TECHNICAL MEMORANDUM

TO: Kristin L. Starbird, Vice President, Environmental Planning
BonTerra Psomas

FROM: Kleinfelder

DATE: December 21, 2016

SUBJECT: Water Quality and Groundwater Impacts Technical Memorandum
Inglewood Oil Field Specific Plan
Culver City, California
Kleinfelder Project No. 20162650.001A

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1 INTRODUCTION

On behalf of BonTerra Psomas (Psomas), in support of its work for the City of Culver City, California (City or Culver City), Kleinfelder, Inc. (Kleinfelder), has prepared this *Water Quality and Groundwater Impacts Technical Memorandum* for the Culver City Inglewood Oil Field (IOF) Specific Plan (Project). In 2008, the County of Los Angeles certified an Environmental Impact Report (EIR) that resulted in the creation of the Baldwin Hills Community Standards District (CSD), which regulates the unincorporated County portion of the IOF. On June 23, 2014, pursuant to Culver City Municipal Code, Chapter 17.570, the City Council of the City of Culver City adopted a resolution declaring its intention to initiate a Specific Plan for the approximate 77.8 acres of the IOF under City jurisdiction (Project Site). This Technical Memorandum will be used as an appendix to the EIR.

The Specific Plan for the City portion of the IOF provides procedures, development and implementation standards, and conditions for future oil and gas exploration, development, and production activities within the City portion of the IOF. The Specific Plan contains several administrative items, required permits and plans, authorized well operations, guidance and requirements for supporting facilities, equipment and standards, guidance for environmental considerations to help reduce potential health and safety impacts on residents, reporting requirements and safety initiatives. Upon adoption of the Specific Plan, there would be an amendment to Culver City Municipal Code's Chapter 9.07 and a repeal of the existing Chapter 11.12, Oil, Gas and Hydrocarbons. The Specific Plan also describes the Maximum Buildout Scenario for Project activities. This is summarized below in Section 2.0, and its effect on water quality is incorporated into the description of water-quality protections, Project impacts, and recommendations throughout this technical memorandum.

Throughout this Technical Memorandum, the City's portion of the IOF (77.8-acres) is referred to as the "Project Site" or the "City IOF." The entire surface boundary limits of the Inglewood Oil Field, including lands within both the City and County, is referred to as "Inglewood Oil Field" or "IOF." The off-Site portion of the Inglewood Oil Field that is within the jurisdiction of the County of Los Angeles is referred to as the "County IOF."

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The CSD was established in 2008 with the approval of the Los Angeles County Board of Supervisors to provide regulations and standards for drilling and oil production in the unincorporated (non-City) portion of the County IOF. While the City IOF is not subject to the requirements identified in the CSD, practices specified by the CSD would provide regional consistency with guidance in development of the City Specific Plan. An example of this is within the CSD where it specifies that the operator shall do the following regarding groundwater monitoring:

- "…develop, implement, and carry out a groundwater quality monitoring program for the oil field that is acceptable to the director and consistent with all requirements of the Regional Water Quality Control Board."
- "…the operator shall install and maintain groundwater monitoring wells in the vicinity of each surface water retention basin" and
- "Such monitoring wells shall be completed to the base of the permeable, potentially water-bearing, alluvium, Lakewood Formation, and San Pedro Formation, and to the top of the underlying, non-water bearing Pico Formation…"

The CSD also identified surface water management and monitoring requirements, including preparing and implementing a Storm Water Pollution Prevention Plan; a Spill Prevention, Control, and Countermeasure plan; and a hydrological analysis to evaluate potential changes in drainage patterns and runoff. A Water Management Plan must also be established for conservation and best management practices.

Currently there are no hydraulic fracturing activities on the Project Site or in the IOF. However, in the past, Plains Exploration & Production Company (PXP) conducted both conventional and high-volume hydraulic fracturing. These techniques were used in vertical or slant borings (Cardno ENTRIX, 2012). If conventional and high-volume hydraulic fracturing are to be performed in the future, the operator, at a minimum, will be required to adhere to the SB 4 well stimulation regulations. No horizontal drilling and/or associated hydraulic fracturing are known to have occurred on the IOF.

2 MAXIMUM BUILDOUT SCENARIO

The following describes the Maximum Buildout Scenario for the Project Site:

- One well pad would be under construction on the Project Site - assumed that no new access roads would need to be constructed to support any well pad construction.
- The maximum number of wells to be drilled or re-drilled on an annual basis will be two wells per year for the first two years, then three per year after that if the Project is protective of the health, safety, and general welfare of the public.
    - Portable temporary tanks (e.g. Baker tanks) will be used to collect drilling fluids.
    - No pits will be constructed or used to store drilling fluids.
    - It is assumed that 100 barrels (4,200 gallons) of potable water will be used per day for the drilling process.
- The maximum total number of 30 wells may be drilled (i.e. new wells) or redrilled (i.e. work on existing wells) on the Project Site. These are assumed to be "new" wells.
    - Associated facilities (e.g., drilling rig, pumps, etc.) are assumed to be located on a graded well pad adjacent to the drill site.

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- A setback of at least 400 feet from Developed Areas and at least 75 feet from any public roadway will be required within the IOF for drilling or redrilling.
- No more than two rigs for reworking, maintenance, and/or abandonment shall be present within the Oil Field at any one time. Limits on simultaneous activity include one drill rig occurring at the same time as two rigs for reworking, maintenance and/or abandonment.

3 METHODOLOGY

The methodology used to develop this Technical Memorandum included the following: review and summarize applicable regulations; review available Project Site and County IOF documents on groundwater and surface water conditions, investigations, and monitoring; review available documents on regional hydrogeologic conditions; evaluate potential impacts from existing Project Site conditions and activities and proposed Project activities; and include recommended mitigation measures for identified impacts, as appropriate.

Water quality is the physical, chemical, and biological characteristics of water. Changes to water quality can result from flowing through developed areas, soil, or rock material as well as from releases to surface water and groundwater. The effects can be identified in both surface water and/or groundwater depending on local surface topography as well as subsurface soil types. By this nature water quality is not accurately evaluated at a single geographic location, whether on the surface or subsurface, but as a collection of geographic locations. This allows for an evaluation of the results to determine if the individual locations are consistent with the overall characteristics of the watershed or groundwater basin. If individual locations are not consistent with the overall characteristics of the watershed or groundwater basin, the monitoring program can be expanded to more accurately identify sources of contamination or the interconnected nature of the surface drainage, or groundwater flow.

The following sections of this report provide the regulatory setting, local environmental setting, and the water quality protections identified within the Specific Plan itself.

4 REGULATORY SETTING

Several Federal, State, and local regulations and rules apply to implementation of the IOF Specific Plan. These include the following:

Federal

- 1972 Federal Clean Water Act (CWA) (33 U.S.C. §1251 et seq.) – established national water-quality goals and the basic structure for regulating discharges of pollutants into the waters of the United States.
  - The CWA also created National Pollutant Discharge Elimination System (NPDES) permits that specify minimum standards for the quality of discharged waters. These permits require states to establish standards specific to water bodies and designate the types of pollutants to be regulated.
  - Total Maximum Daily Loads (TMDLs) fall under Section 303 of the Federal CWA
- 1990 Oil Pollution Act (33 U.S.C. §2701 et seq.) – the act requires oil storage and vessels to submit to the Federal government plans detailing how they will respond to large discharges. Environmental Protection Agency (EPA) has published regulations for

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aboveground storage facilities. OPA also requires the development of an Area Contingency Plan to prepare and plan for oil spill response on a regional scale.

State

- California Code of Regulations (CCR) (Title 14, Chapter 4) and the California Public Resources Code (Section 3000) specify that the California Division of Oil, Gas, and Geothermal Resources (DOGGR) supervise oil well activities to prevent damage to underground and surface waters suitable for irrigation and domestic use.
- Porter-Cologne Water Quality Control Act (Porter-Cologne Act) (California Water Code (CWC) section 13000 et seq.; CCR Title 23, Chapter 3, Chapter 15) – provides a comprehensive water-quality management system for the protection of California waters and regulates the discharge of oil into navigable waters by imposing civil penalties and damages for negligent or intentional oil spills.

  The Porter-Cologne Act also establishes the State Water Resources Control Board (SWRCB) and the nine Regional Water Quality Control Boards (RWQCBs) as the principal state agencies with the responsibility for controlling water quality in California. Each RWQCB is required to develop and update a Water Quality Control Plan, also known as a Basin Plan that recognizes and reflects the region differences in existing water quality, the beneficial uses of the region's groundwater and surface waters, and local water quality conditions and problems. The IOF is located within RWQCB Region 4, for the Los Angeles area (also referred to as LARWQCB).

- California Toxics Rule – water quality criteria for priority toxic pollutants for California inland surface waters, enclosed bays, and estuaries were adopted. The State Water Resources Control Board adopted the "Policy for implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California" in 2000.
    - Disposal of Oil Field Waste (CAC, Title 23, Chapter 3, Subchapter 15, Articles 3 and 5).
    - The California Division of Oil, Gas, and Geothermal Resources has jurisdiction to manage the Underground Injection Control program. In California, all Class II injection wells are regulated by the California Division of Oil, Gas, and Geothermal Resources, under provisions of the Public Resources Code and the federal Safe Drinking Water Act. Class II injection wells fall under the California Division of Oil and Gas and Geothermal Resources' Underground Injection Control program, which is monitored and audited by the U.S. Environmental Protection Agency.
- Senate Bill 4 (SB 4) (Chapter 313) – provides a statewide comprehensive regulatory plan addressing oil and gas well stimulation treatments, including hydraulic fracturing, was signed into law on September 20, 2013. SB 4 amended existing sections of the Public Resources Code, and added a new section which specifically addresses groundwater quality monitoring.
    - A Final EIR Analysis of Oil and Gas Well Stimulation Treatments in California (SB 4 EIR)
    - The independent California Council on Science and Technology (CCST) and Lawrence Berkley National Laboratory study titled, Independent Scientific Assessment of Well Stimulation in California Summary Report (July 2015).
    - The CWC (Section 10783) has been amended with respect to the issue of groundwater monitoring and well stimulation activities.

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Local

- Standard Urban Stormwater Mitigation Plan – adopted by the SWRCB in 2000, this is part of the Development Planning Program of the NPDES, Phase I, Stormwater Permit for the County of Los Angeles of which the City is a part of as a co-permittee. The County of Los Angeles, and the City, developed a Standard Urban Stormwater Mitigation Plan manual that includes the permitting and inspection process for projects required to meet Standard Urban Stormwater Mitigation Plan regulations. The objective of the Standard Urban Stormwater Mitigation Plan is to effectively prohibit non- storm water discharges and reduce the discharge of pollutants from storm water conveyance systems to the Maximum Extent Practicable statutory standard. Standard Urban Stormwater Mitigation Plans define hydrology standards for designing volumetric and flow rate-based Best Management Practices.
- Los Angeles Region Basin Plan – The LARWQCB *Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties* (The Water Quality Control Plan for the Los Angeles Region [1994]) specifies beneficial uses and water-quality objectives for surface water and groundwater in the region indicated by watershed, subwatershed, and groundwater basins. The Basin Plan specifies groundwater-quality objectives, for the following parameters in the Coastal Plain of Los Angeles' Santa Monica Subbasin (Basin No. 4-11-.03):
    - Total Dissolved Solids (TDS), 1000 milligrams per liter (mg/L)
    - Sulfate, 250 mg/L
    - Chloride, 200 mg/L
    - Boron, 0.5 mg/L.

These parameters, with the identified analytical levels, can be used as a "guide post", or a comparison, to evaluate overall groundwater quality within the identified groundwater basin. In this way, the basin can be determined to be meeting groundwater objectives, or not meeting groundwater objectives.

5 ENVIRONMENTAL SETTING

5.1 Groundwater

The Project Site is located near the intersection of the West Coast, Santa Monica, and Central Subbasins of the Los Angeles Groundwater Basin, and, specifically, overlies the southeast corner of the Santa Monica Subbasin. These subbasins meet in an area of faulting and folding (the Baldwin Hills). This faulting and folding has resulted in the uplift, and reportedly in the hydraulic disconnection of aquifers in the IOF area from the regional flow system (Catalyst Environmental Solutions [Catalyst], 2016). Historical groundwater exploration and pumping data for the IOF indicate that groundwater typically occurs in relatively thin lenses (i.e., 10 feet thick or less), and that groundwater extraction rates greater than 1 gallon per minute (gpm) are not sustainable (Cardno ENTRIX, 2012).

LARWQCB Basin Plan has identified the following beneficial uses of groundwater in the Site vicinity (subbasins of the Los Angeles Groundwater Basin):

- Municipal and domestic supply – Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

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- Industrial service supply – industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.
- Industrial process supply – industrial activities that depend primarily on water quality.
- Agricultural supply – farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

A map showing groundwater wells near the Project Site is included as Figure 1.

Groundwater exploration within the County IOF has occurred to a maximum depth of 550 feet below ground surface (bgs), and groundwater has been measured at various depths, although a consistent saturated section beneath the IOF appears to have been present in 2012 in wells screened (gaps, or slots, cut into the well casing to allow groundwater into the well) with an interval of approximately 120 to 170 feet above mean sea level (msl). This may represent a semi-continuous perched zone beneath the IOF, although the recent drought has likely resulted in decreases in water levels and drying of some wells. In addition, investigations described in the CSD EIR (Marine Research Specialists [MRS], 2008) indicate that groundwater has been detected at depths of approximately 50 to 70 feet bgs in and near the IOF. This corresponds to the depths to water identified in the groundwater-monitoring-program wells, as further described below in Section 4.2.

Due to faulting and uplift in the Baldwin Hills, the base of "fresh" water (i.e., "protected water" as defined by SB 4) is unusually shallow compared to adjacent groundwater basins, and ranges from approximately 400 to 550 feet bgs (Cardno ENTRIX, 2012). The top of the Pico Formation, which is encountered within this depth range beneath the IOF, represents the base of the fresh-water zone due to the Formation's high clay content and low permeability. In addition, water-bearing formations at greater depth have much higher total dissolved solids (TDS) concentrations. Groundwater beneath the Project Site represents protected water pursuant to Water Code Section 10783, and a groundwater monitoring program shall be implemented pursuant to *Model Criteria for Groundwater Monitoring in Areas of Oil and Gas Well Stimulation* (SWRCB, 2015).

Descriptions of the sediments beneath the IOF indicate they are non-water-bearing (or "no flow") and discontinuous zones not hydraulically connected to adjacent regional aquifers (MRS, 2008; Cardno ENTRIX, 2012; Catalyst, 2016). However, it is likely that groundwater beneath the IOF is hydraulically connected to adjacent aquifers since known groundwater occurrences have not historically daylighted at ground surface, indicating that, despite long-term recharge, these saturated zones are able to drain to deeper and/or laterally connected aquifers. It does appear, based on recorded hydraulic behavior (e.g., extraction testing), that the shallow aquifer system beneath the IOF is not productive and lateral movement may be slow and of small volume; therefore, this suggests that the groundwater volume is insufficient for water supply and that hydraulic connection with water supply aquifer(s) would be limited. In summary, although groundwater beneath the Project Site appears to occur in a poorly conductive aquifer system, it may be in hydraulic connection with adjacent groundwater basins.

5.2 Inglewood Oil Field Groundwater Monitoring Program

Fifteen groundwater monitoring wells have been installed at the IOF according to Cardno ENTRIX (2012), and a select group of these are included in the current quarterly groundwater monitoring program (Catalyst, 2016) as required by the CSD. Well and groundwater exploration locations are shown on Figure 2 (adapted from Cardno ENTRIX, 2012). Wells included in the current program

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are MW-3, MW-4A, MW-4B, MW-4C, MW-5, MW-6, and MW-7, although only three of them typically contain groundwater. According to Catalyst (2016), "…the LARWQCB requested that the network focus on preferred pathways in native canyon areas and suggested existing catch basins as likely target locations for the monitoring wells to determine impacts of oil field operations on groundwater quality." However, as quoted above (Section 4.1), wells were also required to be installed at multiple depths down to the top of the Pico Formation. Figure 3 shows the relative depth of each well and exploratory borehole (2012 groundwater information is shown on this figure, adapted from Cardno ENTRIX, 2012). The following table summarizes construction and recent groundwater conditions for wells in the current program (Catalyst, 2016):

Groundwater Monitoring Well Specifications (Q3 2016)

WELL	Well Depth (feet)	Screen Interval (feet)	Groundwater Depth (feet)
MW-3	75.32	55 - 75	70.21
MW-4A	120.21	NA	DRY
MW-4B	166.71	NA	DRY
MW-4C	139.95	NA	DRY
MW-5	144.31	115 - 145	DRY
MW-6	73.4	50 - 70	63.64
MW-7	58.4	40 - 60	48.25

NA: not available (may be estimated from Figure 4-3C, Hydraulic Fracturing Study [Cardno ENTRIX, 2012])

These seven wells monitor the entire IOF, although none are within the City IOF. The closest monitored well to the City IOF is MW-7 (approximately 1,100 feet southwest of the City IOF). One well that has not been part of a past, or present, monitoring program is MW-9, which is located in the northeast corner of the City IOF (Figure 2). This well has a screen interval from 15 feet to 35 feet bgs. The operator did not provide any information, or justification, regarding MW-9 not being included in the past or present monitoring programs. The borehole log, from initial installation in 2010, indicates "saturated" and wet conditions starting at approximately 25 feet bgs.

Analytes and parameters tested each quarter include the following:

- Total petroleum hydrocarbons as diesel (TPH-d);
- Total recoverable petroleum hydrocarbons (TRPH);
- TDS;
- Benzene, toluene, ethylbenzene, xylenes (BTEX), and methyl tertiary-butyl ether (MTBE) (volatile organic compounds);
- Metals
- Biochemical oxygen demand (BOD);
- Nitrate and nitrite; and
- pH

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Historical monitoring indicates that concentrations of tested analytes are typically below their respective State and Federal maximum contaminant levels (MCLs), except for arsenic. Except for TDS, monitoring of the parameters listed in Section 3.0 that have identified groundwater-quality objectives for the Coastal Plain of Los Angeles Santa Monica Subbasin are not included the IOF monitoring program.

Although the constituents listed above have not generally been detected, or when detected, have not been measured at or above MCLs in groundwater samples from IOF monitoring wells, the existing groundwater monitoring program does not currently suffice to evaluate potential impacts from deep(er) subsurface activities and activities that may present a potential for impact outside the IOF such as horizontal well stimulation or hydraulic fracturing. In addition, no wells within the Project Site (City IOF) are monitored, so current groundwater conditions beneath the Project Site are unknown. A proposed groundwater monitoring program to evaluate potential impacts from proposed oil and gas production and well stimulation activities is presented in Section 8.0, and is consistent with the Specific Plan

5.3 Surface Water

The IOF is located in the Baldwin Hills with associated topography containing canyons and gullies, as well as modifications from exploration and development activities. Surface water runoff from the IOF is covered under Sections A and B of NPDES General Permit No. CA000002 (RWQCB, 2009), and operational discharges are subject to NPDES permit No. CA0057827, Order No. R4-2013-0021 (RWQCB, 2013).

Six surface water retention basins are located along primary drainages to retain any spills on the IOF. These retention basins are assumed to operate in compliance with the appropriate permit conditions. One of the retention basins is located within the City IOF. This retention basin is identified as the Dabney Lloyd Basin (Basin 002) and is located on the north end of the field. Basin 002 receives runoff from the northwest portion of the field including drainage from the Packard Basin and R.J. Basin. The basin also receives runoff from the Kenneth Hahn State Recreation Area. The maximum capacity of Basin 002 is approximately 294,000 gallons, with a maximum flow of 3.06 million gallons per day (mgd), and a drainage area of approximately 139 acres (Operator supplied information, 2015).

While no perennial or ephemeral streams are located on the IOF (MRS, 2008), these basins ultimately drain to Ballona Creek, a concrete-lined creek located approximately 1,600 feet from the City IOF. Ballona Creek is considered an impaired water body (pursuant to the CWA) and several programs monitor general surface water parameters as well as the constituents that cause the impairment (e.g., Ballona Wetlands Foundation, Friends of Ballona Wetlands Education/Ecology Center, Santa Monica Bay Restoration Project, Los Angeles Regional Water Quality Control Board Trash Total Maximum Daily Load for Ballona Creek and Wetland, etc.).

LARWQCB Basin Plan potential beneficial uses of Ballona Creek in the Site vicinity include the following:

- Municipal and domestic supply (potential) – uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.
- Warm freshwater habitat (potential) – preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

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- Wildlife habitat (potential) – support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Ballona Creek is listed as impaired for cadmium, coliform bacteria, copper, cyanide, lead, selenium, toxicity, trash, viruses, and zinc (Los Angeles RWQCB 2010).

6 WATER QUALITY PROTECTIONS IN THE SPECIFIC PLAN

The IOF Specific Plan contains proposed water-quality protection requirements to safeguard against potential impacts from oil field activities. These are specified in Section 25 (Groundwater Monitoring), Section 26 (Surface Water Management), and Section 27 (Stormwater and Drainage Management) of the Specific Plan. Proposed Specific Plan requirements include:

- Groundwater – the Operator shall develop, implement, and carry out a Groundwater Monitoring Program for the Drilling Project Site or Oil Field, which shall be submitted to the Public Works Director/City Engineer.
- Surface Water – the Operator shall submit a Water Management Plan, to be reviewed and approved by the Public Works Director/City Engineer, that documents best water management practices.
- Stormwater
    - The Operator shall at all times maintain and implement all provisions of a Stormwater Pollution Prevention Plan (SWPPP) that has been inspected by the RWQCB and the Public Works Director/City Engineer.
    - The Operator shall maintain and implement all provisions of a Spill Prevention, Control, and Countermeasure Plan (SPCC), which meets the requirements of the Local California Unified Program Agency and the EPA.
    - A site-specific hydrologic analysis shall be completed to evaluate anticipated changes in drainage patterns and associated increased runoff at the Project Site for any new grading that results in the loss of vegetated, sandy, permeable ground areas, which could alter surface runoff at the site.

7 PROJECT IMPACTS

On-going and proposed, including the Maximum Buildout Scenario, Project activities could impact both surface water (including Ballona Creek) and groundwater from a release of well stimulation chemicals to the ground surface or shallow subsurface, improper control and containment of extracted fluids, rupture of conveyance and storage structures, and drilling and stimulation activities. Spills to the ground surface can drain to and impact surface water and, if not contained, may be conveyed off Site.

Despite compliance with applicable laws, regulations, and rules, impacts may occur due to unexpected release of produced water and oil from drilling activities, failure of any component of the storage, transport, or use of chemicals on the Project Site, and the unanticipated migration of chemicals in the subsurface into aquifers with beneficial uses. The summaries of potential impacts in the following paragraphs include project activities based on the Maximum Buildout Scenario.

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7.1 Site Facilities and Operations

The Project Site is part of an operating oil and gas production field with ongoing activities and facilities associated with the larger operation of the IOF. The Project Site currently contains a tank farm, a retention basin (described above), several active and inactive wells, and associated pipelines related to oil field activities. The tank farm has five tanks and one pump, located with the County IOF, for separating oil and water; these products are piped from the tank farm to a central oil-sales facility outside the Project Site (in the northeastern part of the County IOF). Wells on the Project Site include 37 active wells, 5 idle wells, and 28 plugged or abandoned wells.

Impacts from Project Site, and County IOF facilities, wells, and operation and maintenance activities could result from the following:

- Leaking tanks and transmission piping;
- Leaking well seals;
- Pipeline and tank rupture;
- Percolation of liquids through the bottom of the basin;
- Uncontrolled releases during production.

Compliance with the requirements identified in the Specific Plan, will result in a less than significant impact.

7.2 Site Chemicals and Hazardous Waste

Chemicals and Other Materials Used On Site

Current operations on the Project Site are likely to involve the use of a number of chemicals and other materials associated with well drilling and production. Since no crude oil, gas processing or treatment facilities are located on the Project Site, chemicals specifically associated with processing and treatment are not expected to be used on the Project Site, but would be used in the adjacent County portion of the IOF. Table 7-1 below lists the estimated on-site storage quantities of chemicals and other materials associated with well drilling and production activities that are likely to be used on the Project Site. These values were based on the maximum storage quantities for the entire IOF at the time of the Baldwin Hills CSD EIR, which included 643 active injection and production wells. Those maximum quantities were proportionally scaled down to correspond to the number of injection and production wells allowed by the Specific Plan (30 in total) plus the existing wells already located within the City IOF (37) for a total of 67 wells. Therefore, this table represents the future estimated volume of chemical storage at full buildout. Usage of chemicals in gallons per day were not to be specified (County of Los Angeles Department of Regional Planning [LACDRP], 2008).

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TABLE 7-1

Estimated Volume Of Chemicals And Other Materials Stored On Site For Well Drilling And Production

Type	Description	Estimated Amount*
Anti-foulant	Inhibits corrosion and fouling	7 gallons
Binary Corrosion Inhibitor	Prohibits corrosion of pipes and vessels and helps with pipeline integrity	594 gallons
Corrosion Inhibitor	Prohibits corrosion of pipes and vessels and helps with pipeline integrity	361 gallons
Degreaser	Cuts grease	21 gallons
Oxygen Scavenger	Liquid blend of sulfite formulated to prevent oxygen pitting and general corrosion in pipes and water treatment systems	21 gallons
Scale Inhibitor	A chemical treatment used to control or prevent scale deposition in the extraction process	281 gallons

* Based on the total use of 643 active wells (injection and production wells) at the IOF and the proportionate use of 67 active wells (injection and production wells) in the Culver City portion.

Source: LACDRP, 2008

Compliance with the requirements identified in the Specific Plan, will result in a less than significant impact.

Hazardous Wastes

Hazardous wastes are expected to be generated by well drilling and production activities at the Project Site during routine operations and maintenance. The approximate hazardous waste generation from the Project Site is presented in Table 7-2 below. These values are based on the generation quantities for the entire IOF at the time of the Baldwin Hills CSD, which included 643 active injection and production wells. Those maximum quantities were proportionally reduced to the maximum number of injection and production wells allowed by the Specific Plan (30 in total) plus the existing wells already located within the City IOF (37) for a total of 67 wells.

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TABLE 7-2

Estimated Hazardous Waste Generation

Type	Monthly Waste Volume*	Annual Waste Volume*
Absorbents used for chemical and hazardous material spills	1 pound	12 pounds
Empty 5-gallon containers used for chemicals and hazardous wastes	5 pounds	60 pounds
Off-spec paints	36 pounds	432 pounds
Waste aerosols	25 pounds	300 pounds
Non-hazardous oily debris	3,126 pounds	37,512 pounds

* Based on the total hazardous waste generation of 643 active wells (injection and production wells) at the IOF and the proportionate generation by 67 active wells (injection and production wells) in the Culver City portion.

Source: LACDRP, 2008

Compliance with the requirements identified in the Specific Plan, will result in a less than significant impact.

7.3 Well Abandonment and Well Drilling

Drilling and construction of wells on the Project Site are proposed activities, and this may include directional drilling (e.g., horizontal wells). In addition, 28 abandoned/plugged wells are present on Site. Improper or failed well seals on abandoned/plugged wells could result in a release of hydrocarbons and well chemicals to groundwater or surface water.

During new well drilling, improper or failed well seals could result in a release of hydrocarbons, and well chemicals (including those listed below for well stimulation) to groundwater or surface water, and surface activities could result in spills or improper containment of well fluids. Blowouts may result in releases of hydrocarbons and well chemicals. Any release of drilling related chemicals or hydrocarbons to the groundwater, surface water, or surrounding ground surface would be considered a significant impact. Compliance with the requirements identified in the Specific Plan, will result in a less than significant impact.

7.4 Well Stimulation

Well stimulation activities may include injection of fracking fluids that contain several components. These generally include the following with common chemical examples that may be used (Cardno Entrix, 2012; California Department of Conservation [CDC], 2015):

- Water
- Proppant – sand or resin
- Friction reducer – petroleum distillate, hydro-treated light petroleum distillate polyacrylamide, methanol, ethylene glycol
- Surfactant – ethanol, 1,2,4-trimethylbenzene, heavy aromatic petroleum naphtha, naphthalene, methanol, isopropyl alcohol, 2-butoxyethanol

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- Crosslinker – quartz, borate salts, disodium octaborate tetrahydrate, petroleum distillate, hydrotreated light petroleum distillate, potassium metaborate, triethanolamine zirconate, sodium tetraborate, boric acid, zirconium complex, ethylene glycol, methanol
- Gelling Agent – guar gum, naphtha hydrotreated heavy, petroleum distillate, hydrotreated light petroleum distillate, methanol, polysaccharide blend, ethylene glycol
- Corrosion Inhibitor – isopropanol, methanol, formic acid, acetaldehyde
- Biocide – 2,2 dibromo-3-nitrilopropionamide, 2-monobromo-3-nitrilopropionamide, glutaraldehyde, quaternary ammonium chloride, tetrakis hydroxymethyl-phosphonium sulfate
- Breaker – ammonium persulfate, sodium persulfate. sodium chloride, magnesium peroxide, magnesium oxide, calcium chloride
- Clay Stabilizer – choline chloride, tetramethyl ammonium chloride, sodium chloride
- Corrosion Inhibitor – isopropanol, methanol, formic acid, acetaldehyde
- pH Buffer – sodium hydroxide, potassium carbonate, potassium hydroxide, acetic acid, sodium carbonate
- Iron Control – citric acid, acetic acid, thioglycolic acid, sodium erythorbate
- Non-Emulsifier – lauryl sulfate, isopropanol, ethylene glycol
- Scale Inhibitor – copolymer of acrylamide and sodium acrylate, sodium polycarboxylate, phosphoric acid salt

Many of these chemicals, if released to groundwater or surface water, have the potential for environmental impact, although existing regulations require appropriate storage and use of these chemicals. Well stimulation chemicals could be released and cause surface water and/or groundwater impacts if not stored properly, if they breach well seals and impact groundwater, if they migrate from injection depths into water-supply aquifers or aquifers with beneficial uses or to the ground surface, and mixed fluids from injection depths that are recovered could be improperly contained or transported resulting in releases.

Although this is identified as an impact, there are adequate processes identified in the Specific Plan that describe the necessary procedures to react to any spilled material, that the impact would be considered less than significant assuming identified plans are followed appropriately. If Project activities are performed in accordance with regulations (SB4, etc.) there are no anticipated impacts. This would be verified with the proposed groundwater monitoring program (Section 9.0).

8 CUMULATIVE IMPACTS

Future oil field development at the overall IOF could include up to 500 new oil wells being drilled through year 2028 (Community Health Councils, et al., 2011). Grading and excavations would be required for proposed well pads, pipelines, and storage tanks. The exact locations of the wells and associated infrastructure have not been determined at this time. Natural drainage patterns directing sheet flow toward drainages and one detention basin on the Project Site would be modified by this grading, requiring the need for engineered surfaces and subsurface storm drains (MRS, 2008). Future oil field development would reduce pervious surfaces (the ground surface area capable of absorbing rainfall), and therefore, increase stormwater runoff across the Project Site and into the detention basin. The conversion of existing sandy soils and vegetation to impervious surfaces would alter the existing drainage pattern within the active surface field boundary from general sheet flow to concentrated flows directed from individual well pads and related infrastructure building pads. This increased and concentrated flow would increase the

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rate and amount of storm surface runoff that would flow into the detention basins, thus potentially resulting in basin over-topping. This is a potentially significant impact on drainage and flooding and requires mitigation. Mitigation of this potential impact is addressed in the CSD EIR (MRS, 2008), and includes a hydrologic analysis to provide sufficient data for adequate basin design.

The CSD also identified the need for a groundwater, and surface water, monitoring program. By its nature a groundwater or surface water monitoring program is a regional program used to identify individual locations that don't conform to the regional characteristics. Although a monitoring program has been implemented, it does not include sufficient locations to meet the intent of a groundwater or surface water program. This program is necessary if limited operations occur, or if the Maximum Buildout Scenario is implemented.

9 CONCLUSIONS

There were several main subject areas that were identified as impacts of the proposed Project. These impacts need to be addressed with respect to water quality related to well stimulation activities at the Project Site as a result of the implementation of SB 4. SB 4 the Specific Plan, and the RWQCB require:

- Groundwater monitoring and appropriate characterization be implemented in the vicinity of well stimulation operations and resultant fractures to detect impacts to "protected water" (defined as total dissolved solids [TDS] less than 10,000 milligrams per liter). Monitoring of the parameters listed in Section 3.0 that have groundwater-quality objectives for the Coastal Plain of Los Angeles Santa Monica Subbasin should be incorporated into the Project monitoring program for comparison to Basin objectives.
- Based on the amended section of the Water Code, the State Water Resources Control Board will "…develop model groundwater monitoring criteria to be implemented either on a well-by-well basis for a well subject to well stimulation treatment, or on a regional scale. The model criteria shall address a range of spatial sampling scales from methods for conducting appropriate monitoring on individual oil and gas wells subject to a well stimulation treatment, to methods for conducting a regional groundwater monitoring program. The State Board shall prioritize monitoring of groundwater that is or has the potential to be a source of drinking water, but shall protect all waters designated for any beneficial use."
- Groundwater monitoring plans should be developed, should include background monitoring data, and should include targeted monitoring in proximity to potential fracture extensions as well as potential cross-contamination from stimulation operations in older wells. The plans themselves would not mitigate such releases but would act as an early warning system to identify the "best practices" to detect releases before they migrate further, or cause further damage.
- Additionally, operators are required to inform neighboring property owners or tenants "within a 1,500 foot radius of the wellhead and a 500 foot radius of the surface representation of the horizontal path of the subsurface parts of such well" before doing well stimulation treatment (See Public Resources Code, § 3160, subd. (d).) This advanced notice enables these individuals to obtain water quality testing – both before and after the well stimulation.

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Groundwater Monitoring Program

In order for the Specific Plan to be consistent with the requirements in SB 4, CSD EIR (MRS, 2008), and other applicable regulations, the following recommendations should be included in the existing groundwater monitoring program:

- Identify existing groundwater monitoring wells not currently in the monitoring program, and characterize their condition. If necessary, rehabilitate the wells identified in the following bullets that are recommended for inclusion in the groundwater monitoring program.
- Incorporate well MW-9, which is within the City IOF, into the groundwater monitoring program if it contains groundwater. This will all for the establishment of a baseline for shallow groundwater conditions within City property.
- Incorporate well MW-13 (in unincorporated IOF), which is a deep well (near the Pico Formation), into the groundwater monitoring program.
- Install a deep groundwater well within the City IOF to be included in the overall monitoring program. This new well and well MW-13 will establish baseline deep groundwater conditions beneath the IOF and specifically beneath the City IOF.

The following recommendations/mitigations apply to groundwater monitoring related to potential oil and gas production and well stimulation activities:

- Develop a groundwater monitoring plan consistent with the requirements of SB 4. Monitoring should be implemented prior to new Project Site activities so as to establish baseline conditions against which potential changes can be compared.
- Because recent research (Briskin et al., 2015) indicates that groundwater impacts related to well stimulation activities are more likely to derive from well failures and surface spills/discharges rather than from well stimulation, shallow and deep groundwater monitoring wells (within the fresh zone) should be installed adjacent to the vertical portions of slant and horizontal wells to establish baseline groundwater conditions and provide post-stimulation monitoring.
- Prior to well stimulation activities, install shallow and deep groundwater monitoring wells above the proposed horizontal stimulation transect and collect groundwater samples to establish baseline groundwater conditions.
- The Annual Drilling Plan shall be reviewed for planned well stimulation and directional drilling activities, so appropriate modifications can be made to the groundwater monitoring plan for resultant hydraulic fracturing.
- Based on review of water levels with respect to lithology, better subsurface understanding is needed to evaluate saturated conditions or perched intervals. Continuous logging of new boreholes for groundwater wells is recommended.
- Monitor groundwater wells on a regular (e.g., quarterly) basis to identify potential impacts to groundwater that may occur due to well stimulation activities. If contamination is detected, further assessment and mitigation will be required based on nature of the release or impact. Impacts may be reduced by implementing this measure due to earlier detection of a release leading to earlier attempts at remediation.

Data from groundwater monitoring is expected to provide information on the nature and extent of a potential release as well as potential early warning of a release, thereby improving the remedial response.

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Surface Water Monitoring Programs

The following recommendations apply to surface water monitoring programs for the Specific Plan:

- "… the Operator shall submit a Water Management Plan, to be reviewed and approved by the Public Works Director/City Engineer, that documents best water management practices."
- Any changes to drainage patterns and runoff at the City IOF will require a hydrologic analysis prior to implementation of grading.
- Specify that NPDES monitoring and testing requirements are applicable.
- State that, based on SB 4 EIR and the CCST study, produced water from stimulated wells should not be used for purposes such as irrigation.

Discharges from the Project Site that may reach Ballona Creek should be prevented and monitoring programs established to identify releases should be reviewed and updated as necessary. Currently, the NPDES permit requires sampling of the first detention pond discharge of each rainy season for various compounds, and each discharge must also be analyzed for additional compounds. Effluent monitoring must also be conducted within the first hour of each discharge event.

As previously stated, groundwater and surface water monitoring programs are regional by nature so that individual locations can be compared to the regional characteristics. Monitoring programs are required by the Specific Plan, SB4, the State, and as mitigation for the CSD. However, the existing program does not provide enough information about the overall IOF, or the smaller City IOF to determine groundwater or surface water quality.

Mitigation Measure for Inadequate Monitoring Program

In order to ensure that an adequate monitoring is developed, a licensed groundwater and a surface hydrologist shall prepare and certify the overall program.

10 LIMITATIONS

This work was prepared in a manner consistent with the level of care and skill ordinarily exercised by other members of Kleinfelder, Inc.'s, profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions, and recommendations are based on a limited number of observations and data. We have, however, satisfied ourselves that the quantity and nature of the existing observations and data are appropriate in our professional opinion to support our work per the standard of care to which we adhere. Kleinfelder, Inc., makes no other representation, guarantee, or warranty, expressed or implied, regarding the services, communication (oral or written), report opinion, or instrument of service provided.

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FIGURES

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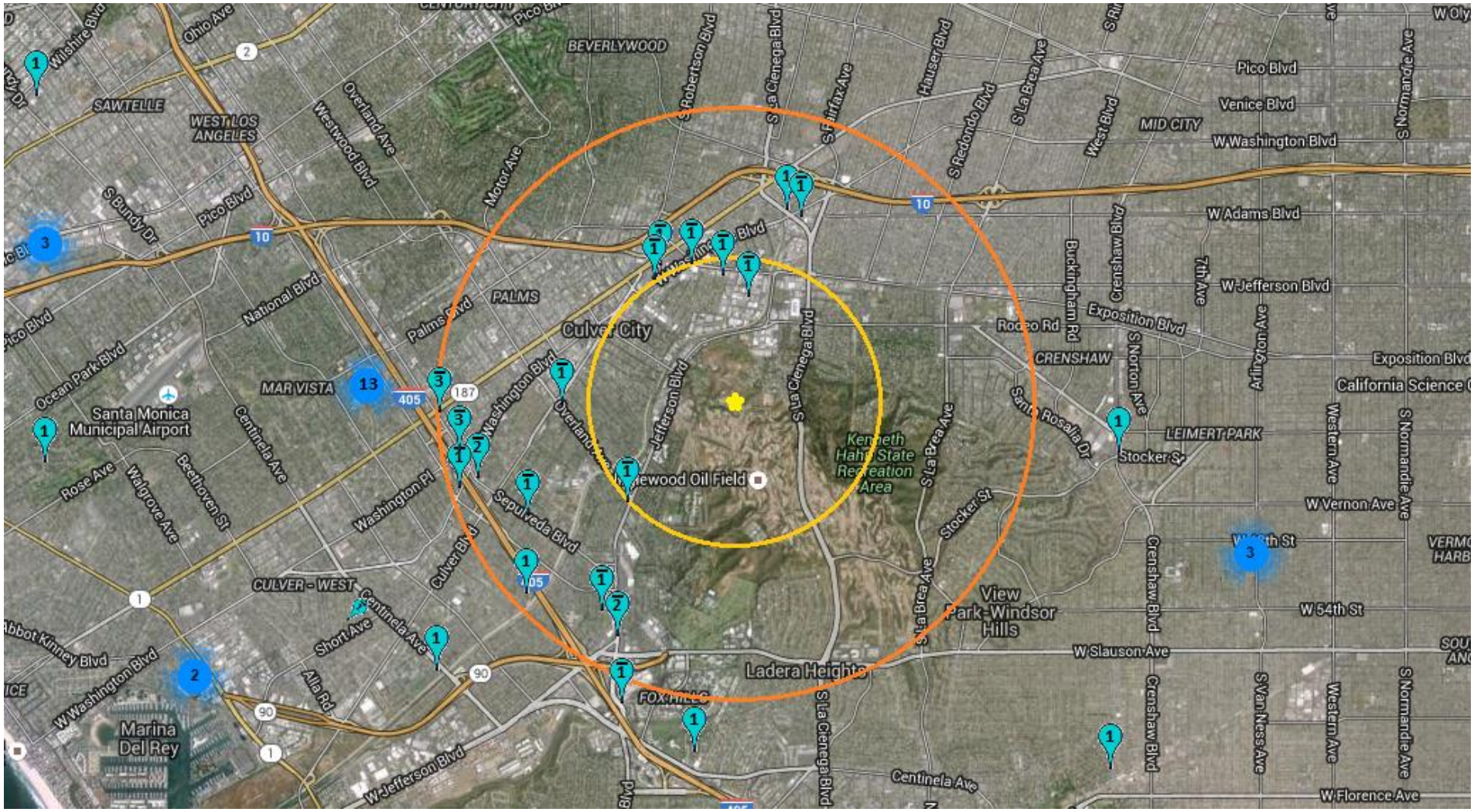

LEGEND

- Well Location, number of wells
- Approximate 1-mile radius from Project site
- Approximate 2-mile radius from Project site

Sources: Los Angeles County, 10/2016, http://dpw.lacounty.gov/general/wells/
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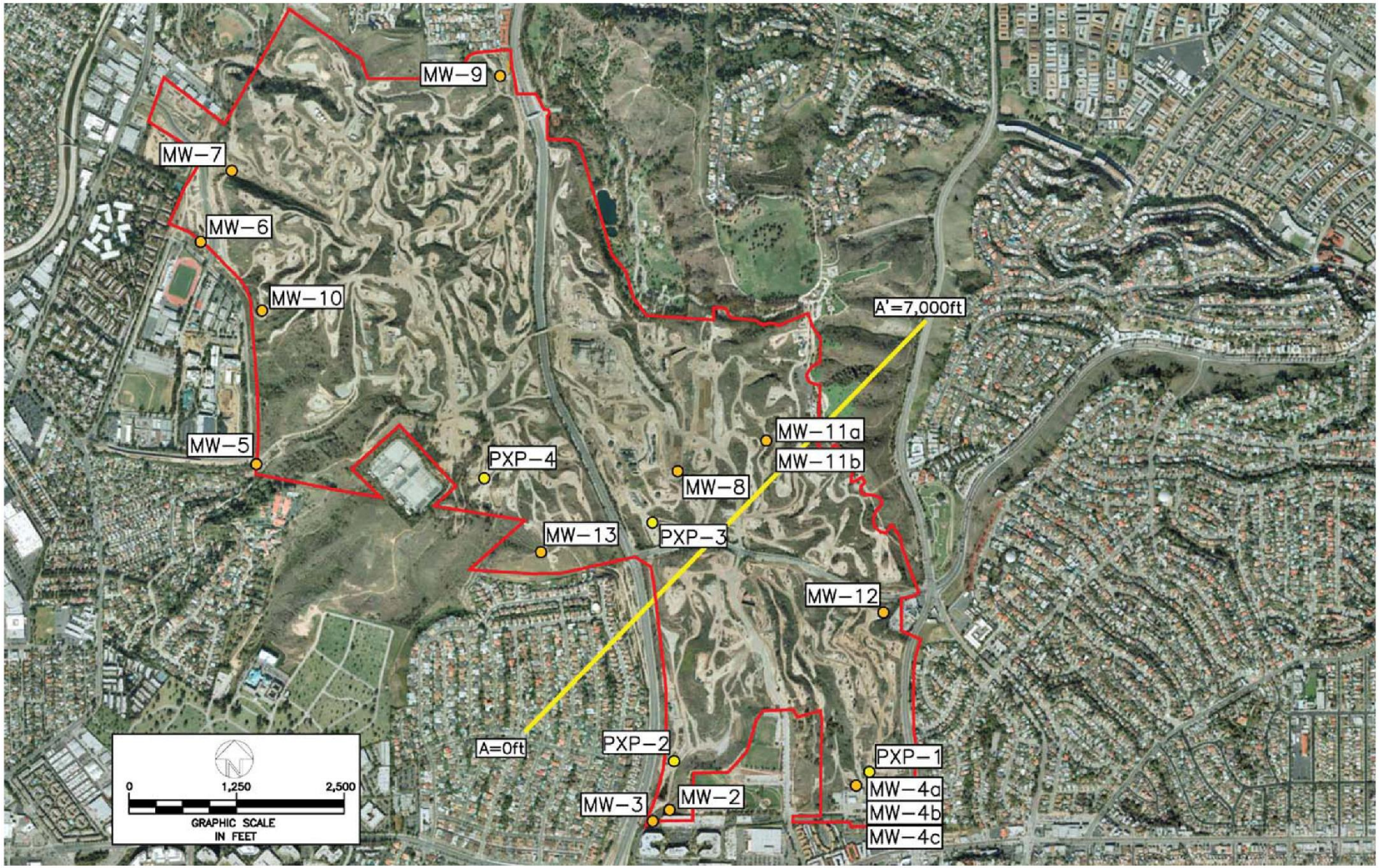
Groundwater Wells near the Project Site

HYDROLOGY AND WATER QUALITY TECHNICAL MEMORANDUM INGLEWOOD OIL FIELD SPECIFIC PLAN CULVER CITY, CALIFORNIA

FIGURE
1



LEGEND

- (MW) Monitoring Well Location
- PXP Dry Borehole
- Active Surface Field Boundary
- Cross-Section

Figure from Cardno ENTRIX, 2012. Hydraulic Fracturing Study PXP Inglewood Oil Field Prepared for Plains Exploration & Production Company, October

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Site Plan Showing Groundwater Well Locations

HYDROLOGY AND WATER QUALITY TECHNICAL MEMORANDUM INGLEWOOD OIL FIELD SPECIFIC PLAN CULVER CITY, CALIFORNIA

FIGURE 2

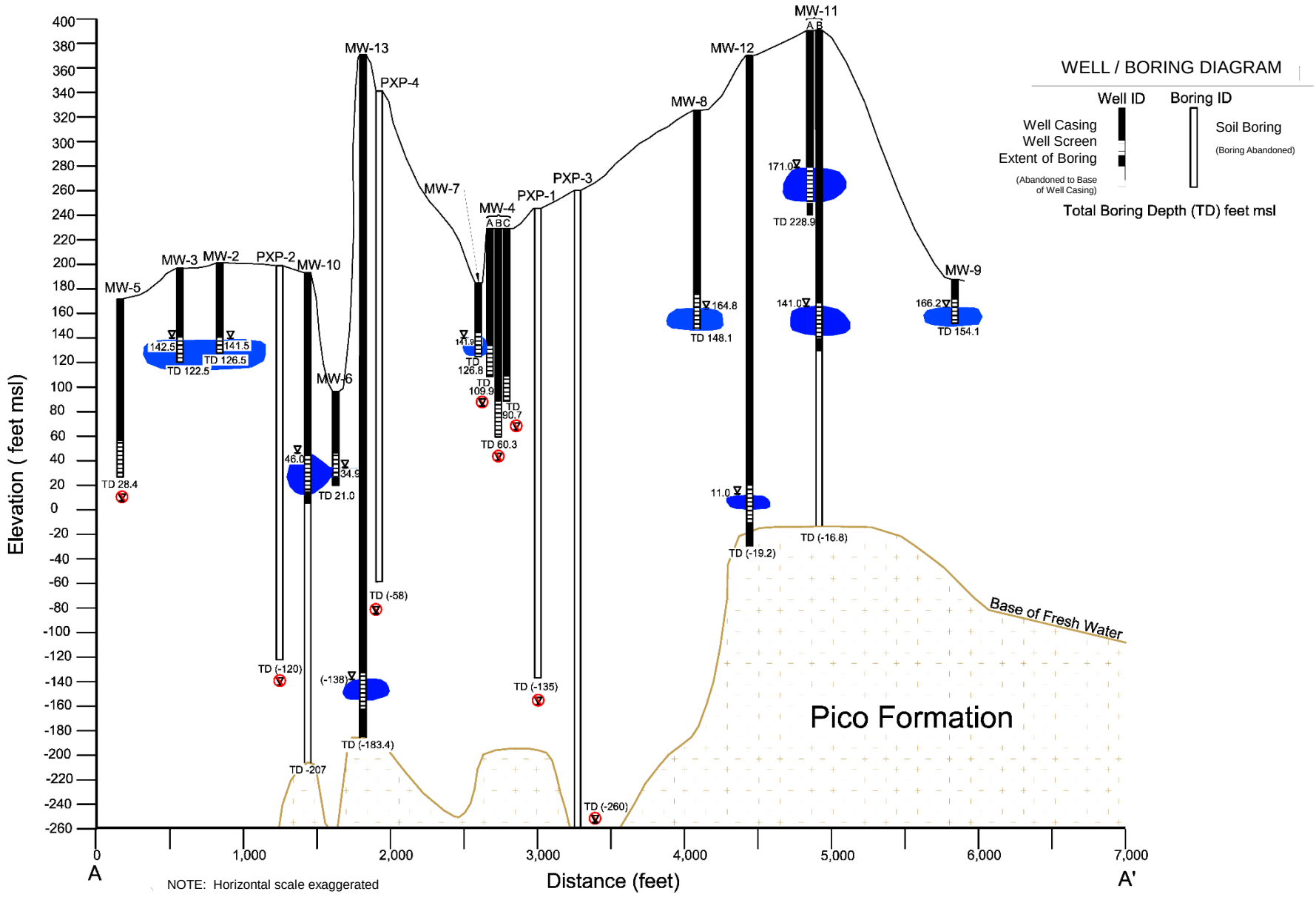

Figure from Cardno ENTRIX, 2012. Hydraulic Fracturing Study PXP Inglewood Oil Field Prepared for Plains Exploration & Production Company, October

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Groundwater Well Cross Section

HYDROLOGY AND WATER QUALITY TECHNICAL MEMORANDUM INGLEWOOD OIL FIELD SPECIFIC PLAN CULVER CITY, CALIFORNIA

FIGURE **3**