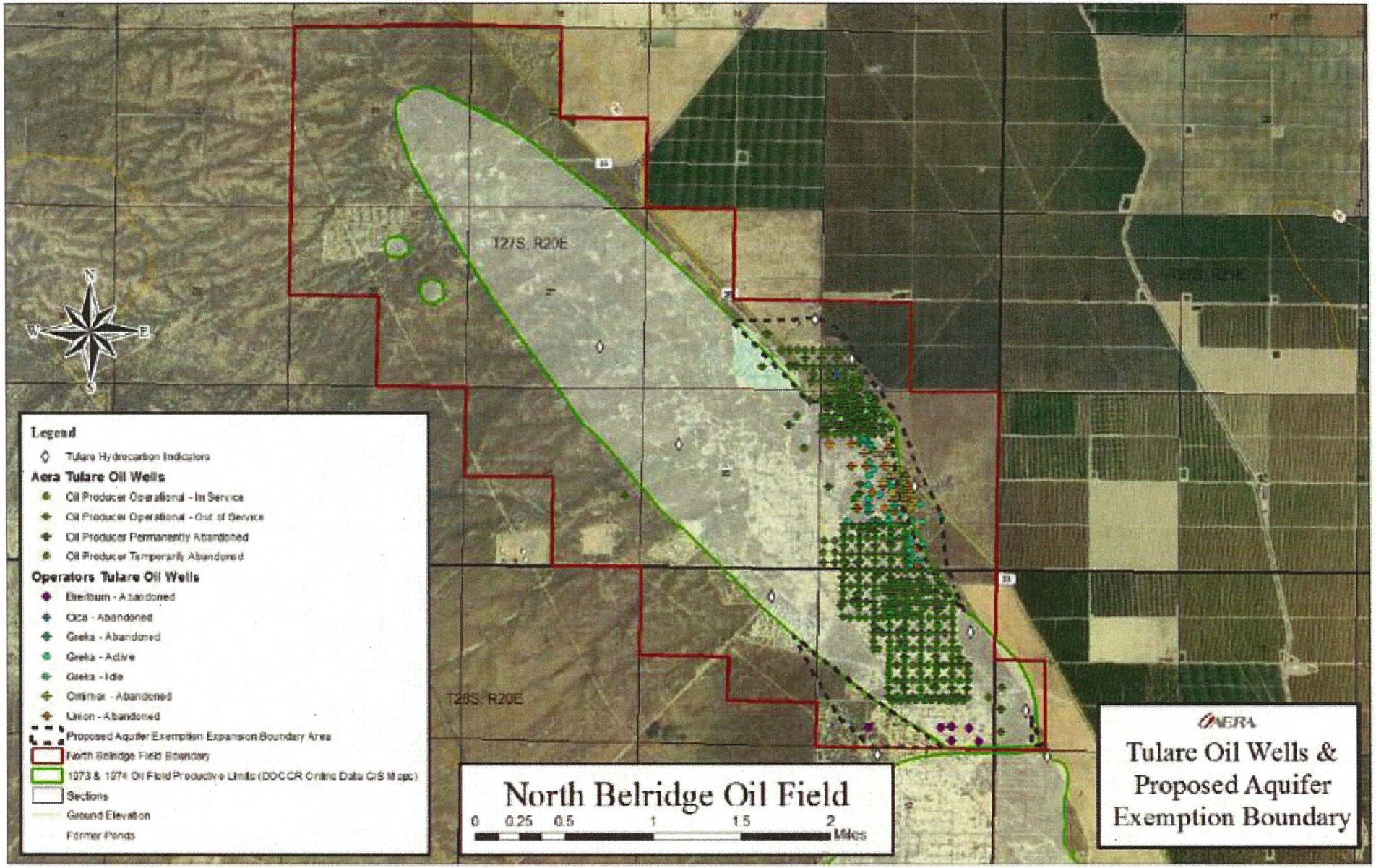
Additionally, the commenter questioned whether the current AE criteria reflect changing climate conditions and modern water treatment technologies. In considering whether the portions of the aquifer proposed for exemption cannot now and will not in the future serve as a source of drinking water because it is hydrocarbon producing, the EPA reviewed data about hydrocarbon production in the portions of the Tulare Formation that are proposed for exemption. Based on a review of historic production data, well logs, and core data, the EPA concludes that the formation will continue to be commercially producible into the foreseeable future and meets the existing requirements at 40 CFR § 146.4(b)(1).

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, the EPA finds that the exemption criteria at 40 CFR § 146.4(a) and § 146.4(b)(1) have been met, and the EPA approves the aquifer exemption request as a non-substantial program revision.

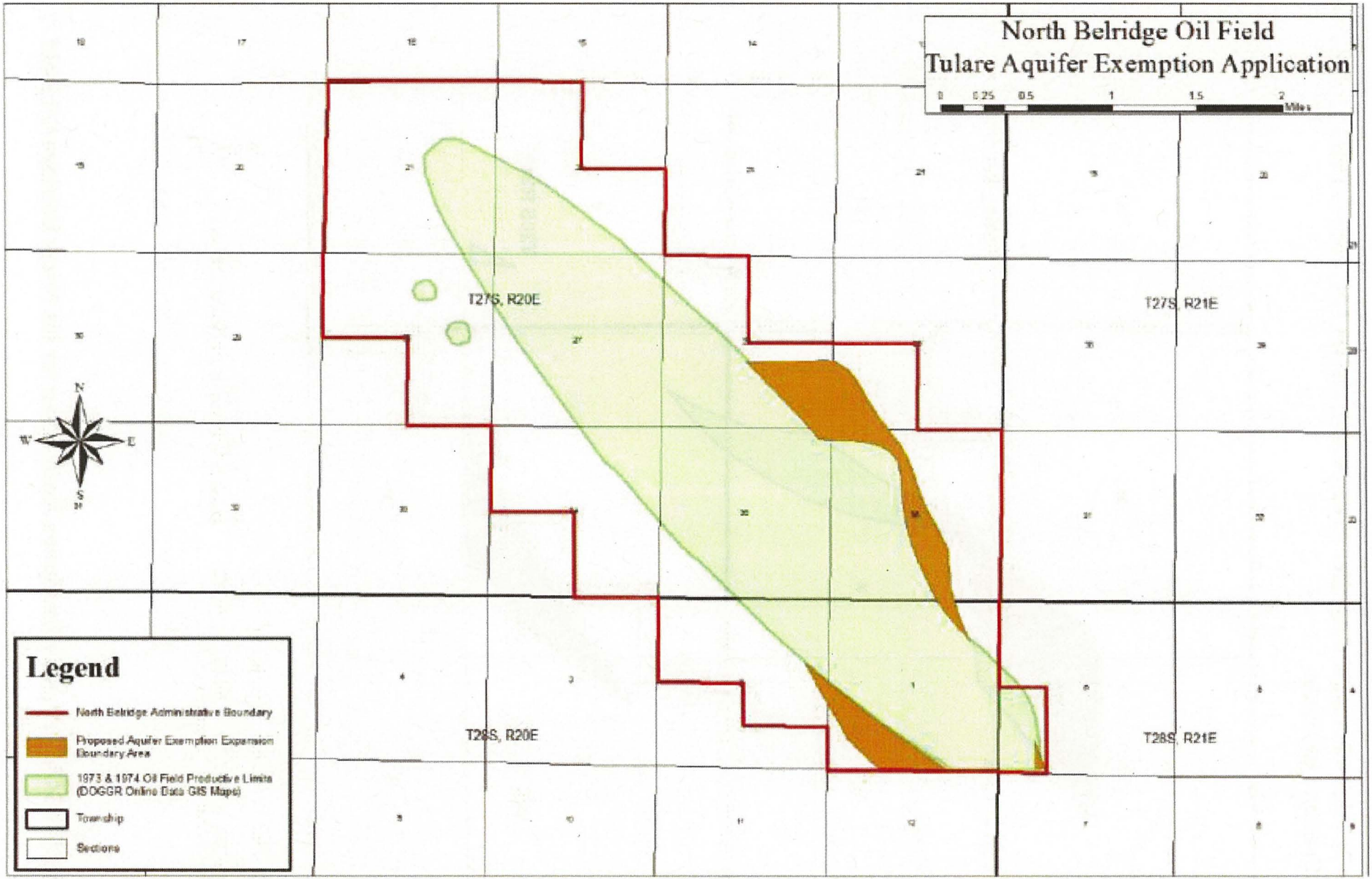
Effective Date: June 7, 2019

Figure 4: Tulare Formation Producing Wells, North Belridge Oil Field, Kern County, California



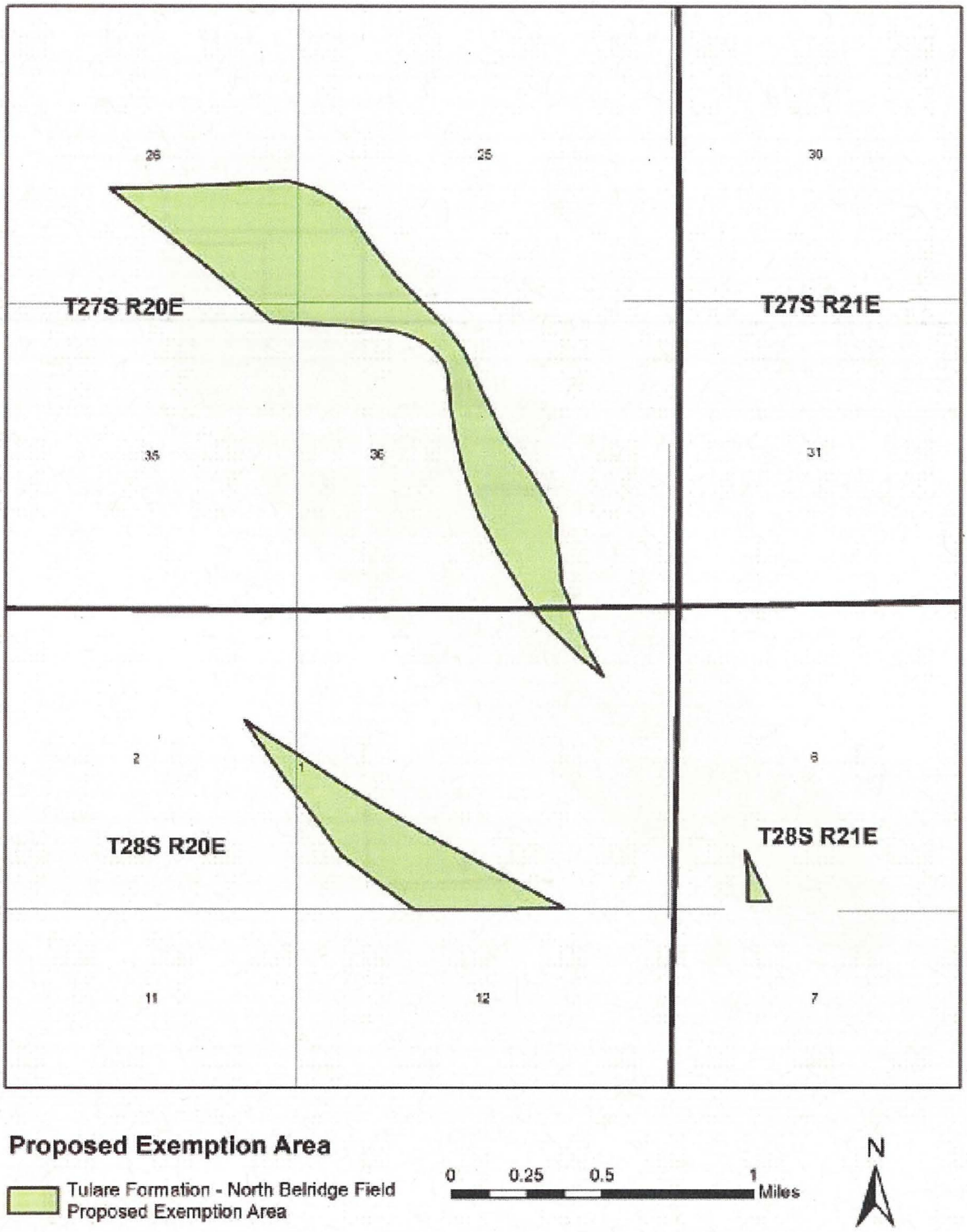
Source: Figure 6, DOGGR's Aquifer Exemption Application for the North Belridge Oil Field

Figure 1: Location of the North Belridge Oil Field, Kern County, California



Source: Figure 10, DOGGR's Aquifer Exemption Application for the North Belridge Oil Field

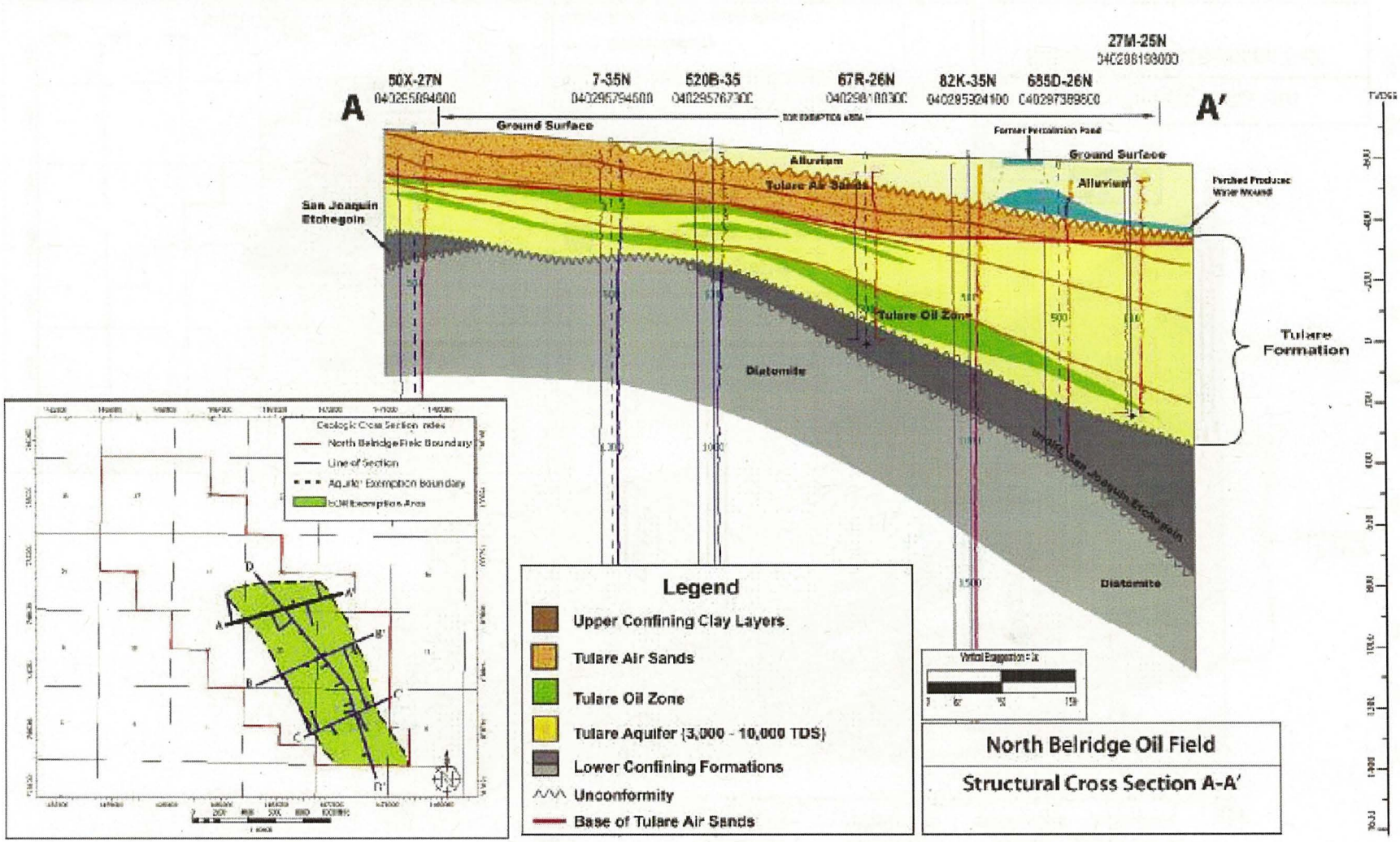
Figure 2: Tulare Formation Aquifer Exemption Location Map, North Belridge Oil Field, Kern County, California



Source: DOGGR's Aquifer Exemption Application for the North Belridge Oil Field

Figure 3.1: Cross Section A–A' across the Tulare Formation Aquifer Exemption Area

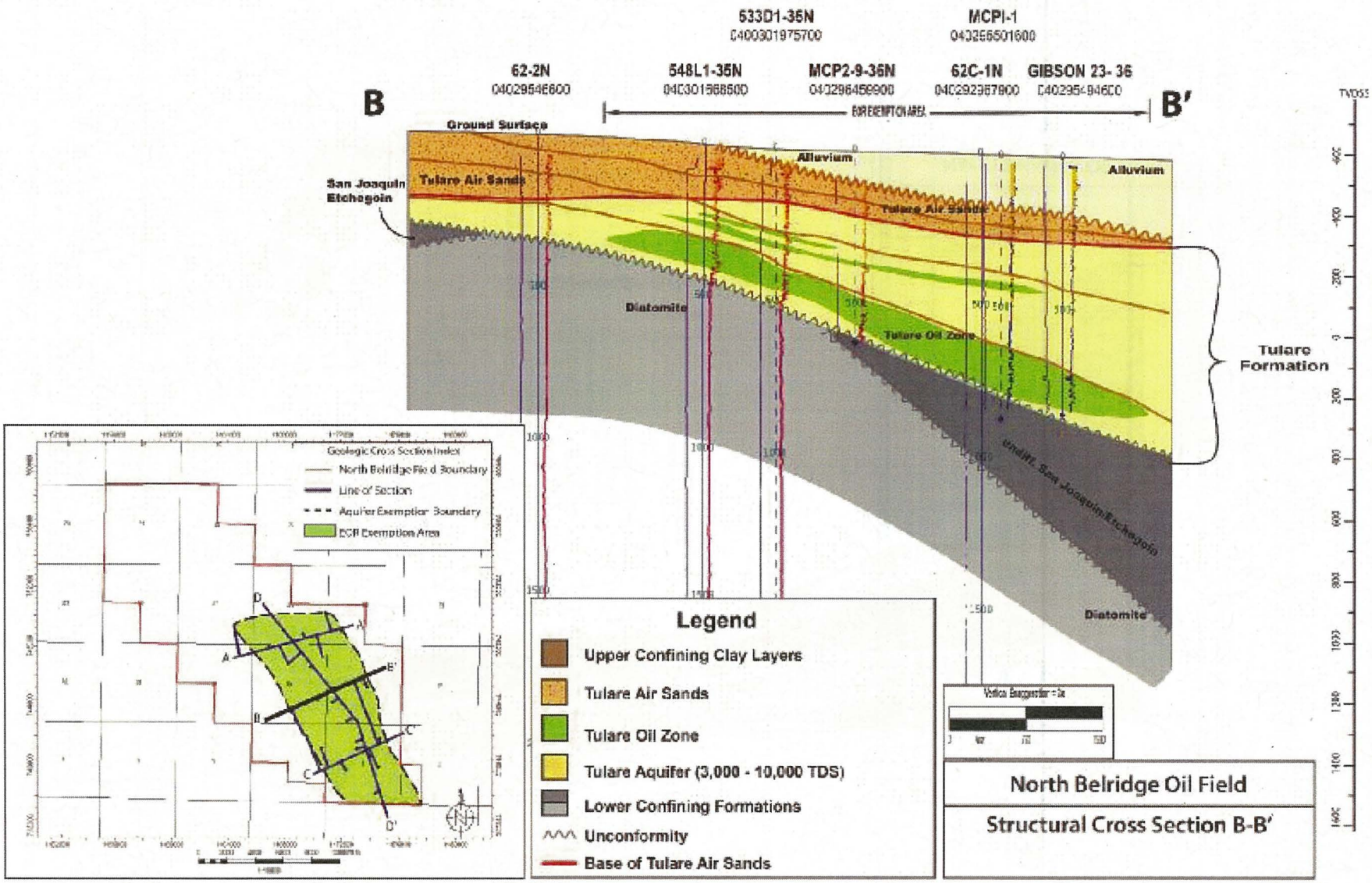
North Belridge Oil Field, Kern County, California



Source: Appendix E, DOGGR's Aquifer Exemption Application for the North Belridge Oil Field

Figure 3.2: Cross Section B-B' across the Tulare Formation Aquifer Exemption Area

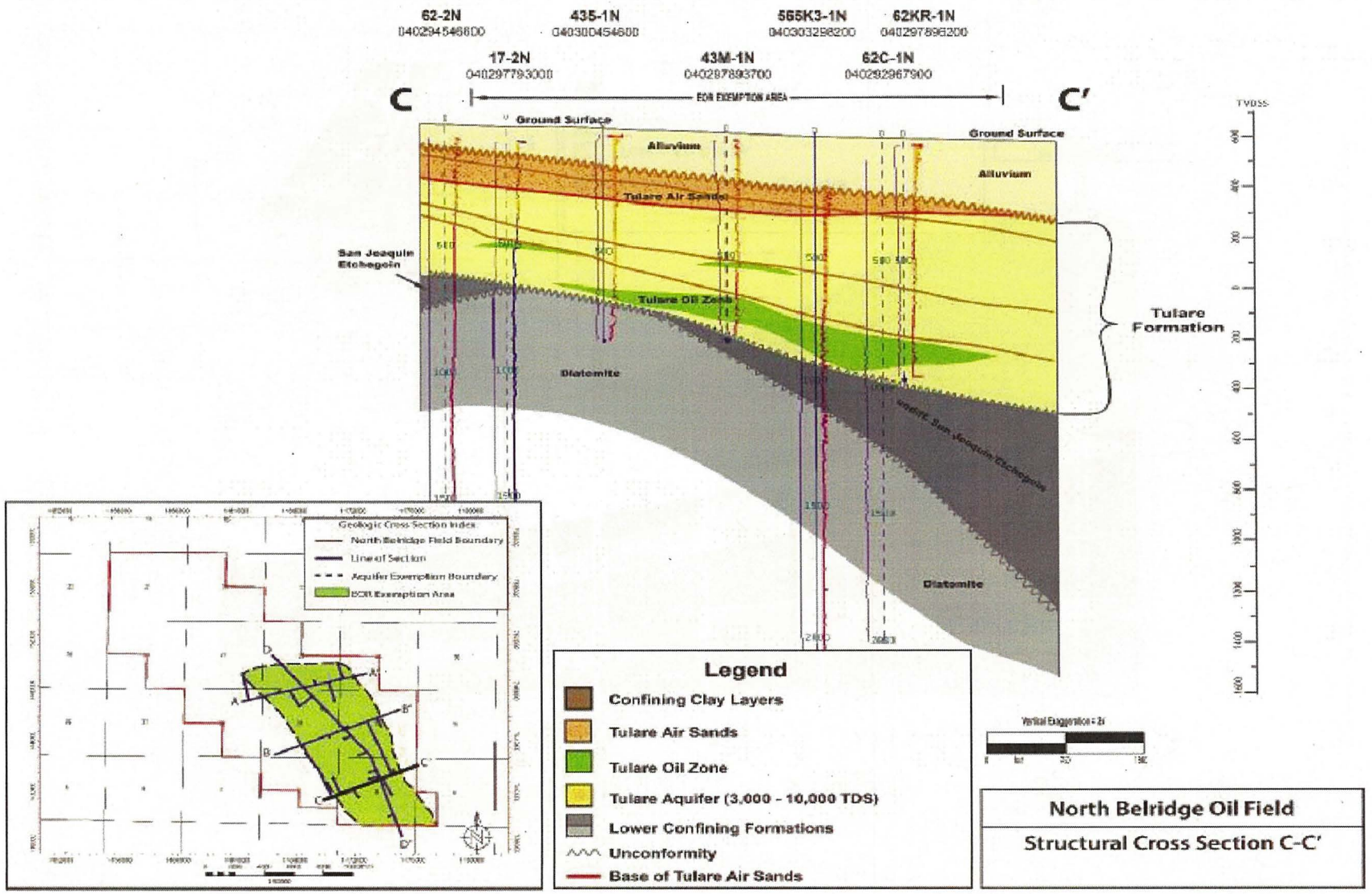
North Belridge Oil Field, Kern County, California



Source: Appendix E, DOGGR's Aquifer Exemption Application for the North Belridge Oil Field

Figure 3.3: Cross Section C-C' across the Tulare Formation Aquifer Exemption Area

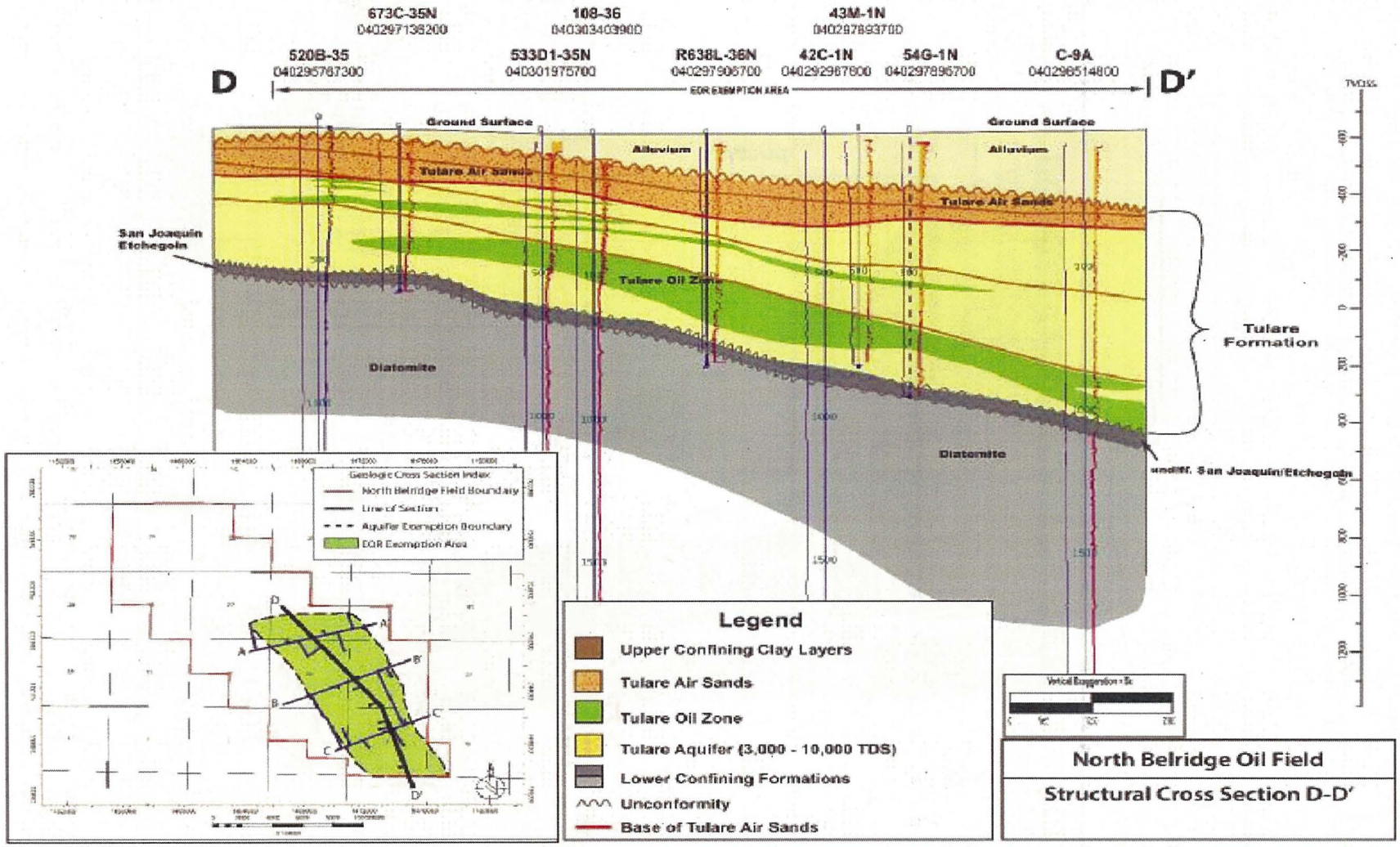
North Belridge Oil Field, Kern County, California



Source: Appendix E, DOGGR's Aquifer Exemption Application for the North Belridge Oil Field

Figure 3.4: Cross Section D-D' across the Tulare Formation Aquifer Exemption Area

North Belridge Oil Field, Kern County, California



Source: Appendix E, DOGGR's Aquifer Exemption Application for the North Belridge Oil Field