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Risk of Upset Analysis
Inglewood Oil Field Specific Plan EIR
Culver City, California

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Acronyms

API	American Petroleum Institute
ATSDR	Agency for Toxic Substances and Disease Registry
bbl	barrel
Blvd.	Boulevard
BSI	British Standards Institution
CAEMA	California Emergency Management Agency
CA OES	California Office of Emergency Services
CCST	California Council on Science and Technology
CDC	California Department of Conservation
CDE	California Department of Education
CUPA	Certified Unified Program Agency
DOGGR	California Division of Oil, Gas, and Geothermal Resources (DOGGR)
Dr.	Drive
FM O&G	Freeport-McMoRan Oil and Gas
ft	feet
gsf	gross square feet
HUD	U.S. Department of Housing and Urban Development
IOF	Inglewood Oil Field
kW	kilowatt
LACoFD	Los Angeles County Fire Department
LRT	Light Rail Transit
m^2	square meter
mi	mile
NOAA	National Oceanic and Atmospheric Administration
ppmv	parts per million, volume
psig	pounds per square inch gauge
PXP	Plains Exploration and Production
SCAQMD	South Coast Air Quality Management District
sec	second
sf	square feet
TOD	Transit on Demand
USEPA	U.S. Environmental Protection Agency
yr	year

SECTION 1.0 INTRODUCTION

1.1 PURPOSE

This Risk of Upset Technical Report ("Report") provides a discussion of risks of upset and public safety associated with oil and gas field operations at the Project Site, which is a portion of the Inglewood Oil Field (IOF) that lies within Culver City, California (Figure 1-1). This Report addresses various upset scenarios that could adversely affect public safety and provides a discussion of the analysis methods, results, and conclusions with recommended mitigation measures, as appropriate.

1.2 SCOPE

For this analysis, the Project Site study area includes: a tank farm, retention basin, several types of wells (active, idle, production, injection), and pipelines to transport the produced oil, water, and natural gas. The existing facilities are dispersed throughout the Project Site. The Report provides an assessment of both existing conditions and the Maximum Buildout Scenario, as discussed further below and is based on the assumption that the Inglewood Oil Field Specific Plan ("Specific Plan") has been implemented. The Specific Plan is a set of oil drilling regulations designed to help protect the public health, safety and welfare of the City of Culver City and surrounding communities, and the environment, based on site-specific conditions. Section 20, Safety and Risk of Upset, of the Specific Plan is the main relevant section for this Report and is included in Appendix A. Also relevant are the new storage tank setback of 500 feet (ft) (Section 16.D), and the drilling and redrilling setbacks for developed areas of 400 ft (Section 21.J).

1.3 RISK ANALYSIS APPROACH

1.3.1 PROJECT SITE CURRENT AND MAXIMUM BUILDOUT CONDITIONS

The analysis of the Project Site current and Maximum Buildout scenarios was accomplished in a three step process:

1. Identify potential upset scenarios.

2. Assess the likelihood that the upset scenarios could occur.

3. Analyze the consequences assuming the scenarios do occur.

Descriptions of the current and Maximum Buildout scenarios are provided in Section 1.4.3.

1.3.2 CUMULATIVE IMPACTS

The assessment of cumulative impacts includes an examination of the combined exposures from all sources in a geographic area. Sixteen projects in Culver City are considered to be cumulative projects (Table 1-1 and Figure 1-2).

TABLE 1-1. CUMULATIVE PROJECTS

No.	Project	Proposed Land Uses	Location	Jurisdiction
1	New single-story retail/office building	Single-story retail building totaling 14,800 sf with rooftop parking	5450 Sepulveda Blvd	City of Culver City
2	Washington/Landmark Mixed Use TOD (Platform)	New commercial development consisting of 41,745 gsf of restaurant and retail use, and 38,732 gsf of office use.	8810 thru 8850 Washington Blvd	City of Culver City
3	Access Culver City Mixed Use TOD	New mixed use development consisting of 115 residential units, retail (market and cafe) 31,240 gsf	8770 Washington Blvd	City of Culver City
4	Jesuit Novitiate	Construction of 4,740 sf of dormitories and related rooms with a total of 36 bedrooms and replacement of the existing chapel with a 1,660-sf chapel	10755 Deshire Pl	City of Culver City
5	Union 76	Gas station and convenience store; 2,676 gsf	10638 Culver Blvd	City of Culver City
6	Stoneview Nature Center	A new 4-acre park with a new 1-story, 4,000-sf building, with a multi-purpose room, staff office, and restrooms	5950 Stoneview Dr	City of Culver City
7	Sony 8-story office building, production services, and Culver parking expansion, Comprehensive Plan Conformance Review	Construction of an 8-story 218,450-sf office building, 51,716-sf support building, and expansion of an existing parking structure. Total demolition of 57,642 sf and replacement with212,524 net new sf	10202 Washington Blvd	City of Culver City
8	Airport Marina Ford	27,568-sf addition consisting of 29 service bays and 12,900 sf of parts and service	6002 Centinela Ave	City of Culver City
9	Willows School Comprehensive Plan	*Phase I:* new surface parking; increased student enrollment by 50 (from 425 to 475). *Phases II and III:* increase student enrollment by 100 (from 475 to 575).	8509 Higuera St and 8476 Warner Ave	City of Culver City
10	Expo LRT	New Light Rail station (Phase II)	Washington Blvd/National Ave	City of Culver City
11	12714–12718 Washington Blvd Mixed Use	New 4-story mixed-use building and subterranean parking with 5 units, 3,414 sf of retail, and 11,516 sf of residential.	12712–12718 Washington Blvd	City of Culver City
12	Wende Museum	Conversion of existing 12,596 sf armory building into a museum	10808 Culver Blvd	City of Culver City
13	11198 Washington Pl	New single-story commercial building comprising 3,850 sf with 11 parking spaces and 500 sf of outdoor dining/seating on vacant land	11198 Washington Pl	City of Culver City

No.	Project	Proposed Land Uses	Location	Jurisdiction
14	West Los Angeles College Community College Master Plan and EIR	Approximately 92,000 sf of new building construction and renovation. Anticipated future student population of approximately 18,904 students.	9000 Overland Ave	Los Angeles County
15	Fresh Paint	3-story mixed-use building consisting of a ground level salon, a mezzanine, and an office totaling 2,947 sf and 4 residential units on the third floor.	9355 Culver Blvd	City of Culver City
16	Inglewood Oil Field	Expand operations at the existing oil field to add as many as 500 new wells	Los Angeles County – immediately south of the Project Site	Los Angeles County

Source: City of Culver City 2015.
sf: square feet
TOD: transit on demand
gsf: gross square feet
LRT: Light Rail Transit

Cumulative projects #1 through #15 do not involve the production or handling of crude oil or gas, so would not increase the cumulative oil/gas release risk. Project #16 is the IOF, of which the Project Site is a portion. The IOF includes a much larger network of wells, pipelines, and processing facilities. The potential impacts of operating the IOF have been previously assessed through the development of potential scenarios and subsequent consequences (Los Angeles County 2008). These scenarios will be used for the cumulative impact assessment.

1.4 OIL FIELD CONDITIONS

1.4.1 INGLEWOOD OIL FIELD

This section provides a discussion of risk and hazard mitigation measures that have been implemented in the IOF. While there are locked gates where access to the IOF could be obtained (one is near Culver City Park), the main access to the site is located on Fairfax Avenue, south of Stocker Street, which is outside Culver City. The Fairfax/Stocker entrance provides on-site access to most of the IOF areas through internal roadways and bridges over La Cienega Boulevard.

Provisions established under the Baldwin Hills Community Standards District, which includes the IOF, are periodically reviewed, and implementation of the following provisions relative to security, upset, and emergency response have been found effective in mitigating the risk of upsets (Los Angeles County 2015):

- E.1. Fire Protection and Response
- E.3. Safety and Risk of Upset. Secondary containment volume is capable of containing volumes in excess of full tank volumes. Most of the above ground piping is not protected by pipeline-specific secondary containment or basin structures. Oil retention basin, however, prevents any fluid from this piping from going beyond the oil field boundaries.
- E.9. Lighting.
- E.13. Signs.
- E.20. Fencing.
- E.22. Security.
- E.25. Storage of Hazardous Materials.
- E.26. Drilling, Redrilling, and Reworking Operations (includes hydraulic fracturing).
- E.29. Tanks.
- F.3. Safety Inspection, Maintenance, and Quality Assurance Program.
- F.4. Annual Emergency Response Drills of the County and Culver City Fire Departments.

Table 1-2 provides a summary for the past five years of reported petroleum or chemical/hazardous material releases for IOF operations in the Los Angeles County portion. There has been one reportable release at the Project Site in the last five years – on November 24, 2013, an inter-facility pipeline between the Freeport-McMoRan Oil and Gas (FM O&G) “Packard” facility in the City of Los Angeles and the IOF, leaked seven barrels of produced water

that drained onto the street and then into the storm drain near Blackwelder Street (intersection of La Cienega and Fairfax Ave.). The produced water did not reach Ballona Creek.

TABLE 1-2. INGLEWOOD OIL FIELD REPORTED PETROLEUM OR CHEMICAL/HAZARDOUS MATERIAL RELEASES (LOS ANGELES COUNTY PORTION)

Date	Reported To	Volume	Location/Comments
06/11/2010	CAEMA LACoFD CUPA DOGGR	2.25 bbls oil 208 bbls produced water	Pipeline leak on pool line from the LAI 220 setting. Released fluids contained in a containment basin on site.
10/06/2010	CAEMA LACoFD CUPA DOGGR SCAQMD	7.4 bbls oil 90 bbls produced water	T-2 Tank overflow – all released fluids were isolated and contained on site.
06/24/2011	CAEMA LACoFD CUPA DOGGR	30 bbls oil	A valve on a tank failed causing the tank to overflow. All released oil was isolated and contained on site.
02/25/2012	CA EMA LACoFD CUPA DOGGR	90 bbls produced water	An injection trunk line leaked and approximately 2 bbls of the 90 bbls of produced water went out the front gate, down Stocker Street and back onto the lease.
03/04/2013	CA EMA LACoFD CUPA DOGGR	40 gallons oil 378 gallons produced water	A pool line leaked 40 gallons of oil and 378 gallons of produced water. All released fluids were isolated and contained on site.
05/01/2013	CA EMA LACoFD CUPA DOGGR	2 bbls oil	2 bbls of oil leaked from the LACT pipeline near well LAI1 197. All released oil was isolated and contained on site.
05/10/2013	CAEMA LACoFD CUPA DOGGR	1 bbl produced water	A produced water line leaked 1bbl of produced water. All released fluids were contained and isolated on site.
09/20/2013	CAEMA LACoFD CUPA DOGGR SCAQMD	30 bbls oil 600 bbls produced water	The LAI gunnite tank released oil and produced water to a containment basin on site. All released material was isolated and contained on site.
02/04/2014	CA OES NRC LACoFD CUPA DOGGR	5 bbls oíl	5 bbls of oil leaked from a pipeline from the BC Tank setting. All released oil was isolated and contained on site.
03/07/2014	CA OES LACoFD CUPA DOGGR	3bbls oil 10 bbls produced water	A flow line to well LAI1 429 released a mixture of oil and produced water. All released material was isolated and contained on site.
05/05/2014	CA OES NRC LACoFD CUPA DOGGR	>1 gallon produced water/oil mix	>1 gallon oil/water mix misted approximately 10' outside the FM O&G fence along La Cienega due to a pipeline leak.
05/08/2014	CA OES LACoFD CUPA DOGGR	25 bbls produced water	8" injection line released produced water near well LAI1 449. All of the produced water was isolated and contained on site.
07/12/2014	CA OES	20 bbls produced water	8" trunk line release near La Cienega and IOF overpass. The incident was reported as the line misted into the air and there was potential for the produced water to get off site; however, all released fluid was isolated and contained on site.

Date	Reported To	Volume	Location/Comments
02/23/2015	CA OES LACoFD CUPA DOGGR	10 bbls produced water	An injection trunk line released produced water from BC hill into a v-ditch along the north side of Stocker St. The water travelled west down Stocker and back onto the field prior to La Cienega Blvd. All released fluid was contained on site.
03/27/2015	CA OES LACoFD CUPA DOGGR	40 bbls oil 600 bbls produced water	T-1 tank pump malfunction results in a release. All released material was isolated and contained on site.
09/25/2015	CA OES LACoFD CUPA DOGGR	2.6 bbls oil 6 bbls produced water	VRU VIC1 flow line leaked. All released material was contained and isolated on site.

Source: FM O&G 2015b.
bbl: barrel
CAEMA: California Emergency Management Agency
CA OES: California Office of Emergency Services
CUPA: Certified Unified Program Agency
DOGGR: California Division of Oil, Gas, and Geothermal Resources
LACoFD: Los Angeles County Fire Department
SCAQMD: South Coast Air Quality Management District

A liquid release outside of the field would require that a drainage retention basin is drained when there is a release or that the valves controlling the release of material from the drainage basin are left open and a release occurs before the next inspection of the retention basin discovers the incorrect valve position. The IOF has an established procedure for confirming that there are no sheens or oil on the surface of retention basins before drainage. The retention basins are also inspected on a regular basis. Based on these procedures, a rupture release to the environment that would affect the areas/creek beds outside of the field was estimated to occur on the order of once every 5,200 years, assuming that all areas drain to a basin or containment area (Los Angeles County 2008).

Based on Phase I and Phase II site assessments conducted in 1990 and 1991, chemical contamination was reported in several locations within the IOF. The majority of the soil contamination was found to contain non-hazardous hydrocarbons (Non-hazardous Hydrocarbon-Impacted Soils) and low levels of heavy metals and other contaminants, below the action levels prescribed by the pertinent agencies (Los Angeles County 2008). According to the Envirostor Database, maintained by the California Department of Toxic Substances Control, the IOF is not located on the "Cortese" list and as such is not a hazardous materials site pursuant to Government Code Section 65962.5.

1.4.2 PROJECT SITE

Current Conditions

Seventy wells have been identified within the Project Site. Of the 70 wells, 37 are reported to be active (27 production wells and 10 injection wells), five wells are identified as idle, and 28 wells are identified as "plugged or abandoned" (DOGGR 2015). In addition to the wells, the T-Vickers Tank Farm is located in the Project Site and has the following equipment:

- 3 – 5,000 barrel above-ground storage tanks
- 1 – 3,000 barrel above-ground storage tank
- 1 – 1,000 barrel above-ground storage tank

- 1 – 100 horsepower pump

At the tank farm, oil and water are separated in large gravity settling tanks. The oil is continuously skimmed off the tanks and routed to holding tanks. From the storage tanks, the produced water and the oil are pumped to the central oil sales facility located outside the Project Site, in the northeastern portion of the Inglewood Oil Field (Los Angeles County 2008). The tank farm is surrounded by a dike, with an area of 30,456 ft^2 and an effective depth of 2 ft (60,912 cubic feet), which provides secondary containment for the rupture of one the larger tanks full of oil.

Water from the T-Vickers production tank is processed separately at the T-Vickers water plant, which consists of a single raw water tank, clarifier, and filtered water tank. The produced water is piped from the storage tanks to the central water plant or the small water plant at T-Vickers lease where it is treated and piped to injection wells for injection into the subsurface (Los Angeles County 2008). Neither water plant is located in the Project Site; therefore failures at these plants are outside the scope of this risk of upset analysis.

The Dabney Lloyd Basin is located within the boundaries of the Project Site on the north end of the field. The Basin 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 (Los Angeles County 2008).

The Culver City Fire Department (Department) has three fire stations, which are equipped to respond to emergencies at the IOF (Table 1-3). Fire Station #1 is located closest to the Project Site, but Fire Station #3 is closest to the entrance. The Fire Suppression Division includes both Hazardous Materials Response and Heavy Rescue Teams. The Department is supported by a mutual aid system with surrounding communities and agencies.

TABLE 1-3. CULVER CITY FIRE STATIONS

Station	Address	Equipment
Station #1	9600 Culver Blvd.	Headquarters
Station #2	11252 Washington Blvd.	1 Ladder Truck Available
Station #3	11304 Segrell Way	Engine Company

Table 1-4 summarizes the Department response to incidents at or near the Project Site in the last five years.

The City inspects oil wells and facilities at the field and issues operating permits for the equipment. During drilling activities, the California Division of Oil, Gas, and Geothermal Resources (DOGGR) issues the permits, oversees the drilling operations and inspects tanks. Once drilling is completed, the Department issues permits for the operations.

TABLE 1-4. CALLS FOR SERVICE AT OR NEAR THE PROJECT SITE BY THE CULVER CITY FIRE DEPARTMENT

Incident Address	Incident Date	Notes
9930 Jefferson Blvd.	January 2011	Edison liquid eliminator line stuck check valve; roadway leading to oil fields
9800 Jefferson Blvd.	March 2011	Report of smoke coming from the oil fields; nothing on arrival
9800 Jefferson Blvd.	June 2011	Brush fire behind West LA College
9800 Jefferson Blvd.	August 2011	Reported possible smoke in oil fields; nothing on arrival
9910 Jefferson Blvd.	July 2012	Grass fire in the park near baseball field
9910 Jefferson Blvd.	July 2012	Dog walker noticed gas smell at dog park; nothing on arrival
7009 Wrightcrest Dr.	April 2013	Brush fire at base of radio tower
5913 Stoneview Dr.	October 2013	Brush fire behind 5913 Stoneview Drive
6030 Wright Terrace	October 2013	Brush fire at top of Hetzler Road; electrical arcing blown transformer (Edison pole #0671); 4 acres
9800 Jefferson Blvd.	October 2013	1/2 acre fire 150 yards SW of Botts Field entrance of oil field
9800 Jefferson Blvd.	January 2015	50'x50' brush fire in park
9800 Jefferson Blvd.	January 2015	10'x10' brush fire in park
9800 Jefferson Blvd.	May 2015	Reported possible brush fire in oil fields; nothing on arrival

Blvd.: Boulevard
Dr.: Drive

Maximum Buildout Scenario

The risk of upset analysis is based on a "Maximum Buildout Scenario," rather than the procedures of a specific leaseholder or operator, as such procedures may change over time. The Maximum Buildout Scenario describes a combination of activities (e.g. construction, maintenance, and operation) that conservatively represents the potential impacts of oil field development in the context of the requirements and restrictions set forth in the Specific Plan. Because the Project would allow for activities within the Project Site to occur over time at an unknown rate of implementation through 2031, construction, maintenance, and operation activities will likely be occurring at the same time. Therefore, there would not be a defined short-term construction period and defined long-term operational period, like there is for most land development projects. Rather, the risk of upset analysis relies on the Maximum Buildout Scenario to set forth conservative development conditions within the Project Site.

According to Section 31.B.1. of the Specific Plan (Consolidation and Annual Drilling, Redrilling, Well Abandonment, and Well Pad Restoration Plan), the maximum number of wells to be drilled or redrilled on an annual basis will be two wells per year for the first two years. If the Community Development Director determines that the project is protective of the public health, safety and welfare, and the environment, then three wells per year may be drilled. A 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 over the ten year period.

Table 1-5 provides the assumed schedule of the Project Site well drilling activities in the context of existing wells that are assumed to be operational in future years.

TABLE 1-5. ANNUAL MAXIMUM NUMBER OF NEW WELLS ON PROJECT SITE

Year	Annual Maximum Number of New Wells	Existing/Future Conditions (Active Production and Injection)	Cumulative Total of On-Site Wells (Active Production and Injection)
Year 1: 2017	2	37	39
Year 2: 2018	2	39	41
Year 3: 2019	3	41	44
Year 4: 2020	3	44	47
Year 5: 2021	3	47	50
Year 6: 2022	3	50	53
Year 7: 2023	3	53	56
Year 8: 2024	3	56	59
Year 9: 2025	3	59	62
Year 10: 2026	3	62	65
Year 11: 2027	2	65	67

Well stimulation is not part of the drilling process but is a well completion technique applied after the well is drilled and sealed and is performed to maximize the extraction of underground resources from the target zone. Initial design of a given well takes into consideration whether stimulation is planned for that well. After the well is drilled and the casing is cemented through the producing interval, perforations are made through the casing with small, specially designed charges, which fracture the surrounding geological formation to allow hydrocarbon fluid from the producing formation to enter the well. Well stimulation might not be used until months or years after production has started in a given well (CDC 2015).

The Specific Plan currently does not have any restrictions on the number of wells that may be stimulated. Instead, a determination as to whether and upon what terms the adopted Specific Plan would allow well stimulation treatments to be conducted within the Project Site will be determined by the City Council after having reviewed the available information. It has been assumed that one is the maximum number of wells that may be hydraulically fractured at one time in the Maximum Buildout Scenario.

Figure 1-3 shows the Maximum Buildout Scenario constraints based on pipeline and tank setback requirements.

1.4.3 CHARACTERISTICS OF OIL, NATURAL GAS, AND ODORANT

As it emerges from the wellhead, crude oil is a mixture of solids, liquids, and gases, including sediments, water and water vapor, salts, acid gases (e.g., carbon dioxide and, sometimes, hydrogen sulfide), and flammable vapors (e.g. methane, propane, butane, and pentane).

Crude oil comes in many forms. Low viscosity and volatile oils are called "light", whereas viscous and low- or non-volatile oils are called "heavy". Light oils have an API gravity of 30 to 40 degrees, which means that the density is much less than 1.0 gram per cubic centimeter (g/cc) (the density of water). These oils float easily on water. By contrast, some heavy oils have an API gravity of less than 12 degrees and are so dense that they sink, rather than float, in water. Oil that has the same density of water has an API gravity of 10 degrees.

Crude oils are also characterized by REID vapor pressure. REID vapor pressure (ASTM Method D 323) is the absolute vapor pressure exerted by a liquid at 100°F. The higher this value, the more volatile the liquid and the more readily it will evaporate.

Hydrocarbons compose the majority of most crude oils and there are four main hydrocarbon groups:

- Saturates – hydrocarbons consisting of straight chains of carbon atoms.
- Aromatics – hydrocarbons consisting of rings of carbon.
- Asphaltenes – complex polycyclic hydrocarbons that contain many complicated carbon rings.
- Nitrogen-, sulfur- and oxygen-containing compounds.

In most oils, the saturate fraction is the largest, and is made up of two subgroups called paraffins and isoprenoids. Paraffins are simple, straight-chain hydrocarbons, whereas isoprenoids are hydrocarbon chains with branches. Waxes are long-chain paraffins that are solid at surface temperatures and may contain as many as 50 carbon atoms. Waxy oils tend to be thick and viscous, whereas aromatic oils tend to be light and volatile.

The major hydrocarbon constituents include:

- Alkanes (paraffins) **-** straight-chain normal alkanes and branched iso-alkanes with the general formula C_nH_{2n+2}. The major paraffinic components of most crude oils are in the C1 to C35 range.
- Cycloalkanes (naphthenes) - saturated hydrocarbons containing structures with carbon atoms linked in a ring. The cycloalkane composition in crude oil worldwide typically varies from 30 to 60 percent.
- Aromatic Hydrocarbons - most commonly benzene, benzene derivatives, and fused benzene ring compounds. The concentration of benzene in crude oil ranges between 0.01% and 1%.

Sulfur is a component of many natural compounds found in crude oil, including hydrogen sulfide. Total sulfur ranges from approximately 1%-4% by weight in crude oils, and hydrogen sulfide concentrations can reach 100 parts per million (ppm) in “sour” crudes. Hydrogen sulfide is a toxic gas that can cause injuries or fatalities if released to the atmosphere and inhaled. It has a strong, pungent odor detectable by humans at concentrations substantially below those which cause health effects; however, it also causes paralysis of the olfactory functions at concentrations below health effects (Los Angeles County 2008).

In contrast, the crude oil currently produced at the IOF is “sweet” crude oil, meaning it does not contain appreciable quantities of hydrogen sulfide. Other constituents of crude oil include nitrogen and oxygen compounds, and water- and metal-containing compounds, such as iron, vanadium, and nickel (Los Angeles County 2008).

Information regarding the physical properties of crude oil is needed to assess the effects of a potential spill from the facilities. These data are summarized in Table 1-6.

TABLE 1-6. CURRENT OPERATIONS CRUDE OIL PROPERTIES

Property	Value
API Gravity at 60° F	18.6-21.5[a]
REID Vapor Pressure (pounds per square inch)	0.65-0.88[b]
Sulfur Content (percent weight) (not the same as hydrogen sulfide)	< 1%
Hydrogen Sulfide	trace

Source: Los Angeles County 2008.
a. API Gravity is a measure of the quality of the crude. The lower the number the heavier the crude oil. Crude oil with API Gravity in the range of 18.6-21.5 would be considered moderately heavy crude.
b. REID vapor pressure is a measure of the volatility of the material. The crude oil has a fairly low level of volatility compared with other crude oils.
API: American Petroleum Institute

Hydrocarbon gas is also recovered from subsurface geological formations and processed at the IOF in the gas plant. The processed gas must conform to requirements established by Southern California Gas Company for use in their distribution system. The majority of the gas is methane with historical levels (between 2005 and 2007) of between 78-86%, with some smaller amounts of ethane (5%) propane (3%), butane (2%), pentane (1%), hexane+ (1-2%) and inert compounds (such as carbon dioxide up to 3%). Natural gas may present a hazard due to its flammability in the form of vapor cloud fires and explosions, and thermal radiation impacts due to flame jet fires emanating from a gas leak or rupture. Produced gas as it emerges from the wellheads at the field has historically contained some hydrogen sulfide in levels ranging from 0 to 10 ppm, which may be of health concern for humans if exposure to this concentration lasts for 10 minutes or more (ATSDR 2014).

Because natural gas is essentially odorless, an odorant is added to provide warning in case of a natural gas leak. The odorant used at the IOF odorant station, which is located in the County portion, is 100% tetrahydrothiophene (C_4H_8S). It is a liquid at standard conditions (68°F and atmospheric pressure) and has a boiling point of approximately 247°F. It can produce a flammable vapor with explosion limits of 1.1% to 12.3%. It has a low flash point of approximately 54°F; meaning that, above this temperature, sufficient volatile vapors are produced to create a flash if brought in contact with an ignition source. If spilled, or opened to the atmosphere, the odorant produces a vapor that is approximately three times heavier than air. It is defined as a colorless liquid with a stench, and is insoluble in water. Because the odorant's molecular structure contains sulfur atoms, if exposed to flames or high temperatures, it can produce toxic sulfur oxides.

1.5 CONCEPTUAL SITE MODEL

The conceptual site model describes the sources of physical hazard and the mechanisms or pathways by which humans or the built environment could be adversely affected should the identified hazard events occur.

Potential Hazards

Potential human impacts from Site operations can be initiated by upsets (e.g., accidents, breaks) at oil or gas wells, pipes, or tanks. Potential physical hazards of these upsets include fire, or explosions. Fires can result if flammable materials (e.g., oil and gas) are contacted by ignition sources (e.g., open flames, electrical sparks) in the presence of an oxidizer (e.g., oxygen in air). Different materials require different levels of ignition sources and oxidizers for a fire to result.

Explosions may result if a gas concentration is between its lower and upper explosive limits, and the gas is exposed to an igniter (e.g., open flame) in the presence of an oxidizer (e.g., oxygen in air). Different gases have different lower and upper explosive limits.

In the unlikely event of a fire or explosion, nearby human populations may be exposed to thermal radiation from a fire, which can result in burns, or the pressure wave from an explosion, which can cause external and internal physical damage.

Public receptors may also be exposed to hazardous and/or toxic chemicals during an upset condition.

Potentially Affected Public Receptors

Based on 2014 Census data, the population of Culver City was 38,949 (CDC 2015) in an area of 5.19 square miles. Approximately 8,400 residents are age 18 and under, and 5,400 are age 65 and older. Schools and parks are found throughout the City. The Brotman Medical Center is the major medical facility in the City. Nursing homes are located around the City.

Figure 1-4 shows the adjacent land uses. The area immediately north of the Project Site includes the single-family residential neighborhood of Blair Hills in Culver City, a multi-family development, Blair Hills Park, Baldwin Hills Scenic Overlook, and the Overlook's retention basin. The Baldwin Hills Scenic Overlook is a 68-acre State-owned park that has a visitor center and provides a hilltop vantage point of the surrounding communities and the Los Angeles Valley. West of the Project Site are some buildings off Jefferson Boulevard, and the Culver City Park, a 41.6-acre City park that is developed with a skate park (Culver City Skate Park), a dog park (The Boneyard), playgrounds, recreation huts with restroom facilities and picnic areas, barbeques, softball diamonds, half basketball courts, walking trails, a ropes course, and soccer fields. The southern boundary is the remainder of IOF. The eastern boundary of the Project Site is generally defined by La Cienega Boulevard.

Table 1-7 summarizes the distances to the nearest human receptors around the Project Site boundaries.

TABLE 1-7. NEAREST RECEPTORS TO PROJECT SITE

Human Receptor Location	Distance from Release to Receptor
Buildings off Jefferson Blvd.	50 ft
Blair Hill residences	650 ft (for Project Site gas pipeline) 1,200 ft (for Project Site oil pipeline and tanks)

Source: Los Angeles County (2008). Verified on imagery from Google Earth dated 7/8/2016.
Blvd.: Boulevard
ft: feet

Two schools are located within 0.25 miles of the Project Site:

- Star Education (10117 Jefferson Boulevard) located approximately 400 feet southwest of the western edge of the Project Site
- West Los Angeles Community College (9000 Overland Avenue) located approximately 1,000 feet south of the western section of the Project Site.

SECTION 2.0 UPSET SCENARIOS FOR ANALYSIS

Six primary upset scenarios for the current and Maximum Buildout scenarios were developed based on the operations and infrastructure described in Section 1.4. New processing facilities are not allowed under the Specific Plan, so were not addressed.

Table 2-1 summarizes the scenario conditions, consequence considered, and the human receptor locations of concern. The distance from each of the Scenarios to the nearest sensitive receptor is also listed. The Blair Hills area is just north of the Project Site and has 1,700 feet of piping within 650 feet (200 meters) of the development (Los Angeles County 2008).

TABLE 2-1. SCENARIO DESCRIPTIONS

Oil Field Equipment	Scenario ID	Upset Type	Conditions	Consequence Considered	Current Conditions		Changed Conditions in Maximum Buildout Scenario	
					Human Receptor Location*	Distance from Release to Receptor[a]	Human Receptor Location	Conditions
Oil Pipeline	A	Leak of 100 bbl.[b]	Ambient pressure; oil pool: 2,246 ft^2, 3 inches deep.	Pool fire	Blair Hill residences	1,200 ft.	.Developed Area	400 ft. setback for new pipelines
Gas Pipeline	B-L	Leak	18 inch pipe; 15 psig; 1 inch hole.	Jet fire	Blair Hills residences	650 ft.	.Developed Area	400 ft. setback for new pipelines
	B-R	Rupture	18 inch pipe; 15 psig; pipe completely severed.		Buildings off Jefferson Blvd.	50 ft.		
Wellhead (construction or operation)	C-L	Leak	Scenarios A and B-L have similar impacts, so Scenario C-L will not be separately assessed.				Developed Area	Up to 30 new wells. 400 ft. setback for new drilling or redrilling.
	C-R	Rupture	Scenarios A and B-R have similar impacts, so Scenario C-R will not be separately assessed.					
Tank (T-Vickers Farm)	D	Rupture (oil fills diked area)	Ambient pressure; oil pool: 30,456 ft^2, 0.5 ft deep.	Pool fire	Blair Hills residences	1,200 ft.	Developed Area	500 ft. setback for new tanks
Gas in Field	E	Gas in subsurface	Methane migration to nearby building.	Explosion	Nearby buildings	Within building	No change	
Well	F	Stimulation effect	NA	Increased seismicity	City residents and workers	Varied	Current locations and future developed areas	Increased number of well stimulation activities

a. Los Angeles (2008), Figure 2-9. Verified on imagery from Google Earth dated 7/8/2016.
b. Rounded up from largest oil leak reported in IOF during 2010 through 2015 (Table 1-4).
NA: not applicable
bbl: barrel
ft^2: square feet
ft: feet
psig: pounds per square inch gauge

"Daisy-chain" upsets, wherein one upset causes one or more additional upsets to occur are unlikely given the low (i.e., near ambient) pressure state of environmental and industrial conditions. Failure in an oil field system that is not under pressure generally lacks the requisite energy to trigger failure in another oil field system. Consequently, scenarios were considered individually.

Scenario A. Oil Pipeline Leak

An oil pipeline leaks 100 bbls, which is twice the largest IOF leak in Table 1-4. It is assumed that this spill is on level ground and spreads to a depth of 0.25 ft, which creates a pool size of 2,446 ft^2. It is further assumed that this results in a pool fire.

Scenario B. Gas Pipeline Leak or Rupture

The gas pipelines are 18 inches in diameter with a pressure of 15 pounds per square inch gauge (psig) (Los Angeles County 2008). The pipeline either has a leak from a 1-inch hole (scenario B-L), or is completely ruptured (scenario B-R). A jet fire results in both cases.

Scenario C. Wellhead Leak or Rupture

The wellhead surface pipes may leak or rupture, similar to Scenarios A and B. Thus, impacts for Scenario C are not separately calculated, but are addressed with Scenarios A and B. Except for some pressurized subsurface pockets, the oil and gas produced at the Project Site has not been under pressure (hence the need for well stimulation); therefore, well blow-outs, or high pressure pipeline leaks or ruptures have been rare.. This condition may change as drilling goes into deeper layers (e.g., Nodular shale and Sentours). Data on potential site blow-out conditions are not available.

Scenario D. Tank Rupture

As described in Section 1.4.3, the Project Site has an oil tank farm with secondary containment of 30,456 ft^2. It is assumed that oil pools to a depth of 0.5 ft following tank rupture and catches fire. The impacts discussed in Section 4 are dependent on the pool surface area and not on its depth.

Scenario E. Gas in Field

The near-surface gas is not under pressure. It may migrate, however, through the soil and enter a building, depending on the soil vapor pressure, migration pathways, and the characteristics of the building's foundation.

Scenario F. Well Stimulation

Currently, well stimulation is not occurring in the IOF (City or County areas). Well stimulation activities will commence in the future. Well stimulation activities in the Project Site will introduce increased pore pressure on the existing faults of the Newport-Inglewood Fault Zone. The very nature of hydraulic fracturing is to fracture the bedrock, thus creating microseisms (Kleinfelder 2016).

Increased seismicity has been reported with well stimulation in other states. No study, however, has specifically addressed seismicity associated with well stimulation in California (CCST 2015).

SECTION 3.0 RISK ANALYSIS METHODS

Risk is a function of probability and consequence. In other words, the likelihood of an adverse event and the nature and magnitude of the consequence of that event define the significance of a given risk. Risk managers depend on levels of risk significance to make decisions about whether a given risk requires mitigation. In this section, the risks identified in Scenarios A through F are analyzed, and to the extent possible, quantified and then compared to levels of significance that have been used in infrastructure and industrial risk assessments.

3.1 RISK ANALYSIS OF THERMAL RADIATION EXPOSURE

Potential thermal radiation burn injuries were estimated for fires that may occur under Scenarios 1 through 4 using ALOHA® version 5.4.5 software from the Office of Emergency Management, U.S. Environmental Protection Agency (USEPA), and Emergency Response Division, National Oceanic and Atmospheric Administration (NOAA) (USEPA/NOAA 2015). Atmospheric conditions for the model were set at the default California conditions (CDE 2007):

- Class D (neutral atmospheric stability).
- Wind speed of 3 m/sec.
- Temperature of 77^{o} F.
- Relative humidity of 50%.
- Cloud cover of 50%.

Meteorological sensors are located on the IOF meteorological station tower, which is 33 feet tall and located on the well pad of well #129 on Vickers Lease. Data from 2010 through 2014 indicate that winds are principally from the southwest except there are also winds from the northeast during the winter (December through February) (PXP 2011, 2012, 2013, and FM O&G 2014, 2015a). The receptors were set in ALOHA to be downwind of the incident for maximum exposure.

Chemical and source information for the ALOHA model are described in Table 2-1. ALOHA does not have crude oil as one of its described chemicals; therefore, CDE (2007) guidance was followed to use hexane as a substitute for crude oil to evaluate pool fires, with the exposure distances results then adjusted by a factor of 0.71 to account for the chemical substitution.

Scenario E was evaluated qualitatively because insufficient quantitative data were available for application to the Project Site with regard to explosion hazards, which may be associated with methane(e.g., near-surface methane concentrations, transport routes, and building conditions). The “Geology, Soils and Seismicity Technical Memorandum” (Kleinfelder 2016) does not provide quantitative information about the potential for seismic events from IOF well stimulation, so Scenario F was evaluated qualitatively.

3.2 THERMAL RADIATION EXPOSURE HEALTH CRITERIA

Table 3-1 contains quantitative criteria to evaluate potential thermal radiation injuries. The U.S. Department of Housing and Urban Development (HUD) considers 450 Btu/ft^2/hr (approximately equal to 1.4 kW/m^2 in metric units) as the maximum acceptable level of thermal radiation for people in open spaces where they congregate, such as parks and playgrounds (HUD 2011). The British maximum allowable value is 1.5 kW/m^2 for areas with people without protective clothing (BSI 2007). The two values are similar, and this Report uses 1.4 kW/m^2 for a thermal exposure safety criterion.

TABLE 3-1. THERMAL RADIATION BURN INJURY CRITERIA

Radiation Intensity (kW/m^2)	Time for Severe Pain (sec)	Time for Second Degree Burns (sec)
1	115	663
2	45	187
3	27	92
4	18	57
5	13	40
6	11	30
8	7	20
10	5	14 (potentially lethal within 60 sec)
12	4	11

Durations that correspond to effects like pain and second degree burns can vary considerably, depending on the circumstances. These effects were observed on bare skin that was exposed directly to the thermal radiation. Some types of clothing can serve as a protective barrier, and can affect the exposure duration.
Source: USEPA/NOAA 2015.
kW: kilowatts
m^2: square meters
sec: seconds

SECTION 4.0 RESULTS

4.1 SCENARIO PROBABILITIES

Table 4-1 presents probability estimates for each of the risk scenarios evaluated in this report. No data was found to distinguish above and below ground pipe failure rates. All probability estimates are considered low, with the highest probability being 5E-04 (0.0005) per year, or about once every 2000 years. Note these are not the probabilities that a leak or rupture will occur anywhere on the Project Site, but the probabilities that a leak or rupture may occur within the specified distance to human receptors, resulting in the estimated impact presented in Section 4. Also, the probabilities do not state when a leak or rupture will occur, only a long-run average condition. A leak or rupture might occur tomorrow, or not for hundreds or thousands of years.

4.2 SCENARIO IMPACTS

Scenarios A through D

Table 4-2 summarizes the analysis results for Scenarios A through D. Appendix B provides the inputs and outputs of the model runs. Considering both the current and maximum buildout conditions, there were only three scenarios and conditions in which the thermal radiation exposure exceeded 1.4 kW/m^2:

- Scenarios B-R and C-R. The buildings off Jefferson Boulevard are close to the gas pipeline under current and maximum buildout conditions. If people were outside when a pipeline ruptured and the contents caught fire, they could quickly suffer severe burns, with possibly fatal consequences if they are unable to evacuate quickly. Buildings would offer temporary protection from a fire, reducing the impacts if the people were inside at the time of the rupture. The buildings may also catch fire from the flame. This scenario, however, is estimated to have an occurrence frequency of about 6E-06 (0.000006) per year, or once in about 200,000 years. Gas pipelines are regularly sited through residential neighborhoods to supply natural gas to homes and fires or explosions associated with these installations are exceedingly rare on a pipeline-mile/year basis.

TABLE 4-1. SCENARIO PROBABILITIES

Oil Field Equipment	Scenario ID	Unit Release Probability	Units	Conditional Probability of Leak or Rupture Given Release	Conditional Probability of Ignition Given Leak or Rupture	Conditional Probability of Fire Given Ignition	Scenario Probability[a] (per yr)
Oil Pipeline	A	0.0023 per mi-yr	0.32 mi[b] (1700 ft)	0.8	0.09	0.95	5E-05
Gas Pipeline	B-L	0.00021 per mi-yr	0.32 mi[b] (1700 ft)	0.8	0.3	0.99	2E-05
	B-R	0.00021 per mi-yr	0.32 mi[b] (1700 ft)	0.2	0.45	0.99	6E-06
Wellhead (construction or operation)	C-L	Current conditions assumed to be similar to Scenarios A and B-L.					
	C-R	Current conditions assumed to be similar to Scenarios A and B-R.					
Tank (T-Vickers Farm)	D	2E-04[c]	5	1[c]	0.5[c]	0.95	5E-04
Gas in Field	E	NA	NA	NA	NA	NA	NA
Well	F	NA	NA	NA	NA	NA	NA

All conditional probabilities values are from CDE (2007) unless otherwise indicated.
a. Scenario probability is the product of the factors in the columns to the left..
b. Pipeline length assumed to present a continuous level of receptor exposure.
c. Los Angeles County (2008).
NA: quantitative data not available.
ft: feet
mi: mile
yr: year

TABLE 4-2. SCENARIO CONDITIONS AND CONSEQUENCES

Oil Field Equipment	Scenario ID	Upset Type	Conditions	Consequence Considered	Distance	Impact (thermal radiation, kW/m^2)
Oil Pipeline	A	Leak of 100 bbl.	Ambient pressure; oil pool: 2,246 ft^2, 3 inches deep	Pool fire	1,200 ft. 400 ft.	0.057 0.62
Gas Pipeline	B-L	Leak	18 inch pipe; 15 psig; 1 inch hole	Jet fire	650 ft. 400 ft. 50 ft.	Too small for software to report 0.043
	B-R	Rupture	18 inch pipe; 15 psig; pipe severed	Jet fire	650 ft. 400 ft. 50 ft.	0.31 0.85 **18**
Wellhead (construction or operation)	C-L	Leak	See results for Scenarios A and B-L.			
	C-R	Rupture	See results for Scenarios A and B-R.			
Tank (T-Vickers Farm)	D	Rupture (oil fills diked area)	Ambient pressure; oil pool: 30,456 ft^2, 6 inches deep	Pool fire	1,200 ft. 500 ft.	0.77 **4.9**

Values in **bold** exceed the HUD acceptable level of thermal radiation of 1.4 kW/m^2 (converted to metric units).
kW: kilowatts
m^2: square meters
bbl: barrel
ft^2: square feet
ft: feet
psig: pounds per square inch gauge

- Scenario D, at the maximum buildout. The maximum buildout assumed a distance of only 500 ft between a new tank and developed areas. At the estimated thermal exposure of 4.9 kW/m^2 for a person located outdoors, pain would be felt within about 13 seconds and second degree burns would occur after an exposure of about 40 seconds. Buildings would offer temporary protection from a fire, reducing the impacts if the people were inside at the time of the rupture. This scenario is estimated to have an occurrence frequency of 0.0005 per year, or once in about 2,000 years.

These results do not depend on the cause of the upset type and conditions (e.g., earthquake, corrosion). More wells in the maximum buildout scenario, if located near receptors (Table 2-1) will increase the probability of the upsets compared to the current condition for Scenarios C-L and C-R proportional to the increase in the number of wells over the current condition at the distances indicated. Because new wells will have a setback of 400 ft. (Table 2-1), they should not have a significant impact on thermal radiation impacts (see Table 4-2).

Volatile chemicals and odorants discussed in Section 1.4.3 are emitted in these scenarios, and may be detected by nearby receptors. These chemicals may be irritating and may produce short-term effects in sensitive receptors (e.g., children, elderly, and the infirm) under some conditions, but with regard to the scenarios discussed should be short-term in duration and not cause acute effects in healthy adults.

Scenario E – Gas in Field

In this scenario, soil methane is assumed to migrate by diffusion through the soil and enter a building. Methane concentrations cannot increase as it migrates through soil. Vapor concentrations decrease substantially going from soil to buildings. Only pressurized methane soil

gas can achieve explosive concentrations in building spaces adjacent to subsurface sources of methane. Re-pressurization conditions, however, can result in a hazard with soil gas at concentrations equal to or greater than lower explosive limit. Rising groundwater, formation of perched water above the diluted gas, low permeability soil, or confining layers above the gas can lead to a pressure increase. Ultimately, for a hazard to occur, the methane volume divided by the building's volume must be greater than methane's lower explosive limit, which is 50,000 parts per million by volume (ppmv) (Sepich 2006).

Over 90 soil gas samples were taken in the IOF during the Baldwin Hills Community Standards District environmental impact review. A majority showed soil gas extremely low concentrations (less than 2 ppmv). Higher concentrations were found near leaking wells. There is very little free gas associated with the reservoirs and gas migration does not appear to be an issue at IOF (Los Angeles County 2008).

The available information indicates that soil methane field conditions at the Project Site do not match the requirements for explosive impacts on buildings. However, it is not possible to preclude future conditions that might pressurize the gas in particular areas, potentially leading to an explosion. Changes in Project Site conditions that may lead to a pressurization of the soil gas should be reviewed to determine whether restrictions are required.

Scenario F – Well Stimulation

No induced earthquakes due to well stimulation are known to have been reported in California. The consensus among most researchers is that the likelihood of a large and damaging earthquake induced by well stimulation appears to be remote. However, research documents indicate that a minor to light-size earthquake could happen (Kleinfelder 2016).

It is not known to what extent the induced seismicity, from one hydraulic fracturing (or deep-well injection) event or numerous events may alter, or affect, the stress regime of an active fault, like the Newport-Inglewood Fault Zone, especially given that new wells will undergo hydraulic fracturing, and possibly deep water injection, within a relatively small oil field area. Research into this possibility is not known to exist. Therefore, the induced seismicity caused by hydraulic fracturing/deep water injection may trigger an earthquake along the active Newport-Inglewood fault with accompanying ground rupture. This could expose people or structures in the area to substantial geologic hazards, which could contribute to the risk of loss, injury, or death. Therefore this is considered a potentially significant impact at the Project Site.

It is also unknown what the effects of the induced seismicity from new wells in close proximity to each other will have on the stress regime of the Newport-Inglewood fault. Therefore, the induced seismicity could trigger a larger earthquake with accompanying strong ground shaking. This could expose people or structures in the area to substantial geologic hazards, which could contribute to the risk of loss, injury, or death. Therefore this is considered potentially significant impact at the Project Site.

The faults within the Project Site are part of the Newport-Inglewood Fault Zone, which is also located within the County IOF. Unfortunately, any induced-earthquake (due to well stimulation and/or wastewater disposal activities) ground rupture or shaking occurring within the County IOF will also affect the Project Site and vice versa and these consequences are considered to be significant and unavoidable (Kleinfelder 2016). Mitigation for ground rupture and shaking are generally accepted to be avoidance and advance preparation (Kleinfelder 2016).

4.3 SIGNIFICANCE CRITERIA

As defined in CEQA Appendix G (VII) (the Environmental Checklist Form), a significant safety effect is one in which the project "create[s] a potential health hazard or involve[s] the use,

production or disposal of materials which pose a hazard to people, animal or plant populations in the area affected".

This test of significance has been applied in this section by determining whether any of the following thresholds are exceeded:

- Threshold 7-2: Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment. This includes a thermal radiation exposure criterion of 1.4 kW/m^2.

- Threshold 7-3: Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter-mile of an existing or proposed school. Threshold 7-4: Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment.

- Threshold 7-5: Impair implementation of or physically interfere with an adopted emergency response or emergency evacuation plan.

4.4 EVALUATION OF EXISTING AND MAXIMUM BUILDOUT CONDITIONS

Table 4-3 summarizes the evaluation of the existing conditions of the Project Site against the thresholds relevant to upset conditions. Only Threshold 7-2, "Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment" is exceeded, with potentially significant impacts. Threshold 7-3 may be exceeded during an upset condition with the emissions of air contaminants

TABLE 4-3. SUMMARY OF PROJECT SITE THRESHOLD EVALUATION

Threshold Number	Threshold Condition	Existing Conditions	Maximum Buildout	Cumulative Impacts
7-2	Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment.	Diffusion of soil methane into a building may lead to an explosion if the soil gas is pressurized (e.g., rising groundwater).	Same as Existing Conditions. Thermal radiation exposure from a tank pool fire exceeds health criterion with the proposed 500-ft setback. The occurrence frequency is about once in 2,000 years. Well stimulation is considered a potentially significant seismic impact.	Additional facilities, flammable gases, and materials present increased risk of injuries, presenting potentially significant impacts.

Threshold Number	Threshold Condition	Existing Conditions	Maximum Buildout	Cumulative Impacts
7-3	Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter-mile of an existing or proposed school.	Two schools are within 0.25 miles, and thus may be exposed to air contaminants during an upset condition. Tthe wind is generally from the southwest, however, which will tend to blow any air releases away from the schools.	Same as Existing Conditions.	Same as Existing Conditions.
7-4	Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment.	Inglewood Oil Field is not on the list.	Same as Existing Conditions.	Same as Existing Conditions.
7-5	Impair implementation of or physically interfere with an adopted emergency response or emergency evacuation plan.	Unlikely that Project Site oil and gas activities will interfere with emergency response or emergency evacuation plans in the surrounding communities.	Same as Existing Conditions.	Same as Existing Conditions.

4.5 CUMULATIVE IMPACTS

Cumulative projects that could impact the safety and risk analysis include commercial, industrial, educational, as well as residential projects. For risk of upset and safety, impacts of a cumulative project are realized by increasing the receptor populations that could be affected by the future field operations, increasing the frequency or volume of oil spills into the same environment as the potential development, or increasing the public safety risks to the same populations as the potential development.

Although the winds are generally from the southwest, the results for the assessment of the entire IOF are used to approximate the maximum potential cumulative public safety impacts to Culver City from IOF incidents. The IOF assessment scenarios (Los Angeles County 2008) included:

Scenario 1: Rupture or Leak of Gas Plant Low Side Equipment (scenario 1a1)

This scenario involves rupture of the gas equipment downstream of the gas gathering system but before compression to higher pressures. The release location would be at the gas plant. Failures would be due to piping or valve breaks, vessel failures, pressure safety valve releases or a compressor failure. It was modeled as both a rupture and a leak with the entire contents of the gas gathering system being released. The rupture case conservatively assumed a break of 18 inches, or the largest pipe diameter. The leak case assumed a hole size of one-inch. The release was modeled at normal operating pressure

and temperature. The gas composition was produced gas. Possible consequences include flame jets and flammable vapor clouds.

Scenario 1a2: Rupture of Field Vacuum piping under pressure (scenario 1a2-4)

This scenario involves rupture of the gas gathering piping in the field before compression to higher pressures. The release location would be at three locations around the field that are located close to residential areas. These include near Freshman Avenue, near Kenneth Hahn State Recreation Area and near Windsor Hills. Failure would be due to piping ruptures or leaks and a corresponding failure of the vacuum system to retain vacuum, allowing the gathering system to pressurize. Pipe lengths were evaluated based on the length of gathering piping located within 650 feet (200 meters) of residential areas. It was modeled as both a rupture and a leak with the entire contents of the gas gathering system being released. The rupture case conservatively assumed a break of 18 inches, or the largest pipeline diameter. The leak case assumed a hole size of one-inch. The release was modeled at normal operating pressure and temperature. The gas composition was produced gas. Possible consequences include flame jets and flammable vapor clouds.

Scenarios 2–5: Rupture or Leak of Gas Plant Equipment

These scenarios involve a rupture or leak of equipment within the gas plant located near the center of the IOF. Releases would be due to piping failures, vessels failures, valve failures, pressure safety valve releases, heat exchanger failures or compressor failures. The gas plant equipment was divided into four operating groups, at 100 pounds per square inch gauge (psig), 300 psig, 600 psig and 1,000 psig.

Scenario 6: Rupture or Leak at Propane Vessels and Loading Equipment

This scenario encompasses the propane storage and loading area. This system is located in the center of the facility just southeast of the gas plant. The rupture case assumed a rupture of the vessels or a pipe rupture of three inches (the pipe diameter) or a failure of the loading hose or truck system. The leak case assumed a hole size of one-inch. Release dispersion assumed a 2-phase jet. The release was modeled at normal operating pressure and temperature. Possible consequences include flame jets, flammable vapor clouds, explosions and Boiling Liquid Expanding Vapor Explosions.

Scenario 7: Rupture or Leak at Gas Liquids Vessel

This scenario encompasses the gas liquids storage area. This system is located in the center of the facility just southeast of the gas plant. The rupture case assumed a rupture of the vessels or a pipe rupture of two inches (the pipe diameter). The leak case assumed a hole size of one-inch. Release dispersion assumed a 2-phase jet. The release was modeled at normal operating pressure and temperature. The composition was assumed to be butane. Possible consequences include flame jets, flammable vapor clouds, explosions and Boiling Liquid Expanding Vapor Explosions.

Scenario 8: Rupture or Leak at Propane Refrigeration System

This scenario encompasses the propane refrigeration system. This system is located in the gas plant. The rupture case assumed a rupture of the vessels or a pipe rupture of two inches (the pipe diameter). The leak case assumed a hole size of one inch. Release dispersion would be a 2-phase jet. The release was modeled at normal operating pressure and temperature. Possible consequences include flame jets, flammable vapor clouds, explosions and Boiling Liquid Expanding Vapor Explosions.

Scenario 9: Crude Oil Release with Fire at Storage or Spill Outside Field

This scenario encompasses the crude oil storage systems at the site. The equipment includes a crude oil storage tank and piping and is located in various locations throughout the site. The scenario assumes a catastrophic loss of the tank contents into the dike area with subsequent ignition and fire. Possible consequences include large crude oil fires and thermal radiation. The LAI tank farm area is located closest to populations (La Cienega Blvd) and was used as the worst case location for a crude oil fire.

This scenario also encompasses a spill of crude oil from any crude tank or piping at the field with subsequent failure of the drainage basins to contain the spill. A release from the drainage basin is addressed through an operator opening the drain valve or the drain valve being left open and not closed during a subsequent basin inspection. This scenario assumes that all tank and piping areas would drain to a drainage basin.

Scenario 10: Odorant Releases

This scenario includes the odorant facilities located at the gas plant. Releases would be due to equipment or tank failures or releases during tank filling operations if vapor control is not implemented or fails. Odorant could cause toxic impacts if inhaled at sufficiently high concentrations.

The following scenario impacts were described (Los Angeles County 2008):

- Most of the scenario releases do not produce fatalities at populated areas. The gas plant is located more than 300 feet from La Cienega Blvd and more than 600 feet from Kenneth Hahn State Recreation Area. The field gas piping is located no closer than 250-300 feet from residences and roadways. The only scenarios that could produce fatalities offsite, at a frequency of about once in a million years, are:
    - The rupture releases from the propane storage and transfer facilities and the gas liquids facility, including explosions and Boiling Liquid Expanding Vapor Explosions that could reach Kenneth Hahn State Recreation Area.
    - The crude oil tanks at the LAI facility, if a large spill occurred with a subsequent fire, could cause thermal radiation on La Cienega Blvd that could cause fatalities.
- The proximity of the gas liquid (e.g., propane and butane) storage system to Kenneth Hahn State Recreation Area produces significant risk due to the potential for large gas liquids releases.
- The injury scenarios that reach populated areas include:
    - Release of flammable gas from the gas plant impacting La Cienega Blvd.
    - Releases of propane and gas liquids.
    - Releases of crude oil at the LAI tank farm causing thermal impacts along La Cienega Blvd.
    - Releases from field piping near Windsor Hill, Kenneth Hahn State Recreation Area and Freshman Ave.

- The odorant releases producing concentrations sufficient to produce serious injuries or fatalities do not reach populated areas. None of the injury scenarios occur at a frequency or produce of sufficient magnitude to produce significant risk. This is due to the separation distances from the gas plant to residences or Kenneth Hahn State Recreation Area and the use of a vacuum based field gas gathering system, which reduces the frequency of piping releases.

With the implementation of the identified mitigation measures, these cumulative impacts would be reduced to less than significant levels (Los Angeles County 2008). Thus, they would not contribute significantly to the Project Site impacts.

Well stimulation over the IOF creates a potentially significant impact, but adherence to the proposed mitigation actions will help lessen the effects from induced earthquake ground rupture or shaking to less than significant with mitigation

4.6 UNCERTAINTIES

There are many sources of uncertainty that affect the risk results. These uncertainties include:

- Release frequency.
- Release size.
- Population impacts, including likelihood of fatality/serious injury.
- Behavior of the release (jet mixing versus passive dispersion).
- Accuracy of the hazard model.
- Ignition sources and probabilities.

The release frequencies and sizes are the most important contributors to overall uncertainty. Changes in failure rates will directly influence the risk profile. A doubling of the event frequencies would double the probability of injuries. Changes in the relative sizes of leaks and ruptures will influence the risks.

SECTION 5.0 CONCLUSIONS AND RECOMMENDATIONS

Although their probabilities of occurrence may be low, the scenarios that show the Project Site presents potentially significant impacts if they do occur are the following:

- Siting new tanks at the proposed 500-ft setback.
- Migration of soil methane into buildings if the gas is re-pressurized.
- Increased well stimulation possibly leading to increased seismicity.

The remainder of this section provides a discussion of mitigation measures and residual levels of significance.

5.1 MITIGATION MEASURES

Mitigation measures that would reduce the projected impacts in the current and Maximum Buildout scenarios include:

- Decrease the probability and/or potential impacts (e.g., increase setback distance, reduce diked surface area) of tank rupture oil fires.

- Test the local soils for soil gas, and periodically review for changed conditions that might re-pressurize the soil gas at the Project Site.

- Since larger earthquakes are related to deep-water injection, not necessarily hydraulic fracturing, then mitigation should include prohibition of wastewater disposal into deeper strata indefinitely, subject to the discretion the City of Culver City.

5.2 RESIDUAL LEVELS OF SIGNIFICANCE

The implementation of the mitigation measures should reduce the residual risk levels to insignificance.

The residual risks associated with well stimulation may include groundwater pollution for well integrity issues, release of methane to groundwater or to atmosphere if a damaging earthquake occurs, and public concerns about hazards associated with living next to an oil field conducting well stimulation along an active fault.

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FIGURES

Figure 1-1. Project Site Location

Figure 1-2. Location of Cumulative Projects

Figure 1-3. Maximum Buildout Scenario Constraints

Figure 1-4. Adjacent Land Uses

Appendix A

Section 20, Safety and Risk of Upset

Inglewood Oil Field Specific Plan (proposed)

SECTION 20. SAFETY AND RISK OF UPSET.

The Operator shall at all times conduct Oil Operations in a manner that minimizes risk of accidents and the release of hazardous materials in accordance with the best available technology and safety devices for the prevention of accidents. Operator shall give written notice to the Fire Chief and Community Development Director, as well as all other required authorities, of any and all reportable accidents occurring as a result of Oil Operations or on the Oil Field site, within two working days of the accident. Failure to provide the required notice may result in revocation of the Drilling Use Permit in accordance with the provisions of Section 8. The Operator shall comply with the following provisions:

A. Blowout Preventer. Operator shall not drill a well without equipping such well with a blowout preventer, installed and maintained as required by DOGGR and with all safety orders of the State Division of Industrial Safety for drilling and production. Upon cementing of the surface string of casing and prior to drilling out the shoe of said string, a blowout preventer, tested and approved by DOGGR, shall be installed in accordance with the most current DOGGR requirements. Such equipment shall be capable of being operated from the driller's station and from another remote station. Redrilling, reworking and maintenance operations shall be equipped with blowout preventer equipment at the onset of operations in accordance with the most recent requirements of DOGGR. Blowout preventers shall be maintained in good condition and shall be required to be tested at intervals as requested by DOGGR. Blowout preventer flanges and kill valves at the casing head shall be kept free of fluids to allow for routine inspection at any time.

B. Well Casings. Operator shall equip the well with casings of sufficient strength and with safety devices in accordance with DOGGR requirements.

C. Safety Precautions. The Operator shall comply with all of the current safety precautions required by any State agency or the City.

D. Belt Guards. Belt guards shall be required over all drive belts on drilling, redrilling and reworking equipment. Guarding shall be in compliance with Title 8 of the California Code of Regulations, Section 6622, or as may be subsequently amended.

E. Secondary Containment for Oil.

1. The Operator shall ensure that all existing oil tanks and all new tanks have secondary containment (berms and/or walls) that can contain at least 110 percent of the largest oil tank volume for as long as necessary to respond and clean up a tank spill, in order to reduce the likelihood of oil spills entering the retention basins. In the event the Public Works Director/City Engineer determines that it would be infeasible to provide 110 percent containment for a particular existing oil tank, the Operator shall provide containment at a level determined by the Public Works Director/City Engineer to be feasible.

2. All above ground piping in the Oil Field that contains or could contain oil shall be protected by basins or secondary containment measures (berms and/or walls). All new piping shall be above ground and shall have alarm sensors or another

comparable system for immediately detecting leaks. All above ground piping shall be visually inspected for leaks on a daily basis. All existing underground piping shall be tested for leaks on an annual basis. Any pipes found to be leaking shall be promptly replaced with new piping meeting the requirements of this Ordinance.

F. Retention Basins. All retention basins used in Oil Operations shall be adequately sized, sited, inspected, maintained and operated to handle a 100-year storm event to the satisfaction of the Public Works Director/City Engineer.

Attachment B

ALOHA® Model Input/Output Summaries

Scenario A

SITE DATA:
Location: LOS ANGELES, CALIFORNIA
Building Air Exchanges Per Hour: 0.66 (unsheltered single storied)
Time: June 1, 2015 1000 hours PDT (user specified)

CHEMICAL DATA:
Chemical Name: N-HEXANE Molecular Weight: 86.18 g/mol
AEGL-1 (60 min): N/A AEGL-2 (60 min): 2900 ppm AEGL-3 (60 min): 8600 ppm
IDLH: 1100 ppm LEL: 12000 ppm UEL: 72000 ppm
Ambient Boiling Point: 155.2° F
Vapor Pressure at Ambient Temperature: 0.20 atm
Ambient Saturation Concentration: 201,950 ppm or 20.2%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 3 meters/second from w at 3 meters
Ground Roughness: open country Cloud Cover: 5 tenths
Air Temperature: 77° F
Stability Class: D (user override)
No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:
Burning Puddle / Pool Fire
Puddle Area: 2246 square feet Average Puddle Depth: 0.25 feet
Initial Puddle Temperature: Air temperature
Flame Length: 34 yards Burn Duration: 8 minutes
Burn Rate: 2,850 pounds/min
Total Amount Burned: 22,995 pounds

THREAT ZONE:
Threat Modeled: Thermal radiation from pool fire
Red : 52 yards --- (10.0 kW/(sq m) = potentially lethal within 60 sec)
Orange: 73 yards --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)
Yellow: 110 yards --- (2.0 kW/(sq m) = pain within 60 sec)

Distances below use the 71% adjustments for a conversion from hexane to crude oil (California Department of Education. 2007. Guidance for Protocol for School Site Risk Analysis).

THREAT AT POINT:
Thermal Radiation Estimates at the point:
Downwind: 563 feet Off Centerline: 0 feet
Max Thermal Radiation: 0.617 kW/(sq m)
This is 400 feet for crude oil.

Thermal Radiation Estimates at the point:
Downwind: 1690 feet Off Centerline: 0 feet
Max Thermal Radiation: 0.0568 kW/(sq m)
This is 1200 feet for crude oil.

Scenario B-L

SITE DATA:
Location: LOS ANGELES, CALIFORNIA
Building Air Exchanges Per Hour: 0.66 (unsheltered single storied)
Time: June 1, 2015 1000 hours PDT (user specified)

CHEMICAL DATA:
Chemical Name: METHANE Molecular Weight: 16.04 g/mol
PAC-1: 2900 ppm PAC-2: 2900 ppm PAC-3: 17000 ppm
LEL: 50000 ppm UEL: 150000 ppm
Ambient Boiling Point: -258.9° F
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 3 meters/second from w at 3 meters
Ground Roughness: open country Cloud Cover: 5 tenths
Air Temperature: 77° F
Stability Class: D (user override)
No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:
Flammable gas is burning as it escapes from pipe
Pipe Diameter: 1 inches Pipe Length: 1700 feet
Unbroken end of the pipe is connected to an infinite source
Pipe Roughness: smooth Hole Area: 0.79 sq in
Pipe Press: 30 psia Pipe Temperature: 77° F
Max Flame Length: 2 yards
Burn Duration: ALOHA limited the duration to 1 hour
Max Burn Rate: 12.1 pounds/min
Total Amount Burned: 77.0 pounds

THREAT ZONE:
Threat Modeled: Thermal radiation from jet fire
Red : less than 10 meters(10.9 yards) --- (10.0 kW/(sq m) = potentially lethal within 60 sec)
Orange: less than 10 meters(10.9 yards) --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)
Yellow: less than 10 meters(10.9 yards) --- (2.0 kW/(sq m) = pain within 60 sec)

THREAT AT POINT:
Thermal Radiation Estimates at the point:
Downwind: 50 feet Off Centerline: 0 feet
Max Thermal Radiation: 0.043 kW/(sq m)

Thermal Radiation Estimates at the point:
Downwind: 400 feet Off Centerline: 0 feet
There is no significant thermal radiation at the point selected.

Thermal Radiation Estimates at the point:
Downwind: 650 feet Off Centerline: 0 feet
There is no significant thermal radiation at the point selected.

Scenario B-R

SITE DATA:
Location: LOS ANGELES, CALIFORNIA
Building Air Exchanges Per Hour: 0.66 (unsheltered single storied)
Time: June 1, 2015 1000 hours PDT (user specified)

CHEMICAL DATA:
Chemical Name: METHANE Molecular Weight: 16.04 g/mol
PAC-1: 2900 ppm PAC-2: 2900 ppm PAC-3: 17000 ppm
LEL: 50000 ppm UEL: 150000 ppm
Ambient Boiling Point: -258.9° F
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 3 meters/second from w at 3 meters
Ground Roughness: open country Cloud Cover: 5 tenths
Air Temperature: 77° F
Stability Class: D (user override)
No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:
Flammable gas is burning as it escapes from pipe
Pipe Diameter: 18 inches Pipe Length: 1700 feet
Unbroken end of the pipe is connected to an infinite source
Pipe Roughness: smooth Hole Area: 254 sq in
Pipe Press: 30 psia Pipe Temperature: 77° F
Flame Length: 39 yards
Burn Duration: ALOHA limited the duration to 1 hour
Burn Rate: 3,930 pounds/min
Total Amount Burned: 144,231 pounds

THREAT ZONE:
Threat Modeled: Thermal radiation from jet fire
Red : 36 yards --- (10.0 kW/(sq m) = potentially lethal within 60 sec)
Orange: 57 yards --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)
Yellow: 90 yards --- (2.0 kW/(sq m) = pain within 60 sec)

Thermal Radiation Estimates at the point:
Downwind: 50 feet Off Centerline: 0 feet
Max Thermal Radiation: 17.8 kW/(sq m)

Thermal Radiation Estimates at the point:
Downwind: 400 feet Off Centerline: 0 feet
Max Thermal Radiation: 0.846 kW/(sq m)

Thermal Radiation Estimates at the point:
Downwind: 650 feet Off Centerline: 0 feet
Max Thermal Radiation: 0.311 kW/(sq m)

Scenario D

SITE DATA:
Location: LOS ANGELES, CALIFORNIA
Building Air Exchanges Per Hour: 0.66 (unsheltered single storied)
Time: June 1, 2015 1000 hours PDT (user specified)

CHEMICAL DATA:
Chemical Name: N-HEXANE Molecular Weight: 86.18 g/mol
AEGL-1 (60 min): N/A AEGL-2 (60 min): 2900 ppm AEGL-3 (60 min): 8600 ppm
IDLH: 1100 ppm LEL: 12000 ppm UEL: 72000 ppm
Ambient Boiling Point: 155.2° F
Vapor Pressure at Ambient Temperature: 0.20 atm
Ambient Saturation Concentration: 201,950 ppm or 20.2%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 3 meters/second from w at 3 meters
Ground Roughness: open country Cloud Cover: 5 tenths
Air Temperature: 77° F
Stability Class: D (user override)
No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:
Burning Puddle / Pool Fire
Puddle Area: 30456 square feet Average Puddle Depth: 0.5 feet
Initial Puddle Temperature: Air temperature
Flame Length: 84 yards Burn Duration: 16 minutes
Burn Rate: 38,600 pounds/min
Total Amount Burned: 623,640 pounds

THREAT ZONE:
Threat Modeled: Thermal radiation from pool fire
Red : 165 yards --- (10.0 kW/(sq m) = potentially lethal within 60 sec)
Orange: 232 yards --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)
Yellow: 360 yards --- (2.0 kW/(sq m) = pain within 60 sec)

Distances below use the 71% adjustments for a conversion from hexane to crude oil (California Department of Education. 2007. Guidance for Protocol for School Site Risk Analysis).

THREAT AT POINT:
Thermal Radiation Estimates at the point:
Downwind: 704 feet Off Centerline: 0 feet
Max Thermal Radiation: 4.89 kW/(sq m)
This is 500 feet for crude oil.

Thermal Radiation Estimates at the point:
Downwind: 1690 feet Off Centerline: 0 feet
Max Thermal Radiation: 0.772 kW/(sq m)
This is 1200 feet for crude oil.