Santa Barbara County
Air Pollution Control District

Our Vision Clean Air

Health Risk Assessment Report

Greka South Cat Canyon Oil and Gas Leases
Reporting Year 2003

1.0 SUMMARY

In March 2010, the Santa Barbara County Air Pollution Control District (District) conducted an air toxics Health Risk Assessment (HRA) for Greka South Cat Canyon Field Oil and Gas Leases, using the Hotspots Analysis and Reporting Program (HARP) software, Version 1.4a (Build 23.07.00). In March 2013, the District revised the HRA using HARP Version 1.4.f (Build 23.11.01). Cancer risk and chronic and acute non-cancer Hazard Index (HI) risk values were calculated and compared to *significance thresholds* for cancer and chronic and acute non-cancer risk adopted by the District's Board of Directors. The calculated risk values and applicable thresholds are as follows (with significant risks shown in **bold**):

	Greka South Cat Canyon Max Risks	Significance Threshold
Cancer risk:	8.33/mil	≥10/million
Chronic non-cancer risk:	0.0336	≥ 1
Acute non-cancer risk:	**3.444**	≥ 1

Based on these results, the operations at Greka South Cat Canyon Field Oil and Gas Leases present a significant risk on a public roadway. For that reason, a new Risk Reduction Audit and Plan is required.

2.0 BACKGROUND

2.1 Facility Operations

Greka's South Cat Canyon Stationary Source is comprised of five oil and gas leases: Bell, Blockman, Palmer Stendl, UCB and Dominion. Production at the Bell, Blockman, Palmer Stendl, UCB and Dominion leases is piped to the central processing facility at the Bell Lease. The crude oil processed at the Bell Lease is sent offsite via pipelines or tanker trucks. Produced gas is separated at the Bell Lease and then piped to Bell's compressor plant where it is scrubbed and compressed. The processed gas is either piped to offsite locations or used in field combustion equipment. Field gas is used by the boilers and heater treaters at the Bell Lease, and to power stationary, natural gas-fired internal combustion engines for gas compression, crude oil pumping and wastewater injection equipment units at the Bell compressor plant.

2.2 Greka South Cat Canyon Historical Ownership

The Bell, Blockman and Palmer Stendl leases were previously owned by Saba Peteroleum and were transferred to Greka in 1999. The UCB and Dominion leases were owned by Santa Maria Refining Company, a subsidiary

of Greka, from 2000 to 2002. From 1997 to 2000, the UCB and Dominion leases were owned by HVI-Cat Canyon, Inc. HVI-Cat Canyon, Inc purchased UCB and Dominion from Oilwell Technologies & Enhancement Corp. at the end of 1997. Oilwell Technologies & Enhancement Corp. owned the leases for just over a year. Dominion Oil/OTEC owned the Dominion lease from late 1991 and the UCB lease from early 1992 through the end of 1996.

In August 2002, the ownership of Vintage's West Cat Canyon leases was transferred from Vintage Petroleum to Greka. Vintage's West Cat Canyon leases became part of Greka's "Cat Canyon Stationary Source". From 2002 through 2008, Greka's "Cat Canyon Stationary Source" consisted of 14 leases. On December 31, 2008, two of these leases, California and United California, were transferred back to Vintage Petroleum. This transfer resulted in the division of Greka's "Cat Canyon Stationary Source" into four stationary sources; Greka North Cat Canyon, Greka South Cat Canyon, Greka Central Cat Canyon and Vintage Central Cat Canyon.

2.3 Greka South Cat Canyon in the AB 2588 Air Toxics "Hot Spots" Program

The Air Toxics "Hot Spots" Information and Assessment Act requires businesses and industries throughout the state to: 1) quantify and report their emissions of listed air toxics; 2) assess the possible health risks from their emissions; 3) notify members of the public who are exposed to significant risks attributable to their emissions; and, 4) take steps to reduce this risk.

Due to Greka's "Cat Canyon Stationary Source" significant risk status in the AB 2588 Air Toxics "Hot Spots" Program, Greka is required to update their air toxics emission inventory and health risk assessment on a quadrennial basis. The HRA described in this report was conducted as part of the quadrennial update process in the AB 2588 program for inventory year 2003.

2.4 Health Risk

As used in this report, the term "health risk" addresses the likelihood that exposure to a given toxic air contaminant under a given set of conditions will result in an adverse health effect. Health risk is affected by several factors, such as: the amount, toxicity, and concentration of the contaminant; the meteorological conditions; the distance from emission sources to people; the distance between emission sources; the age, health, and lifestyle of the people living or working at a location; and, the duration of exposure to the toxic air contaminant.

Health effects are divided into cancer and non-cancer risks. "Cancer risk" refers to the increased chance of contracting cancer as a result of an exposure, and is expressed as a probability: chances-in-a-million. The values expressed for cancer risk do not predict actual cases of cancer that will result from exposure to toxic air contaminants. Rather, they state a possible risk of contracting cancer over and above the background level.

For non-cancer health effects, risk is characterized by a "Hazard Index" (HI), which is obtained by dividing the predicted concentration of a toxic air contaminant (TAC) by a Reference Exposure Level (REL) for that pollutant that has been determined by health professionals, the Office of Environmental Health Hazard Assessment (OEHHA) and the California Air Resources Board (ARB). RELs are used as indicators of the potential adverse effects of chemicals. A REL is the concentration at or below which no adverse health effects are anticipated for specific exposure duration. Thus, the HI is a measure of the exposure relative to a level of safety and is appropriately protective of public health. Each TAC emitted by the facility has a different emission rate and a different REL. A HI for each TAC is calculated separately at each modeled receptor location. A composite HI at each receptor is then calculated as the sum of HIs for each individual TAC. The maximum HI reported here for each scenario is the maximum composite HI among all receptors.

2.5 Health Risk Assessment for Reporting Year 1998

UCB and Dominion leases were not part of the stationary source the last time Greka's Cat Canyon was modeled. The previous HRA results for Greka's Cat Canyon sources based on inventory year 1998 are shown below (with significant risks shown in **bold**).

	Bell, Blockman, Palmer Stendl Max Risks	Significance Threshold
Cancer risk:	**12 /million**	≥10/million
Chronic non-cancer risk:	0.27	≥ 1
Acute non-cancer risk:	**22.93**	≥ 1

The cancer risk identified in the Cat Canyon HRA for inventory year 1998 was driven by polycyclic aromatic hydrocarbons (PAH) from internal combustion engines (ICEs) and boilers. Acrolein from ICEs and boilers was the largest contributor to the acute non-cancer risk.

The 1998 risk from operations at the UCB and Dominion leases are shown below (with significant risks shown in **bold**).

	UCB/Dominion Max Risks	Significance Threshold
Cancer risk:	2 /million	≥10/million
Chronic non-cancer risk:	0.05	≥ 1
Acute non-cancer risk:	**4.3**	≥ 1

Acrolein was the primary contributor to the significant risk status in 1998. Acrolein is a combustion product of boilers, heater treaters, and internal combustion engines operating on field gas.

The acute non-cancer risk in the 2003 HRA is reduced from the 1998 HRAs, largely due to the change in the acute Reference Exposure Level of acrolein. In December 2008, the Office of Environmental Health Hazard Assessment changed the REL of acrolein from 0.19 $\mu g/m^3$ to 2.5 $\mu g /m^3$. OEHHA reevaluated acrolein and found that it is safe for even sensitive individuals to be exposed to acrolein at levels up to 2.5 $\mu g/m^3$.

The chronic non-cancer risk in the 2003 HRA was reduced from the 1998 HRAs, also due to changes in RELs by OEHHA.

2.6 Health Risk Assessment for Reporting Year 2003

The HRA for inventory year 2003 was conducted as part of the quadrennial reporting cycle under the AB 2588 Air Toxics "Hot Spots" Program. Greka submitted an Air Toxics Emission Inventory Plan (ATEIP) that discussed the methodologies used for quantifying emissions. Upon District approval of the ATEIP, Greka calculated the emissions and submitted that information in an Air Toxics Emissions Inventory Report (ATEIR). The District reviewed and modified data in the ATEIR for the HRA as discussed below and in Section 5.0, *Emissions*, of this report.

As part of the ATEIP and ATEIR effort, Greka hired a source test contractor to conduct emissions testing on a boiler for aldehydes. The District reviewed the source test report and approved the report with modifications for inclusion in the HRA. The source test results were used for all external combustion equipment (e.g., boilers, heater treaters, flare). In addition, Greka hired a testing contractor to sample and analyze field gas and diluent tank headspace for hydrogen sulfide. The District reviewed and approved specific results from the report for use in the HRA.

The HRA for 2003 contained emission factors, emission rates, and some source parameters that were revised in Greka's final submittal of the ATEIR or from sampling and source test results. In addition, one emitting source was outside of the property boundary and well area, indicating that the UTM coordinates were not correct. The District modified the UTM coordinates by placing the emitting source near the wells.

The 2003 ATEIP contained property boundaries for Greka's "Cat Canyon Stationary Source." Revised property boundaries were required for the HRA due to the division of the "Cat Canyon Stationary Source" into four stationary sources. For that reason, the District modified the boundaries to reflect the new stationary sources. The District used maps provided by the USGS and the Department of Oil and Gas (DOG), with the boundaries Greka submitted in the ATEIP, to determine the UTM coordinates for the new boundaries for each stationary source. The DOG map, *DOG Map 310.pdf*, and the USGS maps, *Sisquoc_O34120G3_geo.PDF*, and, *Twitchell_Dam_O34120H3_geo.PDF*, are found in the *GrekaSouthCatCanyon2003HRAvol1.zip* file. It was found that the coordinates Greka submitted did not match the coordinates from the USGS maps. For that reason, and since the buildings and stacks coordinates were also submitted by Greka, it was necessary to modify Greka's coordinates instead of using coordinates directly from the USGS maps. For future risk assessments, the UTM coordinates for the property boundaries, buildings, and stacks should be revised based on the same data source (e.g., USGS map). The modified property boundaries are found in *Greka and Vintage Cat Canyon Revised Property Boundaries.xls* in the *GrekaSouthCatCanyon2003HRvol1A.zip* file.

The HRA was updated in March 2013 based on Greka's comments on the draft HRA. The draft HRA used conservative assumptions for the multipathway analysis. At Greka's request, the District conducted a site survey to refine the assumptions used for the multipathway analysis. See Section 8.3 for additional information on the site survey and multipathway analysis.

3.0 FACILITY INFORMATION

EQUIPMENT OWNER/OPERATOR:	Greka
SOURCE IDENTIFICATION NUMBER:	2658
EQUIPMENT LOCATION:	Greka South Cat Canyon
FACILITY UTM COORDINATES:	Greka provided the UTM coordinates of the facility's property boundaries, buildings and structures, and emission release points. The District modified the property boundary to reflect the current stationary source. UTM Zone 10, Datum: NAD 83 Easting: 745200 m, Northing: 3856850 m
EQUIPMENT DESCRIPTION:	The HRA addresses emissions from 64 stacks or emission release points, including internal combustion engines, boilers, tanks, loading racks, well heads, well cellars, solvent usage and fugitive components.

4.0 STACKS AND MODELING PARAMETERS

The stack locations and modeling parameters used in the HRA are found in Table 4.1. Modifications made to the source parameters by the District are documented as footnotes in Table 4.1. Additional information on the modeling parameters and devices is found in the ATEIP and ATEIR.

Table 4.1 – UTM Coordinates and Modeling Parameters for Emission Release Points

HARP Stack ID	Stack Name	Lease	Release Type	UTM East (m)	UTM North (m)	Release Height (ft)	Temp (F)	Velocity (fpm)	Stack Diam (ft)	Sigma Yint Vol Width (ft)	Sigma Zint Vol Height (ft)	Xint Area X-width (ft)	Yint Area Y-width (ft)
1826	Boiler H-117	Bell	Point	745130	3857305	20.0	460	332	1.33	Not applicable to point sources			
1827	Boiler H-118	Bell	Point	745113	3857301	20.0	460	332	1.33				
1828	Glycol Regenerator	Bell	Point	745553	3856125	16.0	460	852	0.83				
1829	Pumping Unit Well 111	Bell	Point	744082	3856967	9.0	531	3600	0.25				
1830	Pumping Unit Well 132	Bell	Point	746228	3855269	9.0	531	3600	0.25				
1831	Pumping Unit Well 135	Bell	Point	745282	3856379	9.0	531	3600	0.25				
1832	Pumping Unit Well 164	Bell	Point	745629	3857264	9.0	531	3600	0.25				
1833	Pumping Unit Well 166	Bell	Point	745408	3857070	9.0	531	3600	0.25				
1834	Pumping Unit Well 169	Bell	Point	746225	3855751	9.0	531	3600	0.25				
1835	Pumping Unit Well 170	Bell	Point	746153	3855960	9.0	531	3600	0.25				
1836	Pumping Unit Well 21	Bell	Point	746426	3855651	9.0	531	3600	0.25				
1837	Pumping Unit Well 171	Bell	Point	745537	3856070	9.0	531	3600	0.25				
1838	Pumping Unit Well 28	Bell	Point	746228	3855309	9.0	531	3600	0.25				
1839	Pumping Unit Well 33	Bell	Point	745711	3857128	9.0	531	3600	0.25				
1840	Pumping Unit Well 92	Bell	Point	745841	3855808	9.0	531	3600	0.25				
1841	Pumping Unit Well 41	Bell	Point	743994	3857874	9.0	531	3600	0.25				
1842	Pumping Unit Well 42	Bell	Point	743941	3858032	9.0	531	3600	0.25				
1843	Pumping Unit Well 51	Bell	Point	743901	3857168	9.0	531	3600	0.25				
1844	Pumping Unit Well 52	Bell	Point	744136	3858205	9.0	531	3600	0.25				
1845	Pumping Unit Well 53	Bell	Point	744139	3857981	9.0	531	3600	0.25				
1846	Pumping Unit Well 75	Bell	Point	744502	3856950	9.0	531	3600	0.25				
1847	Pumping Unit Well 79	Bell	Point	744892	3856134	9.0	531	3600	0.25				
1848	Pumping Unit Well 87	Bell	Point	745522	3856731	9.0	531	3600	0.25				
1849	Pumping Unit Well 89	Bell	Point	744891	3856554	9.0	531	3600	0.25				
1850	Pumping Unit Well 97	Bell	Point	745822	3855414	9.0	531	3600	0.25				
1851	Pumping Unit Well 120	Bell	Point	746010	3855565	9.0	531	3600	0.25				
1852	Pumping Unit Well 161	Bell	Point	745898	3856720	9.0	531	3600	0.25				
1853	Generator 250 BHP	Bell	Point	745525	3856135	9.0	531	3600	0.25				
1854	Crude Tank BE-2001 [1]	Bell	Point	745158	3857304	16.0	150	0.01	0.01				
1855	Wash Tank BE-5001 [1]	Bell	Point	745157	3857277	24.0	180	0.01	0.01				
1856	Wash Tank BE-10001 [1]	Bell	Point	745157	3857249	24.0	180	0.01	0.01				
1857	Pumping Unit Well 4	Blockman	Point	744903	3857532	9.0	531	3600	0.25				
1858	Pumping Unit Well 305-H	Blockman	Point	745153	3857844	9.0	531	3600	0.25				
1859	ICE #2 - Injection Pump #2	Blockman	Point	745234	3857642	9.0	531	3600	0.25				
1860	Injection Pump #2	Blockman	Point	745234	3857642	9.0	531	3600	0.25				
1861	Injection Pump #4	Blockman	Point	745235	3857640	9.0	531	3600	0.25				
1862	Injection Pump #7	Blockman	Point	745240	3857634	9.0	531	3600	0.25				
1863	Injection Pump #10	Blockman	Point	745241	3857624	9.0	531	3600	0.25				
1864	Injection Pump #13	Blockman	Point	745242	3857620	9.0	531	3600	0.25				
1865	Injection Pump #14	Blockman	Point	745242	3857615	9.0	531	3600	0.25				
1866	ICE Injection Charge Pump	Blockman	Point	745206	3857611	9.0	531	3600	0.25				
1867	Pumping Unit Well 12	Palmer-Stendl	Point	745555	3858214	9.0	531	3600	0.25				
1868	Pumping Unit Well 12H	Palmer-Stendl	Point	745567	3858194	9.0	531	3600	0.25				
1869	Pumping Unit Well 48-23	Dominion	Point	745346	3858363	9.0	531	3600	0.25				
1870	Pumping Unit Well 57-23	Dominion	Point	745488	3858503	9.0	531	3600	0.25				
1871	KD Tank DN-501 [1]	Dominion	Point	745247	3858587	14.0	67	0.01	0.01				
2181	Pumping Unit Well UCB #1	UCB	Point	744742	3858365	9.0	531	3600	0.25				
1805	Oil/Water Sump – Upper Pond [2]	Bell	Area	745088	3857341	0.0	Not applicable to area sources					67.08	67.08
1806	Emergency Water Pit [2]	Bell	Area	745086	3857363	0.0						61.97	61.97
1807	Vacuum Truck Clean Out Pit [2]	Bell	Area	745091	3857374	0.0						30.00	30.00
1808	Emergency Pit [2]	Bell	Area	745090	3857368	0.0						31.62	31.62
1809	Crude Drain Pit [2]	Bell	Area	745084	3857337	0.0						94.02	94.02
1810	Grade Level Loading Rack	Bell	Area	745042	3857344	3.3						3.28	3.28
1811	Blochman Ponds Sump [2]	Blockman	Area	745119	3857506	0.0						57.45	57.45
1812	KD Loading Rack [3]	Dominion	Area	745247	3858587	3.3						3.28	3.28
1891	Fugitive Components: Main Process Area (Bell Tank Battery)	Bell	Volume	745100	3857225	3.28	Not applicable to volume sources			76.3	1.53	Not applicable to volume sources	
1799	Well Heads, Well Cellars and Solvent Usage	Bell	Volume	744510	3857592	3.28				451.6	1.53		
2161	Well Heads, Well Cellars and Solvent Usage	Bell	Volume	744600	3856334	3.28				803.3	1.53		
1803	Well Heads, Well Cellars and Solvent Usage [4]	Bell	Volume	745408	3855565	3.28				790.2	1.53		
1892	Fugitive Components: Main Process Area (Blochman Ponds)	Blockman	Volume	745169	3857554	3.28				76.3	1.53		
1885	Well Heads, Well Cellars and Solvent Usage	Blockman	Volume	745103	3857794	3.28				76.3	1.53		
1887	Fugitive Components, Well Heads, Well Cellars and Solvent Usage	Palmer-Stendl	Volume	745517	3858144	3.28				76.3	1.53		
1900	Fugitive Components, Well Heads, Well Cellars and Solvent Usage	Dominion	Volume	745346	3858363	3.28				108.3	1.53		
1919	Fugitive Components, Well Heads, Well Cellars and Solvent Usage	UCB	Volume	745346	3858363	3.28				108.3	1.53		

Notes:

1 The modeling parameters (i.e., release height, temperature) were modified from Greka's submittal to be consistent with the APCD permit for the tanks.

2 The release heights for pits and sumps were modified by the APCD to ground level (0 feet).

3 The UTM coordinates for this stack that were submitted by Greka were not within the Dominion area. The APCD modified these coordinates to be consistent withth the KD Tank DN-501.

4 The UTM coordinates for this stack that were submitted by Greka were outside the facility boundary. The APCD modified the coordinates to so that the stack was within the Bell lease.

5.0 EMISSIONS

The emission estimate techniques were presented in the ATEIP for inventory year 2003. Emissions were quantified in the 2003 ATEIR. Since the submittal of the ATEIP and ATEIR, the District reviewed and modified the sampling/source test results. These included the following:

1. Source test results for a field gas-fired boiler at Bell Lease (Greka South Cat Canyon) for acrolein, formaldehyde and acetaldehyde. Prior to testing, the District reviewed and approved the source test plan. The District reviewed the source test report and modified the results to reflect the method's (ARB Method 430) calculations. The District approved the modified report and used the modified results in the HRA reported herein.

2. Hydrogen sulfide samples were taken at the gas compressor intakes (prior to H_2S removal) at the Bell gas plant on August 27, 2004 and from the diluent tank head space at Greka's North Cat Canyon Security Fee facility on March 25, 2005. The District reviewed and approved the raw gas results. The raw gas results were used for fugitive components, crude storage tanks, crude loading racks, well heads and well cellars. The results from the Greka North Cat Canyon diluent tank headspace were used for diluent tanks and diluent loading racks.

3. In the ATEIP/R, Greka assumed emissions from solvent usage were spread through out the entire year, 8760 hours. In reality, solvent usage is used a few discrete times during the year. Since Greka could not provide records detailing daily solvent usage, the District modified the maximum hourly solvent emissions by assuming the maximum solvent usage was 1.0 lb/hr.

The toxic emissions from the Greka South Cat Canyon for reporting year 2003 are presented in Table 5.1. These emissions include the above-listed modifications to the ATEIP/R.

Table 5.1 – Facility Emissions Summary for 2003 [1]

Pollutant	Emissions (lb/yr)
1,1,2,2-Tetrachloroethane	1.709
1,1,2-Trichloroethane	1.034
1,1-Dichloroethane	0.762
1,2-Dichloropropane	0.881
1,3-Butadiene	44.790
1,3-Dichloropropene	0.861
Acetaldehyde	189.126
Acrolein	177.574
Ammonia	0.440
Anthracene	0.000095
Arsenic	0.00289
Barium	0.0636
Benz[a]anthracene	0.000036
Benzene	756.219
Benzo[a]pyrene	0.0122
Benzo[b]fluoranthene	0.000045
Benzo[k]fluoranthene	0.000012
Beryllium	0.000174
Cadmium	0.0159
Carbon tetrachloride	1.199
Chlorobenzene	1.453
Chloroform	0.928
Chromium	0.0202
Chrysene	0.000012
Cobalt	0.00121
Copper	0.0123
Dibenz[a,h]anthracene	0.000012
Dichlorobenzenes	0.0353
Ethyl benzene	2.488
Ethylene dibromide	3.727
Ethylene dichloride	24.136
Formaldehyde	1385.400
Hexane	26.024
Hydrogen sulfide	209.174
Indeno[1,2,3-cd]pyrene	0.000012
Manganese	0.00549
Mercury	0.00376
Methanol	210.629
Methylene chloride	2.783
Naphthalene	8.910
Nickel	0.0304
PAHs	2.967
Propylene	204.822
Selenium	0.000347
Styrene	0.802
Toluene	286.601
Vanadium	0.0333
Vinyl chloride	0.485
Xylenes	39.993
Zinc	0.419

[1] The facility emissions summary does not include criteria pollutants or pollutants that do not have OEHHA/ARB approved risk assessment health values (i.e., pollutants that have no contribution to risk).

6.0 BUILDING INFORMATION

UTM Coordinates for buildings and structures (e.g., tanks, heater treater) were submitted by Greka in the 2003 ATEIP/R. Building downwash was selected as a control option in the air dispersion analysis and all structures were included in the HRA.

7.0 MET DATA & DEM FILES

Meteorological data used in the dispersion analysis was acquired at the Battles Gas Plant area and is representative of the area surrounding Cat Canyon. The data file is found under *BAT89.ASC* located in the *GrekaSouthCatCanyon2003HRAvol1.zip* file referenced in the Attachment section of this report. The Digital Elevation Model (DEM) files used were *sisquoc.dem*, *twitchell_dam.dem, orcutt.dem* and *foxen_canyon.dem*. These files are also located in the *GrekaSouthCatCanyon2003HRAvol1.zip* file.

8.0 MODEL INFORMATION

The dispersion modeling and risk assessment were conducted using the California Air Resources Board Hotspots Analysis and Reporting Program, Version 1.4a (Build 23.07.00) and updated using Version 1.4f (Build 23.11.01).

8.1 Grid Receptors

Due to the large size of the property boundary and the large number of sources, it was necessary to run the air dispersion model multiple times with smaller grids covering only a portion of the property. Furthermore, multiple grids were required in order to account for the different pasture locations (see Section 8.3 for more detail). Due to the large number of grids used, the results for each grid are summarized in *Summary of Residences and Grid Results for Greka South Cat Canyon 2003 HRA.xls* located in the *GrekaSouthCatCanyon2003HRAvol1.zip* file. The spreadsheet also contains figures detailing the grid areas.

In most cases, the grid increment spacing was set to 50 meters. For smaller areas, the grid increment spacing was decreased to 25 meters. Boundary receptors were generated along the property boundary 50 meters apart. The risk analysis was run for each area. The maximum offsite risk from each area was identified. The maximum risk from all areas is presented on page one of this report. Receptor data is found in the SRC and ISC files located in both the *GrekaSouthCatCanyon2003HRAvol1.zip* and *GrekaSouthCatCanyon2003HRAvol2.zip* files.

8.2 Control Options and Analyses Methods

The Control options that were used for the dispersion model are found in Table 8.2. The cancer analysis method chosen in HARP was the Derived (Adjusted) Method for a 70 year lifetime exposure duration (adult resident). The chronic non-cancer analysis method chosen in HARP was the Derived (OEHHA) Method for a resident.

Table 8.2 – Control Options for Dispersion Model

Control Option	Assumption
Use Regulatory Default?	No
Rural or Urban	Rural
Gradual Plume Rise?	Yes
Stack Tip Downwash?	Yes
Buoyancy Induced Dispersion?	No
Calms Processing?	No
Missing Data Processing?	No
Include Building Downwash?	Yes
Lowbound Option?	No
Terrain Model	Both

8.3 Multipathway Analysis

Multipathway cancer and chronic analyses were performed with a deposition rate of 0.02 m/s. Through GIS software, parcels with residences were identified. In the initial analyses, the following exposure pathways were used for any parcel with a residence: inhalation, soil, dermal, mother's milk, home grown produce, beef, dairy, chicken and eggs. For all other areas (i.e., parcels without residences), the following pathways were used for the multipathway analysis: inhalation, soil, dermal, and mother's milk.

Due to the rural nature of the Cat Canyon area, residents have the ability to grow their own produce and raise chickens. For that reason, the home grown produce and the chicken/eggs pathways were included for any parcels with a residence. The default parameters in HARP were used for the home grown produce (non-urban setting) and chicken/eggs, and are saved in SIT files in both *GrekaSouthCatCanyon2003HRAvol1.zip* and *GrekaSouthCatCanyon2003HRAvol2.zip.*

Due to the rural nature of the Cat Canyon area, residents have the ability to raise cattle. Furthermore, District personnel have witnessed cows grazing at the Cat Canyon oil and gas leases. For these reasons, the beef and dairy pathways were included for any parcel with a residence in the initial analyses. The initial analyses showed a significant cancer risk from the beef and dairy pathway at Residence #2 and Residence #5. (Locations of residences are shown in Figure 8.3, *Greka South Cat Canyon Neighboring Residences,* and detailed in *Summary of Residences and Grid Results for Greka South Cat Canyon 2003 HRA.xls* located in the *GrekaSouthCatCanyon2003HRAvol1.zip* file.) At Greka's request, the District conducted a site survey to determine if the residents actually consume beef or dairy from their cows grazing onsite. The District determined that no one resides at Residence #2. For that reason, the HRA was rerun for Residence #2 with only the inhalation, soil, dermal and mother's milk pathways. The District did not receive a response from Residence #5, despite multiple attempts by phone and mail. The beef and dairy pathway were removed from the analysis for Residence #5 since it could not be confirmed that the residence consumes beef or dairy from cattle grazing onsite. The beef and dairy pathway was used for all other residences (1, 3, 4, 6, and 7) as described below.

HARP allows the location of only one pasture for all grid receptors. Since different parcels have different pasture locations, it was necessary to create multiple grids and run the HRA separately for each parcel with a residence. The HRA was first run without the beef and dairy pathway to determine the offsite Point of Maximum Impact (PMI) at each parcel if no contaminated beef and dairy were consumed. The pasture location was then set to the PMI location without beef and dairy. This may result in an overly conservative result if a parcel's pasture location is not at the area selected in HARP.

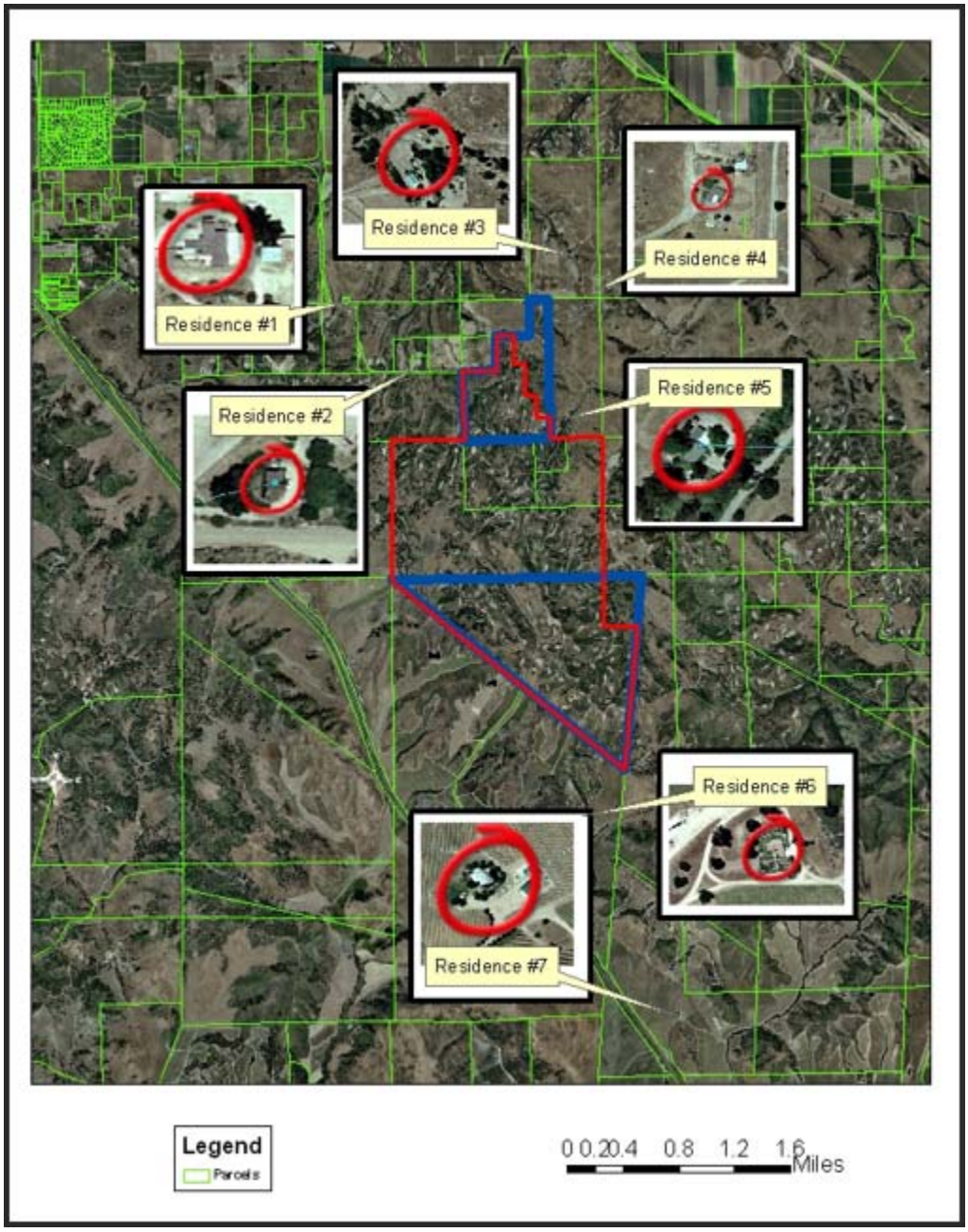


Figure 8.3 – Greka South Cat Canyon Neighboring Residences

When available, the default parameters in HARP were used for the beef and dairy pathway. In addition, default parameters from the ACE2588 HRA modeling program were used. The parameters used for the beef and dairy pathway are found in Table 8.3 and in the SIT files. These parameters were chosen to be conservative and may overestimate an individual's risk if the parameters do not apply (e.g., some or all beef and dairy products consumed are from a grocery store or other offsite source).

Table 8.3 – Parameters for Beef and Dairy Pathways

Parameter		Reference
Area (m^2) of pasture water source	1000	ACE2588
Volume (kg) of pasture water source	2E6	ACE2588
Volume changes per year of pasture water source	5	ACE2588
Fraction of consumed beef from contaminated source	1.0	HARP
Fraction of consumed dairy from contaminated source	1.0	HARP
Fraction of beef cow drinking water from pasture water source	0.25	ACE2588
Fraction of dairy cow drinking water from pasture water source	0.25	ACE2588
Fraction of cows feed from grazing	0.5	ACE2588

9.0 RESULTS

Risk assessment results at the offsite PMI receptor locations for cancer and for chronic and acute non-cancer health effects are shown in Table 9.1. Also shown is the onsite significant acute non-cancer risk located on a public roadway, Palmer Road. The maximum offsite cancer risk occurred on a rural parcel with a residence, southwest of the facility origin (UTME 745485, UTMN 3855035). The maximum offsite chronic non-cancer risk occurred on a rural parcel without any residences or buildings, southeast of the facility origin (UTME 746600, UTMN 3855600). The maximum offsite acute non-cancer risk occurred near the property boundary on the northwest side of the facility (UTME 744550, UTMN 3858350). The *italicized* values indicate the maximum offsite risk for each risk category. Bolded numbers represent a significant risk.

Table 9.0 – Risk at Point of Maximum Impact Receptors

Grid	Receptor	Location	Cancer Risk (per million)	Chronic HI	Acute HI (Screen)	Acute HI (Refined)	UTME (m)	UTMN (m)
Residence 6B	115	PMI	*8.33*	0.00711	0.247	NA	745485	3855035
E	498	PMI	3.68	*0.0336*	0.274	NA	746600	3855600
D	921	PMI	2.23	0.018	*0.834*	NA	744550	3858350
A_3	340	Palmer Rd (Onsite)	11.7	0.0634	3.944	**3.444**	745250	3857550

The onsite acute non-cancer risk locations were plotted on aerial photographs of the facility and adjacent land and are attached to this report. No further refinement of the HRA using contour mapping was performed for the cancer or chronic non-cancer risk as the risks were below the significance threshold. All resultant HRA risk data by receptor are found located in both the *GrekaSouthCatCanyon2003HRAvol1.zip* and *GrekaSouthCatCanyon2003HRAvol2.zip* files referenced in the Attachment section of this report.

The screening acute risk is a timesaving approximation that is conservative in nature. It is calculated by assuming that the contribution of risk from each source is at its maximum at the same instant in time. The maximum hourly risk from each source is summed to give the screening value, as if they had all occurred at the same time. In reality, the time that the risk from each source is at a maximum will differ depending on location and meteorology. The refined screening analysis was run for all onsite receptors greater than one. No offsite receptors had a screening acute risk greater than one.

10.0 RISK DRIVER DEVICES AND POLLUTANTS

10.1 Cancer Risk

The primary cancer risk driver pollutant is PAH. The largest contribution to PAH emissions is from field gas-fired internal combustion engines. However, the analysis indicates that no significant cancer risk is projected beyond the property boundary of the facility.

10.2 Chronic Non-Cancer Risk

Formaldehyde and acrolein are the primary risk driver pollutants for the chronic non-cancer risk. The health endpoint for the chronic non-cancer risk is the respiratory system. The primary risk driving devices are field gas-fired internal combustion engines. However, the analysis indicates that no significant chronic non-cancer risk is projected beyond the property boundary of the facility.

10.3 Acute Non-Cancer Risk

Acrolein and formaldehyde are the risk driver pollutants for the acute non-cancer risk. Eyes are the health endpoint for the acute non-cancer risk. The primary risk driving devices are field gas-fired internal combustion engines. The analysis indicates that no significant acute non-cancer risk is projected beyond the property boundary of the facility. However, there is an onsite significant risk on a public roadway, Palmer Road. Figure 10.3 shows the location of the onsite significant risk on Palmer Road. The red squares indicate an acute risk greater than or equal to one. The property boundary is shown in blue.

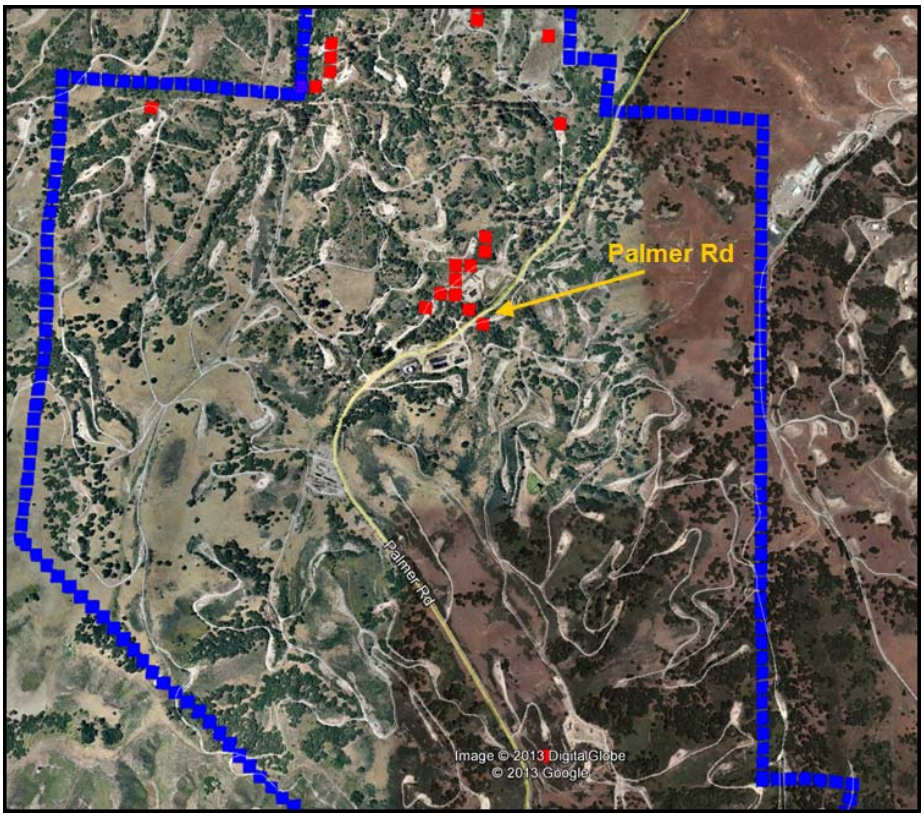


Figure 10.3 – Onsite Significant Acute Risk on Palmer Road

If the engines listed below in Table 10.3 were removed, based on the operations during 2003 the acute non-cancer risk would be below the District's significance thresholds (i.e., acute HI = 0.723).

Table 10.3 – Internal Combustion Engines Contributing to Significant Acute Non-Cancer Risk

HARP Source #	Lease	ICE Name	UTME (m)	UTMN (m)
20	Blockman	Injection Pump #7	745240	3857634
21	Blockman	Injection Pump #10	745241	3857624
22	Blockman	Injection Pump #13	745242	3857620
23	Blockman	Injection Pump #14	745242	3857615
53	Blockman	Injection Pump #2, 0610, 190 HP	745234	3857642

11.0 RISK REDUCTION

In 1999, the District notified Greka that a RRAP was required. Greka submitted the RRAP on July 1, 1999. The District deemed the RRAP incomplete on October 4, 2000. On February 13, 2001, Greka submitted the revised RRAP. On April 19, 2001, the District deemed the revised RRAP incomplete. On November 16, 2001, the District issued NOV # 7140 to Greka for failure to submit a revised RRAP. On August 19, 2002, Greka submitted a revised RRAP. The District remanded the RRAP for failure to evaluate air toxics risk reduction measures and failure to submit an engineering analysis to support their claims of risk reduction. On November 26, 2002, Greka submitted a newly revised RRAP. The November 2002 RRAP claimed a risk reduction due to a reduction in fuel usage. In order to validate this claim, and since the facility was due for a quadrennial update, the District required the submittal of the 2003 ATEIP and ATEIR.

Based on the 2003 HRA results, the risk has not been reduced below the District's significance threshold and a new RRAP is required to address the onsite acute non-cancer risk on a public roadway.

12.0 PUBLIC NOTIFICATION

Greka South Cat Canyon creates an onsite significant risk on a public roadway, Palmer Road. There are no residences or businesses within the significant risk isopleth. Therefore, no public notice will be sent, however, the HRA report will be posted on the District's website at: http://www.sbcapcd.org/airtoxics/GrekaSRS/CatCanyon/greka_cat.htm.

13.0 CONCLUSION

Per District guidelines, if a facility's toxic emissions result in a cancer risk equal to or greater than 10 in a million, it is considered a *significant risk* facility. For non-cancer risk, if a facility's toxic emissions result in a Hazard Index equal to or greater than 1.0, it is considered a *significant risk* facility. The risk assessment results show that Greka South Cat Canyon Field Oil and Gas Leases present a significant risk on a public roadway. Therefore, based on the results of this HRA, a new RRAP is required.

14.0 REFERENCES

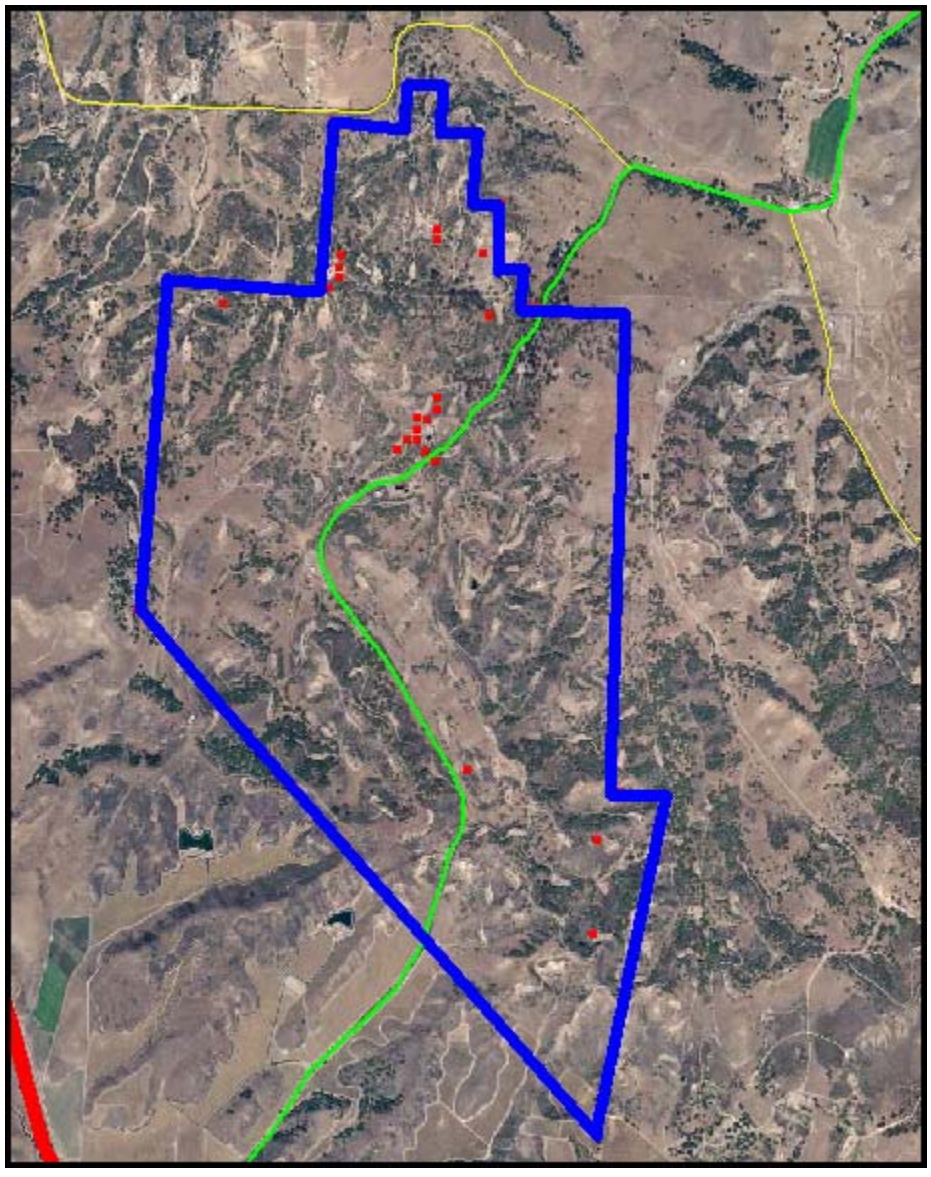
- Risk notification levels were adopted by the Santa Barbara County Air Pollution Control Board of Directors on June 1993. The risk notification levels were set at 10 per million for cancer risk and a Hazard Index of 1.0 for non-cancer risk.
- Risk reduction thresholds were adopted by the Santa Barbara County Air Pollution Control Board of Directors on September 17, 1998. These risk reduction thresholds were set at the same level as public notification thresholds, i.e., 10 per million for cancer risk and a Hazard Index of 1.0 for non-cancer risk.
- *Greka Cat Canyon and Zaca Field H_2S Sampling Results* (Submitted March 31, 2005 and May 4, 2005; Approved by the District June 5, 2007)
- *Toxic Emission Testing Bell Lease H-117 Superior Boiler; Testing on July 21, 2004* (Submitted August 13, 2004, Revised October 5, 2004; Approved and modified by the District May 24, 2007)
- *Air Toxics Emission Inventory Plan for Reporting Year 2003* (Submitted April 6, 2004; Revision dated July 23, 2004 and Additional Information Submitted August 3, 2004)
- *Air Toxic Emission Inventory Report for Reporting Year 2003* (Submitted September 23, 2004; Revisions dated March 31, 2005 and October 9, 2007)

15.0 ATTACHMENTS

- Onsite Acute Risk Locations – Hazard Index of 1.0
- Greka's Comments on Draft HRA
- Response to Comments from Greka
- Comments from the Office of Environmental Health Hazard Assessment
- Response to Comments from the Office of Environmental Health Hazard Assessment
- Source parameter data and HRA input and output files may be found in the following location:
  \\Sbcapcd.org\Toxics\Sources\Greka_South_CC\2003 HRA Report\GrekaSouthCatCanyon2003HRAvol1.zip
  \\Sbcapcd.org\Toxics\Sources\Greka_South_CC\2003 HRA Report\GrekaSouthCatCanyon2003HRAvol2.zip

GREKA SOUTH CAT CANYON

ONSITE ACUTE RISK LOCATIONS IN RED – ACUTE HAZARD INDEX ≥ 1.0



MAXIMUM ACUTE NON-CANCER RISK = 3.44

PROPERTY BOUNDARY IN BLUE
PALMER ROAD IN GREEN

GREKA'S COMMENTS ON DRAFT HRA

1700 Sinton Road
Santa Maria, CA 93458
(805) 347-8700
Fax: (805) 357-2963

April 15, 2011

Kaitlin McNally
Engineering Supervisor, Engineering and Compliance Division
Santa Barbara County Air Pollution Control District
260 North Antonio Road, Suite A
Santa Barbara, California 9310

Subject: **Comments regarding *Health Risk Assessment Report, Greka South Cat Canyon Oil and Gas Leases, Reporting Year 2003***

Dear Ms. McNally;

Greka submits the following comments as requested in your cover letter the above referenced Health Risk Assessment (HRA) Report. The HRA Report concluded that, based on predicted impacts at two residence-locations, the South Cat Canyon facility caused a significant cancer risk in 2003. Greka believes that aspects of the cancer risk analysis of impacts at these residences were unrealistically conservative. These two significant impacts resulted from several overly conservative assumptions:

- Each nearby parcel containing a residence also contains an associated pasture,
- For each parcel with a residence, the pasture location is defined to be the point of maximum impact of cancer risks that derive from non-pasture exposure pathways (i.e., inhalation, dermal, mother's milk, home grown produce, chicken and eggs),
- The residents living on these parcels raise both beef cattle and dairy cattle on co-located pastures, and 100 percent of the beef and dairy-products they consume are from cattle raised on these pastures, and
- The same residents also consume an unspecified amount (possibly 100 percent) of home grown produce, chicken and eggs.

Section 8.3 discusses the way that modeling of parcels with residences incorporated additional exposure pathways for cancer and chronic risk. In addition to the inhalation, soil, dermal, and mother's milk pathways used for all receptor locations, modeling of parcels with residences also included home grown produce, beef, dairy, chicken and eggs pathways. Modeling the beef and dairy pathways required identifying a pasture location in each receptor grid.

The report states that "HARP allows the location of only one pasture for all grid receptors", and "different parcels will have different pasture locations", therefore "it was necessary to create multiple grids and run the HRA separately for each parcel with a residence." The report then states that the point of maximum impact (PMI) was identified for each such parcel. This location was obtained by running the model without the beef and dairy pathways (these runs did not include pasture locations). Finally, a pasture location artificially set equal to the location of the PMI, and the model was run again for each parcel with a residence.

It is not clear why it was necessary to locate the pasture at the point of maximum impact in each grid that was separately created for each parcel containing a residence. It appears that only one pasture-location

was used in each such model run. The report should explain why the actual location of each parcel's pasture was not used. Does each parcel with a residence actually have an associated pasture?

The discussion in Section 8.3 appears to suggest that parcels with residences were modeled with beef and dairy pathways using pasture locations that may not be representative of existing conditions. Only two significant cancer risk-locations were identified by the HRA. Both locations were on parcels with residences which were modeled using the pasture assumptions described above. The report should confirm that these parcels include pastures whose locations are accurately identified and evaluated.

In addition, Table 8.3 indicates that, for these parcels, the HRA modeling assumed that residents consume 100 percent of all their beef *and* 100 percent of all their dairy products (i.e., milk, butter, cheese, yogurt, etc.) from beef and dairy cattle which graze concurrently on their pasture. Table 8-3 does not provide information about the percentage of home-grown produce, chicken, and eggs that were assumed to be consumed by these residents.

The assumptions used for home-grown food consumption appear to go far beyond conservative into the realm of unrealistic. There is a high degree of conservatism inherent in each step of the AB2588 emissions reporting, dispersion modeling and risk assessment processes, for example, the conservative emission factors, worst-case meteorological effects, factors of safety utilized to set exposure risk values, 70-year lifetime exposure duration, etc. The reader might infer that, without utilizing unrealistic beef/dairy pasture assumptions, the HRA may not have predicted significant cancer risk.

Greka requests that the District obtain actual information from the residents, and re-run the HRA using realistic information about pasture locations and food consumption at the two residences for which a significant cancer risk was predicted.

Please contact me at (805) 357-2938 if you have any questions or require additional information.

Sincerely,

Laura M. Nuzzo
Greka Environmental Engineer

P.O. Box 5489
Santa Maria, CA 93456
(805) 347-8700
Fax: (805) 357-2963

June 13, 2011

Kaitlin McNally
Engineering Supervisor, Engineering and Compliance Division
Santa Barbara County Air Pollution Control District
260 North Antonio Road, Suite A
Santa Barbara, California 9310

Subject: ***Health Risk Assessment (HRA) Report, Greka South Cat Canyon Oil and Gas Leases, Reporting Year 2003***

Dear Ms. McNally:

Greka continues to believe that the HRA referenced above was flawed with respect to exposure pathway assumptions included in the cancer risk analyses. Specifically, unreasonable and possibly erroneous assumptions led to predictions of significant cancer risk at two residences. For assessing cancer risks at receptors located on nearby parcels containing residences, the District assumed that: 1) the residents of these parcels raise both beef and dairy cattle on pastures that lie at the location of maximum predicted impact, and 2) those residents consume 100 percent of their beef and 100 percent of all their dairy products from meat and milk produced by home-raised cattle.

Greka objected to these unreasonable assumptions in an April 15, 2011 comment letter. In that letter Greka requested that the District obtain actual information from the residents, and re-run the HRA using actual information about pasture locations, and beef and dairy consumption, at the two residences for which a significant cancer risk was predicted. As of this date, the District has not responded to Greka's comments.

Greka believes that no significant cancer risk is posed at any offsite location, including the two residences identified in the HRA Report. Greka intends to formally challenge the HRA and requests guidance on relevant District protocol/procedures. Greka requests that submittal of a Risk Reduction and Audit Plan, and well as any public notifications, be delayed until our challenge is resolved. If we have not heard back from the District on or before July 15, 2011, we will proceed on the basis that the District agrees with our assessment that the So. Cat Canyon Stationary Source does not pose a significant air toxics risk, and that Greka no longer needs to complete a RRAP or public notification.

Please contact me at 805-357-2938 or lmn@greka.com if you have any questions, or wish to discuss these matters.

Sincerely,

Laura M. Nuzzo
Environmental Engineer

RESPONSE TO COMMENTS FROM GREKA

Our Vision Clean Air

Santa Barbara County
Air Pollution Control District

JUL 15 2011

Via Certified Mail 7009 2250 0004 4637 0719
Return Receipt Requested

Laura Nuzzo
Greka Oil & Gas, Inc.
PO Box 5489
Santa Maria, CA 93456

RE: Site Specific Information for the Health Risk Assessment for Greka South Cat Canyon
Air Toxics "Hot Spots" Information and Assessment Act (AB 2588)

Dear Ms. Nuzzo:

The Santa Barbara County Air Pollution Control District (District) received your letters dated April 15, 2011 and June 13, 2011 regarding your comments on the 2003 Health Risk Assessment (HRA) for Greka's South Cat Canyon Field Oil and Gas Leases.

Based on your comments, the District will be conducting a survey to determine site specific information for the multipathway parameters. Specifically, the District will be collecting information regarding the location of the pasture and water source for the beef and dairy cows at the two residences that show a significant risk. We will also be collecting information on the consumption of beef, dairy, pigs, chicken, eggs, and produce for those two residences.

The District will rerun the 2003 HRA for the two specified residences with the site specific information that is collected. We will notify you of the revised results upon completion of the HRA with an updated HRA report. Public notification and a Risk Reduction Audit and Plan (RRAP) will not be required until after the HRA has been revised with the site specific information.

If you have any questions, please call me at (805) 961-8855.

Sincerely,

Kaitlin McNally

Kaitlin McNally, Engineering Supervisor
Engineering & Compliance Division

cc: Facility AB 2588 Project File
ECD Chron File

\\Sbcapcd.org\aoxics\Sources\Greka_Cat_Canyon\2003 HRA Report\Greka_South_CC\Letter to Greka South Cat Canyon regarding Greka's comments on 2003 HRA.doc

COMMENTS FROM THE OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

Office of Environmental Health Hazard Assessment

George V. Alexeeff, Ph.D., D.A.B.T., Director
Headquarters • 1001 I Street • Sacramento, California 95814
Mailing Address: P.O. Box 4010 • Sacramento, California 95812-4010
Oakland Office • Mailing Address: 1515 Clay Street, 16th Floor • Oakland, California 94612

Matthew Rodriquez
Secretary for
Environmental Protection

Edmund G. Brown Jr.
Governor

July 30, 2013

Ms. Kaitlin McNally, Engineering Supervisor
Engineering Division
Santa Barbara County Air Pollution Control District
260 North San Antonio Road, Suite A
Santa Barbara, California 93110

Subject: Review of risk assessment for Greka South Cat Canyon

Dear Ms. McNally:

The 2003 Air Toxics Hot Spots Program health risk assessment for airborne emissions from **Greka South Cat Canyon** has been reviewed by staff of the Office of Environmental Health Hazard Assessment (OEHHA), as required by Health and Safety Code Section 44361. The facility consists of five oil and gas leases. The report uses HARP Version 1.4.f computer program and models at thousands of receptors in several grid patterns the risks due to 50 Hot Spots chemicals emitted from 64 point, area, and volume sources. The facility based the report on estimated air emissions in 2003 which included 1385 lbs. of formaldehyde, 756 lbs. of benzene, 189 lbs. of acetaldehyde, 176 lbs. of acrolein, 0.0122 lbs. of benzo(a)pyrene, the sentinel polycyclic aromatic hydrocarbon (PAH), and smaller amounts of six other PAHs.

The risk assessment reports that the total cancer risk at the PMI (Point of Maximum Impact, actually on a public road that traverses the facility) is 1.17×10^{-5}. PAHs are the responsible toxic air contaminants. The risk at the MEIR (resident) is 8.33×10^{-6}.

The highest chronic hazard index (HI) is predicted to be 0.0634 for the respiratory system due to emissions of formaldehyde and acrolein.

The highest acute hazard index (HI), also on the public road, is predicted to be 3.444 for the eyes due to emissions of formaldehyde and acrolein.

OEHHA is continuing to update its risk assessment guidelines as mandated by the Children's Environmental Health Protection Act of 1999. In 2008 the Scientific Review Panel on Toxic Air Contaminants approved OEHHA's Technical Support Document for

the Derivation of Noncancer Reference Exposure Levels and the Director of OEHHA adopted new acute, 8-hour, and chronic RELs for acetaldehyde, acrolein, arsenic, formaldehyde, manganese, and mercury. Later OEHHA updated the REL values for nickel and, in July 2013, the REL values for butadiene. The updated health values for nickel and butadiene should be used in any updates of the risk assessment.

Our analysis of the risks depends on the accuracy of the emissions estimates and the appropriateness of the air dispersion modeling. The intent of this letter is to confirm or reevaluate the results of the risk assessment; it should not be construed to imply that OEHHA agrees with any editorial comments or statements contained in the text of the risk assessment that do not impact the results. We hope that our comments are useful to the District and will help in any risk management decisions. If you would like to discuss the review, please call Air Toxics staff at (510) 622-3150.

Sincerely,

James F. Collins

James F. Collins, Ph.D.
Staff Toxicologist
Air Toxicology and
Epidemiology Branch

The District will use the most current RELs during any updates of the HRA for Greka South Cat Canyon.