California Environmental Protection Agency

Kettleman City Community Exposure Assessment Work Plan Technical Support Document

California Environmental Protection Agency
Air Resources Board
Department of Pesticide Regulation
Department of Toxic Substances Control
Office of Environmental Health Hazard Assessment
State Water Resources Control Board

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Kettleman City Community Exposure Assessment
Work Plan Technical Support Document

1.0 INTRODUCTION

In January 2010, Governor Arnold Schwarzenegger directed the California Environmental Protection Agency (Cal/EPA) to conduct an investigation of potential environmental contaminants that might be associated with the recent increase in birth defects reported in Kettleman City (Kings County). Over the next several months and with the help and guidance of the Kettleman City community, Cal/EPA scientists will look for chemicals that are known or suspected of causing birth defects that may be present in the air, water, and soil in the Kettleman City area. The U.S. Environmental Protection Agency (U.S. EPA) will provide assistance to Cal/EPA's Community Exposure Assessment (CEA). Concurrent with Cal/EPA's assessment, the California Concurrent with Cal/EPA's assessment, the California Department of Public Health (CDPH), is interviewing the mothers of the children born with birth defects to assess the role of environmental exposures and generally recognized birth defect risk factors.

Kettleman City is a rural community with a population of approximately 1,500 residents. It is located in southwestern Kings County just to the north of the junction of Interstate 5 (I-5) and State Highway 41 (SR-41), as shown in **Figure 1**. It is one of four unincorporated community areas within Kings County. The community covers approximately 118 acres and consists of two separate areas – one is the highway commercial area along SR-41 immediately north of I-5 and the other is a residential area located along SR-41 (north of the commercial area). Most of the residents are employed by local farming operations or other related industries.

Most sampling will take place within the residential area of approximately 60 acres. **Figure 2** shows the general location and boundaries of the residential area. Some sampling will take place at the Chemical Waste Management, Inc. (CWMI) Kettleman Hills Facility (KHF) that is located approximately 3.5 miles southwest of the city.

Cal/EPA's constituent boards and departments -- including the Department of Toxic Substances Control (DTSC), the Office of Environmental Health Hazard Assessment (OEHHA), the California Air Resources Board (CARB), the California Department of Pesticide Regulation (CDPR), and the State Water Resources Control Board (SWRCB), will perform the proposed CEA outlined in this Sampling and Analysis Plan. Cal/EPA has directed OEHHA to serve as the lead entity for the community assessment.

Cal/EPA prepared a draft outline of the proposed CEA for public review and discussed the outline at a community meeting in Kettleman City on March 25, 2010. Cal/EPA representatives were also available to discuss and answer questions about the outline with interested individuals at a follow-up community meeting in Kettleman City on April 15, 2010. Cal/EPA also invited the public to submit written comments on the outline.

The final outline and this CEA Technical Support Document (TSD) reflect changes made in response to written and oral comments. The final version of this CEA TSD will reflect all of the revisions incorporated into the final work plan outline. Cal/EPA is committed to updating the community and scheduling future meetings in Kettleman City as the CEA progresses.

Key community concerns included an interest in air monitoring for diesel exhaust and chlorinated dioxins, monitoring for PCBs at the Kettleman Hills landfill as well as in the community, testing for chemicals that may relate to health concerns other than birth defects, potential bio-monitoring of community members, and using monitoring in addition to modeling for pesticides. Cal/EPA recognizes the community's concerns. Some of these activities were already envisioned in the draft outline; others have been added in recognition of community concerns, and some activities may occur based on findings in the current assessment.

2.0 BACKGROUND

Kettleman City is located near and adjacent to active agricultural areas and two highways, and is approximately 3.5 miles northeast of the state's principal hazardous waste landfill. There have been exceedances of the public drinking water standard for arsenic in the community's drinking water supply since that standard was lowered several years ago.

Since September 2007, an apparent increase in babies born with structural defects, some of whom have died, has greatly increased the concern within the community of Kettleman City that environmental exposures to contaminants are the cause.

3.0 KETTLEMAN CITY AREA DESCRIPTION

Kettleman City consists of a commercial area and a residential area. The commercial area is composed of motels, restaurants, fuel stations, and truck repair and towing businesses. It is located next to I-5 in the southern portion and bounded to the north by the California Aqueduct which acts as a permanent buffer separation between the two distinct areas of Kettleman City. North of the aqueduct, sits a little area less than a mile long, which consists mostly of open space land with some industrial and commercial uses, including a Chevron mixing and storage facility to the west and Con-Way Freight Transfer Station to the east.

SR-41, which runs adjacent to the residential area, contains commercial businesses. These include a gas station, two very small convenience stores, an auto parts dealer, and two towing companies. The residential area is made up largely of older single family homes with an average 1,100 sq. ft. unit size. It has a fairly large proportion of mobile homes which make up about 14 percent of all residential units. Approximately 300 residential units are located west of SR-41, and 46 are to the east. Community facilities such as the Kettleman City Community Services District (KCCSD) Office, KCCSD Park, Kettleman Elementary School, County Fire Station No. 9, County Library, and Medical Clinic are all located west of the highway.

3.1 Operational History

The community of Kettleman City was founded in 1929, a year after the discovery of oil in nearby Kettleman Hills. The community originally provided housing for the oil workers. The population of Kettleman City rapidly increased as oil production operations were at their peak. By 1940 the community had hotels, libraries, an elementary school, and a population of 600 people. In 1945 oil production began to decline and the community's economy and population growth began to slow. The I-5 freeway, the California Aqueduct, and Chemical Waste Management, Inc. (CWMI) Kettleman Hills Facility (KHF) began operation in the 1970s. Today, the community has a population of about 1,500, and its economy is mostly based on agriculture with some commercial business near the intersection of the I-5 and SR-41.

3.2 Current Uses of Adjacent Properties

Agricultural land surrounds the residential area of Kettleman City to the north, east and portions of the west. A substantial private investment has been made in new orchards across the California Aqueduct immediately west of the existing residential community. North and east of the residential area, the land is farmed with rotating field crops. Orchards on the north were planted 2 to 3 years ago. Orchards to the northeast and east were planted about one year ago. Orchards to the northwest were planted within the last few months. According to the Department of Conservation 2004 Important Farmland Map, Prime Farmland and Farmland of Statewide Importance exist within planned residential growth areas.

The residential community of Kettleman City is also sits approximately 3.5 miles northeast from the CWMI KHF. KFH is a commercial hazardous waste treatment, storage and disposal facility, which also accepts trucks carrying municipal garbage for disposal at a municipal landfill located at KHF. KHF is located in Kings County, California approximately three miles west of I-5, immediately north of State Route 41 (**Figure 1**).

3.3 Planned Public Improvements in the City

Currently, Kettleman City has submitted an application for a State loan to install a surface water treatment plant that would provide the community with surface water from the California Aqueduct as a replacement for its customers and allow it to abandon the current ground water sources.

Caltrans plans a highway rehabilitation project on SR-41 between Utica Avenue and Quail Avenue that is expected to take approximately two years to complete. This includes the segment of the highway that runs through Kettleman City. The project involves an asphalt concrete overlay on the existing highway and a widening of the shoulders. The project is currently delayed due to limited resources and funding, but the project is expected to resume in 2010.

3.4 Groundwater

Kettleman City is located in the southern San Joaquin Valley and is part of the Tulare Lake Basin. Groundwater occurs beneath the community in saturated sandstone beds, or water-bearing zones (WBZs), which are isolated hydraulically from one another by intervening siltstone and claystone intervals. The depth of groundwater below Kettleman City is approximately 170 feet below-ground surface (bgs). This measurement was taken in 1985 and was recorded on the United States Geological Survey's database for groundwater sites. There are two municipal wells which serve Kettleman City residents. One well was drilled to 660 feet bgs. It draws water from 210 to 390 and 420 to 545 feet bgs. The other well is drilled to 700 feet bgs and draws water from 400 to 630 feet bgs. There is a third well which only serves the elementary school.

According to the KCCSD 2008 Consumer Confidence Report on the untreated water from the two municipal wells, arsenic was detected at in one of the wells 16.3 micrograms per liter (μg/L), which exceeds the Maximum Contaminant Level (MCL) of 10 μg/L. Benzene was detected ranging from 6.9 to 120 μg/L, which exceeds the MCL of 1 μg/L. Each of KCCSD's water wells has an aeration system attached to its well head to remove benzene and a chlorination process for disinfection. The post-treatment benzene concentration was below 0.5 μg/L. However, arsenic is not removed by the water treatment process.

The 2009 Annual Report of Community Water System Water Quality prepared by Dellavalle Laboratory, Inc. for the Kettleman City Elementary School stated that arsenic was detected at 14 μg/L in the well supplying water to the school. Benzene was not analyzed in 2008, and the last reported benzene value in 2007 was inconclusive due to elevated detection limits since the analysis was not meant to measure low levels of benzene.

3.5 Climate

Kettleman City is located within the southern part of the San Joaquin Valley. The climate in this area is characteristic of the southern San Joaquin Valley, including hot summers, mild winters, and a small quantity of precipitation per year. Temperatures during the summers in the San Joaquin Valley are known to commonly exceed 100 °F. The Coastal Ranges block much of the moisture from the Pacific Ocean from reaching the interior valley. As a result, the average annual precipitation for Kettleman City is approximately 7 inches. Most of the little rain the region receives is absorbed by dry soils.

3.6 Wind Rose

Many years of meteorological data from Lemoore and Hanford, CA show that the wind within this portion of the San Joaquin Valley generally comes from the northwest and moves toward the southeast. The average wind speed is 5.6 miles per hour (mph). During the winter months, the wind will often travel from the southeast and move towards the northwest. (See Figure 4)

4.0 Possible Sources of Chemicals Associated with Birth Defects

In developing this CEA the following questions were considered:

- *Which chemicals potentially found in Kettleman City are known to cause or might cause birth defects in humans?*
- *What are the possible sources of these chemicals?*
- *How can we sample and analyze for these chemicals?*

The questions and our answers are found below:

- *Which chemicals potentially found in Kettleman City are known to cause or might cause birth defects?*

Experts from the Office of Environmental Health Hazard Assessment (OEHHA) prepared a list of chemicals that are known to cause birth defects and other developmental effects – especially facial clefts. Next, OEHHA consulted with its sister Cal/EPA boards and departments and added other chemicals that should be investigated that might cause birth defects or other developmental effects to the list of substances to be investigated.

In addition to the chemicals identified above, the community also asked Cal/EPA to look at other chemicals that might cause cancer. Many of the procedures and analytical methods that will be used in measuring the environmental levels of chemicals identified above also measure chemicals of community concern, so this additional assessment will be done.

- *What are the possible sources of these chemicals?*

As part of the chemical-identification process, work group members considered the possible sources of these chemicals in the Kettleman City area. In some cases, these chemicals may be present as a result of past activities, or they may be currently used and emitted. Possible sources of these chemicals include:

a) Agricultural operations.
b) CWMI KFH hazardous waste storage, treatment and disposal facility.
c) Groundwater contamination from naturally occurring arsenic, or from benzene and petroleum compounds.

d) Illegal dumping of automobiles and household trash that has taken place periodically throughout the area.
e) Past contamination by former industrial/commercial operations that might be identified through records searches.
f) Petroleum sources, including naturally occurring petroleum deposits, a petroleum pipeline and former natural-gas wells in the vicinity of the town, gas stations, and an oil-storage facility. Sporadic, unrecorded dumping of oil wastes during the early- to mid-20th century may have occurred.

Some of the forms in which chemicals from these sources conceivably could be present in Kettleman City are:

a) Air pollutants originating from the Kettleman Hills waste management facility, agricultural pesticide applications, diesel trucks and motor vehicles, and other sources.
b) Drinking water contaminants, particularly arsenic.
c) Contaminants in soil as a result of past releases or dumping of oil waste, industrial waste and household waste.

- *How can we sample and analyze for these chemicals?*

The answer to this question is contained in the following plans from DTSC, CARB, and CDPR.

Department of Toxics Substances Control's Sampling Plan

1.0 Background

Environmental and/or Human Impact

The Department of Toxic Substances Control (DTSC) recently performed a Phase I Environmental Site Assessment of the Kettleman City residential area. The Phase 1 assessment involves gathering background information from review of historical documents and visits to the community. The assessment confirmed some of the possible sources of concern listed in section 4.0 of the introduction.

The following five recognized environmental conditions (RECs) were indicated in connection with the area around Kettleman City.

REC #1: Age and condition of buildings and infrastructure
Explanation: The Kettleman City community was first developed in 1929. By 1940 the population was 600. As of the census of 2000, there were 1,499 people, 320 households and 289 families residing in the residential area. Most of homes were built prior to 1975. For these old structures, lead from lead-based paint, organochloride pesticides (OCPs) from termiticide application and polychlorinated biphenyls (PCBs) are potential sources of soil contamination. In addition to structures, old piping used to supply residents with water may decrease drinking water quality and may require investigation.

REC #2: Agricultural Operations and Pesticide Applications
Explanation: Kettleman City is located adjacent to pistachio and almond orchards to the west, north and east. Orchards to the west (past First Street) appear to have existed for some time and are separated from the city by an approximately 0.7 mile buffer zone. The orchards to the north and east have been planted within the last three years and are located just outside of the city with only the adjacent streets (Edward St. to the north, and Carter St. to the east) acting as a buffer zone. Pesticides commonly associated with agricultural operations are applied at various times of the year and may have the potential to drift to the city. For more details please refer to the map, **Figure.2**.

REC #3: Drinking Water Quality
Explanation: Kettleman City has two drinking water wells that have exceeded the MCL for benzene and arsenic. The wells currently have a simple air stripping treatment system for benzene removal and daily chlorination. A third well also is located within the Kettleman City Elementary School. It has no treatment system and is used for all purposes, including drinking water. Many residents believe the water is contaminated and avoid using it for drinking and cooking.

REC #4 Kettleman Hills Facility (KHF)
Explanation: The residential community of Kettleman City is approximately 3.5 miles northeast from the Chemical Waste Management, Inc., facility. The KHF is a permitted commercial hazardous waste treatment, storage and disposal facility. Hazardous Waste is transported to the KHF along I-5 and SR-41 (**Figure 1**). The residential community is separated from the KHF by rolling hills and valleys. Based on the prevailing wind pattern, the KHF is primarily cross wind of the residential community. Groundwater in saturated sandstone beds beneath the KHF is isolated hydraulically from water-bearing zones (WBZ) under Kettleman City, by intervening siltstone and claystone intervals.

REC #5: Previous Oil Operations in the Area
Explanation: Kettleman City was originally developed in 1929 as oil operations in the adjacent area reached its peak. Seven idle oil wells from previous operations are located outside of the city. Oil from previous operations and some gasoline spills may have potentially affected groundwater or soils beneath the city resulting in a potential reduction in water quality or air quality within structures due to soil gases. Figure 3 shows a map of oil fields around the vicinity of Kettleman City.

2.0 FIELD SAMPLING PLAN

2.1 Sampling Strategy and Approach

As discussed, five RECs were identified through the recent completion of a Phase I review of information on the Kettleman City residential area. This sampling strategy is proposed to address those RECs. DTSC relied on the following guidance in developing the sampling approach:

- DTSC's Preliminary Endangerment Assessment Guidance Manual, dated January 1994 and revised June 1999
- DTSC's Draft Interim Guidance for Sampling Agricultural Lands (Third Revision), dated November 2007
- DTSC's Advisory – Soil Gas Investigations, dated January 28, 2003 (ASGI)
- DTSC's Interim Guidance – Evaluating of School Sites with Potential Soil Contamination as a Result of Lead from Lead-Based Paint, Organochloride Pesticides from Termiticides, and Polychlorinated Biphenyls from Electrical Transformers, Revised 06/09/06
- DTSC's "Methodology for the Sampling, Handling, and Storing of Soils to be Analyzed for VOCs (Method 5035)" on use of EPA Method 5035A
- DTSC's Draft Interim Guidance - Evaluating Human Health Risks from Total Petroleum Hydrocarbons (TPH), dated April 29, 2008
- USEPA's Sampling and Analysis Plan – Guidance and Template, Version 3, Brownfields Projects, R9QA/006, June 2004 (SAP)

Based on recognized environmental concerns and the sampling approach recommended by the DTSC guidance documents, the field investigation will consist of -

- Soil Gas Survey: Samples of the vapors from soil will be collected and evaluated to collect soil gas samples to evaluate the to determine the impact of past operations or activities at or near the city on subsurface soil gas.

- Soil Matrix Sampling: Random soil samples will be collected to evaluate the impact of past operations or activities at the city on the soil.

- Water Sampling: Water samples from the three water well heads, the irrigation canal, and faucets at randomly selected residential homes will be collected to assess water quality in the city. .

- Sediment Sampling: Soil sediment samples will be collected from the aqueduct and irrigation canal to evaluate potential impacts to fish, caught and consumed by community members from illegal dumping or agricultural runoff.

- Air Quality Sampling and Analysis: Refer to the plans submitted by the Air Resources Board and the Department of Pesticide Regulation.

2.1.1 Soil Gas Survey

Oil was discovered in the Kettleman Hills in 1928. Subsequently in 1929, the town of Kettleman City was established to provide a community for the workers of the oil fields (**Figure 3**) which were being developed in the Kettleman Plains. Three oil pipelines are currently running along the south boundary of the residential area. However, no oil or gas fields or oil processing facilities were located within half a mile of the area. There three gasoline stations within the residential community – one is still in business and the other two were closed with unknown closure requirements or oversight. Local groundwater contains elevated levels of benzene.

The selected environmental drillers (EDs) and mobile laboratories (MLs) shall be capable of conducting a soil gas survey, following DTSC's Advisory – Soil Gas Investigations for probe installation, soil gas sample collection, and analysis. Soil gas samples shall be analyzed for volatile organic compounds (VOCs), including benzene, toluene, ethylbenzene and xylene (BTEX), and oxygenate compounds [i.e., methyl tertiary butyl ether (MTBE), ethyl tert-butyl ether (ETBE), di-isopropyl ether (DIPE), tert-amyl methyl ether (TAME), tertiary butyl alcohol (TBA) and ethanol], using modified EPA Method 8260C, and methane (CH_4) and hydrogen sulfide (H_2S), using a hand held instrument (HHI) or equivalent.

The detection limits (DLs) for target carcinogenic VOCs (see California Office of Environmental Health Hazard Assessment Toxicity Criteria Database) shall be 0.1 micrograms per liter (μg/L) or less. The DLs for CH_4 and H_2S should be 1,000 and 0.5

parts per million by volume (ppmv), respectively, or less. Any excessive detection levels by an HHI shall be confirmed by a separate HHI or equivalent.

Soil gas survey is planned as follows:

- Collection of 12 primary soil gas samples from 12 borings at five feet bgs listed below and analyses by a mobile laboratory to assess the potential for soil VOC contamination and indoor air intrusion. If canisters are used, canister samples shall meet the requirements specified herein.

- Four boring locations in the area where current or previous underground storage tanks (USTs) are located;

- Six boring locations in a grid system over the entire residential area; and

- Two boring locations in areas to be determined in the field or during the visit, each at 5-foot bgs.

- Collection and analysis of one soil parameter sample at 5-foot bgs from the continuously cored borings or other borings as necessary. The selected mobile laboratory shall be responsible for this specific requirement.

2.1.2 Soil Matrix Sampling

The selected environmental drillers (EDs) shall be capable of advancing boreholes by direct push method(s) and obtaining samples as specified in this Sampling and Analysis Plan or its equivalent. The EDs shall provide proper sample sleeves for this soil sampling event. The ED shall provide drums and be responsible for disposal of investigation-derived wastes (IDWs). Final sample locations, number and depths will be determined in the field or during the area visit. No compositing is planned.

Field QA/QC Samples: In addition to regular samples, field QA/QC samples will be collected and analyzed, following USEPA's "Sampling and Analysis Plan." Background samples for heavy metals are not planned.

As a backup, hand augers and hand trowels may be used as appropriate. Necessary sample containers will be provided by the analytical laboratory. Proper amount of soil samples will be transferred from the sampling devices to sample containers.

Hand trowels may be used to collect the surface soil samples that are to be collected within 6-12 inches of the ground surface. Exact soil sampling locations will be determined in the field based on accessibility, visible signs of potential contamination (e.g., stained soils), and topographical features that may indicate location of hazardous substance disposal (e.g., depressions that may indicate a historic excavation). Soil sample locations will be recorded in the field logbook as sampling is completed. A sketch of the sample location will be entered into the logbook and any physical reference points will be labeled. If possible, distances to the reference points will be given.

Hand augers may be used to collect subsurface samples that are to be collected 30-36 inches bgs. Subsurface samples will be transferred to appropriate containers. Exact soil sampling locations will be determined in the field based on accessibility, visible signs of potential contamination (e.g., stained soils), and topographical features which may indicate the location of hazardous substance disposal (e.g., depressions that may indicate a historic excavation) should be provided. If subsurface refusal is encountered, a new location 10 feet away from the proposed location with refusal will be selected in the field as a replacement.

As previously stated, regular soil matrix samples will be collected and grouped into five parts which are described below:

Agricultural Operation Assessment – 12 samples

Kettleman City is immediately adjacent to agricultural lands to the west, north and east.

DTSC plans to collect 12 soil matrix samples from six borings and analyze for organochloride pesticides (OCPs) and arsenic – two borings on each of the west, north and east boundaries. At each soil boring, soil matrix samples shall be collected from two depths, surface (0 to 6 inches below native soil) and subsurface (2.5 to 3 feet bgs).

Residential Property Assessment – 18 samples

The Kettleman City community was first developed in 1929. By 1940 the population was 600. As of the census of 2000, there were 1,499 people, 320 households and 289 families residing at the city. Most of homes were built prior to 1975. At and around these older structures, lead from lead-based paint, OCPs from termiticide application and polychlorinated biphenyls (PCBs) from electrical transformers are potential sources of soil contamination.

DTSC plans to collect 18 soil samples from residential properties as follows:

- 16 soil matrix samples from two residential homes, four borings at each home and two depths of surface and 3 feet bgs at each boring, for analyses of Title 22 metals and OCPs. (We may take additional surface samples to evaluate the direct contact threat at more locations throughout the City.)

- Two soil matrix samples from one location within close proximity of the base of one pole mounted transformer or in areas of visible staining (assumed), at two depths of surface and 3 feet bgs at the boring location, for analysis of PCBs

Commercial Property Assessment

The Kettleman City commercial sites include the current and past fuel stations, and towing companies. Surface soil samples will be collected and analyzed for chemicals based on the type of businesses present at the site. These chemicals may include Total Petroleum Hydrocarbon (TPH), Semi-Volatile Organic Compounds, PCBs and California Assessment Manual (CAM) 17 metals.

All soil samples will be screened for radioactivity with a hand held direct read instrument such as a Ludlum Radiation meter.

Soil Gas Results – two samples

Based on results of the soil gas survey, DTSC may collect two soil matrix samples from depths corresponding to or associated with low- or no-flow lithologic conditions or where soil vapor VOCs are detected, using EPA Method 5035A (field preservation method only), and analyze for VOCs. See DTSC's "Methodology for the Sampling, Handling, and Storing of Soils to be Analyzed for VOCs (Method 5035)" on use of EPA Method 5035A.

Inorganic Background Dataset

No background samples are planned.

2.1.3 Water Sampling

The Kettleman City community has raised concerns over the municipal water quality. The Kettleman City Community Services District (KCCSD) supplies municipal water from two (2) local water wells. The Kettleman City Elementary School gets its water supply from a third water well located at the school. The 2008 Consumer Confidence Report prepared by the KCCSD indicated that arsenic was detected at 16.3 μg/L in one of the municipal wells, which exceeds the MCL of 10 μg/L, and benzene was detected ranging from 6.9 to 120 μg/L, which exceeds the MCL of 1 μg/L. A potential source for arsenic include erosion of natural deposits. Typical sources of benzene include petroleum storage tanks, pipelines, and naturally occurring oil-bearing strata under Kettleman City. Each of KCCSD's water wells has an aeration system attached to its well head to remove benzene. The after treatment benzene concentration was below 0.5 μg/L. The water quality analysis of the well at the school in 2009 showed an arsenic level of 14 μg/L, but the level of benzene is unknown.

If possible, DTSC will collect 15 water samples for analysis of metals, total petroleum hydrocarbons (TPHs), PCBs, Semi-VOCs and VOCs as below:

- Three groundwater samples – one each from three onsite water wells
- Two surface water samples – one each from the California Aqueduct and the irrigation canal along Interstate Highway 41.

- Ten faucet water samples – one each from faucets at 10 residential properties. The properties will be identified by placing a ten part grid over the residential area and randomly select one home in each part, thereby providing a representative cross section of the city's water.

Previous studies have shown that groundwater beneath the Kettleman Hills Facility is not connected to the groundwater beneath Kettleman City. DTSC and the Regional Water Board will review those studies. In general terms, the hydrogeologic system at the Kettleman Hills Facility can be characterized by: (1) stratigraphically confined and restricted flow paths, (2) small ambient gradients that are primarily along strike, (3) apparent low or stagnant horizontal groundwater velocities, and (4) geographic and hydraulic isolation from regional groundwater resources[1].

2.1.4 Sediment Sampling

If possible, DTSC will collect two sediment soil samples from the aqueduct and irrigation canal. DTSC plans to analyze for metals, total petroleum hydrocarbons (TPHs), PCBs, and Semi-VOCs to evaluate potential impacts to fish, and to humans who consume the fish.

[1] AMEC Geomatrix, Inc., 2010, Fourth Quarter 2009 Groundwater and Unsaturated Zone Monitoring Report for the Class I Waste Management Units, Kettleman Hills Facility, Kings County, California, unpublished report prepared for Chemical Waste Management, Inc., 22p.

Air Resources Board Sampling Plan

1.0 Background

The Air Resources Board (ARB) has been requested by the California Environmental Protection Agency (Cal/EPA) to conduct air sampling in Kettleman City to assess possible exposure to environmental contaminants that have the potential to cause birth defects.

2.0 Sampling Locations

The Air Resources Board's (ARB) Monitoring and Laboratory Division (MLD) proposes to conduct ambient air monitoring at two monitoring sites:

1) Kettleman City Elementary School (see **Figure 2**) is located at 701 General Petroleum Street, Kettleman City. ARB proposes to install an ambient air monitoring trailer, which will be outfitted with air monitoring instruments.

2) Kettleman Hills hazardous waste management facility is located approximately three miles to the southwest of Kettleman City. ARB proposes to conduct ambient air monitoring at the southeast corner of the facility property, co-located with the facility's existing monitoring site.

3.0 Target Analytes, Sample Duration and Frequency

The specific metals, volatile organic compounds (VOCs), sulfur dioxide, polychlorinated biphenyls (PCBs), dioxins, and furans to be measured were selected by the Office of Environmental Health Hazard Assessment (OEHHA) and are analytes for which ARB has sampling and/or analytical capability. A list of these analytes is provided in Table 1, Target Analytes. ARB will also conduct air sampling for fine particulate matter (particles with a diameter of 2.5 microns and smaller, referred to as PM2.5).

In addition, due to community concern, ARB will assess the public's exposure to diesel exhaust in Kettleman City. Diesel exhaust contributes to airborne PM2.5 and consists of a mixture of many chemical compounds. Because of this, there is no method to directly sample the air for diesel exhaust. Therefore, ARB proposes to use well established approaches to assess local and regional exposure to diesel exhaust. To assess local exposure to diesel exhaust in Kettleman City, ARB proposes to use modeling of emissions from trucks and other diesel sources. This is an established method for assessing local exposure to diesel exhaust that ARB uses at ports, rail yards, freeways, and warehouse distribution centers. This method has been used as the basis of ARB regulations to reduce emissions of diesel particulate matter. Regional exposure to diesel exhaust will be assessed by conducting ambient air sampling in Kettleman City for nitrogen oxides. These results are used as surrogates to estimate diesel exhaust levels in the region.

Table 1: Target Analytes

Metals	VOCs	PCBs	Dioxins/ Furans
Arsenic	Benzene	3,3',4,4'-TeCB (77)	**Dioxins**
Cadmium	Toluene	3,4,4',5-TeCB (81)	2,3,7,8-TCDD
Lead	Ethyl Benzene	2,3,3',4,4'-PeCB (105)	1,2,3,7,8-PeCDD
Nickel	Carbon Disulfide	2,3,4,4',5-PeCB (114)	1,2,3,4,7,8-HxCDD
Hexavalent Chromium		2,3',4,4',5-PeCB (118)	1,2,3,6,7,8-HxCDD
	Other	2',3,4,4',5-PeCB (123)	1,2,3,7,8,9-HxCDD
	Sulfur Dioxide	3,3',4,4',5-PeCB (126)	1,2,3,4,6,7,8-HpCDD
		2,3,3',4,4',5-HxCB (156)	OCDD
		2,3,3',4,4',5'-HxCB (157)	**Furans**
		2,3',4,4',5,5'-HxCB (167)	2,3,7,8-TCDF
		3,3',4,4',5,5'-HxCB (169)	1,2,3,7,8-PeCDF
		2,3,3',4,4',5,5'-HpCB (189)	2,3,4,7,8-PeCDF
			1,2,3,4,7,8-HxCDF
			1,2,3,6,7,8-HxCDF
			1,2,3,7,8,9-HxCDF
			2,3,4,6,7,8-HxCDF
			1,2,3,4,6,7,8-HpCDF
			1,2,3,4,7,8,9-HpCDF
			OCDF

Ambient air monitoring is proposed from late May through late August 2010. For metals and VOCs, 24- hour samples will be collected twice weekly for 12 weeks, for a total of twenty-four (24) discrete sampling periods. The sampling duration for PCBs, dioxins, and furans will be 28 days in length, for a total of three samples between late May and late August. (The extended sampling duration for PCBs allows for more sensitive detections.) For sulfur dioxide, PM2.5, and nitrogen oxides, analyzers will be operated that will measure hourly air concentrations.

Laboratory analyses for metals and VOCs will be performed by the ARB. The U.S. EPA's Mississippi Laboratory will conduct analyses for PCBs, dioxins, and furans analyses.

Data on other, non-target metals and VOCs will be collected concurrently as part of ARB's sampling and analysis methods. These other metals and VOCs have not been associated with birth defects. For informational purposes, ARB will provide these additional data to OEHHA.

4.0 Sampling and Analysis Methods

The monitoring equipment at each site includes the use of a Xonteck Model 910PC toxic gaseous sampler for VOCs, two BGI PQ100 portable programmable mass flow controlled sampler for metals, and a Thermo Andersen Poly-Urethane Foam (PUF) Sampler-Special for PCBs, dioxins and furans.

The Xonteck 910PC samples will be collected in stainless steel canisters. The airflow to the canister is uniformly maintained in order to fill to a sufficient volume (10 to 16 psi) for VOCs laboratory analyses as well as to obtain a representative sample over a 24-hour period. Air samples are analyzed by direct injection, Gas Chromatography/Mass Spectrometry (GC/MS).

The BGI PQ100 mass flow controlled sampler will be used to collect ambient air samples which then will be analyzed for metals. A 37 mm Teflon filter will be installed on the PQ100 and sampled at a flow rate of approximately 12 standard liters per minute (slpm). Air samples are acid extracted and analyzed by Inductively Coupled Plasma/Mass Spectrometry (ICP/MS).

A second BGI PQ100 will be used to sample for hexavalent chromium. Bicarbonate impregnated 37 mm cellulose filters will be sampled at approximately 12 slpm. To achieve similar limits of detection to ARB's standard methodology, seven to nine filters will be composited for water extraction and subsequent analysis by Ion Chromatography.

For sampling of PCBs, dioxins, and furans, the Thermo Andersen Poly-Urethane Foam (PUF) Sampler-Special will be used. It consists of a sampling head which is designed to hold a circular 4-inch-diameter quartz-fiber filter (QFF) and a 2.5-inch-diameter by 5-inch-long cylindrical glass sample cartridge containing a 3-inch polyurethane foam (PUF) sorbent trap that fits snugly into the cartridge. Particulates in the sample stream are collected on the filter, while any vapors that pass through the filter are collected by the PUF sorbent. The flow rate will be set at approximately 240 slpm. Samples will be collected for 5-6 days, 24 hours per day. Samplers will then be turned off to remove and replace the QFF with a new one. The PUF will remain in place. Sampling will resume for another 5-6 days followed by a filter change. There will be a total of four QFFs collected along with one PUF over the 28 day sampling period that makes up a single sample. The four QFFs and one PUF will be composited for a single analysis. Air samples are extracted and analyzed by High Resolution GC/MS.

Air sampling for sulfur dioxide, PM2.5 and nitrogen oxides will be conducted only at the Kettleman Hills Elementary School and is described in the following paragraphs.

Sulfur dioxide (SO2) will be measured using a continuous SO2 analyzer (Thermo 43C). The principle measurement method is based on ultraviolet (UV) fluorescence. SO2 molecules become excited when exposed to photons of the appropriate UV wavelength (~214 nm). As the excited SO2 molecules decay, the wavelength of fluoresced light (~330 nm) is monitored. The SO2 concentration is directly related to the fluoresced light emitted within the sample chamber.

PM2.5 will be measured using a continuous PM2.5 sampler (Met One Beta-Attenuation Monitor, BAM-1020). The Met One-1020 automatically measures and records airborne fine particulate concentrations using beta ray attenuation. A small carbon 14 source emits a constant source of high-energy electrons know as beta particles inside the sampler. These beta particles are detected and counted by a sensitive scintillation counter (photomultiplier tube). An external pump pulls a measured amount of ambient air through a filter tape. The measured differential particulate loading on the filter tape is calculated into mass.

Nitrogen oxides (NOx) will be measured using a continuous NOx analyzer (Teledyne – Advanced Pollution Instrumentation model 200A). This analyzer is designed to directly measure nitrogen oxide (NO) and nitrogen oxides (NOx), and then automatically calculates the air concentration of nitrogen dioxide (NO2).

In addition to air sampling, wind speed and direction and temperature will be measured continuously for the entire three-month period at both monitoring sites. Wind speed is monitored using a cup anemometer (Met One 010 wind speed sensor). Wind direction is monitored using a vane (Met One 020 wind direction sensor). Outside temperature is monitored using a thermistor (Met One 060 temperature sensor). All three meteorological parameters will be averaged for each hour and digitally stored.

5.0 Quality Control

ARB's Quality Assurance Section will perform flow audits on ambient air samplers using National Institute of Standards and Technology (NIST)-traceable flow measuring device. Audits will be conducted at the beginning and end of the field study.

In addition, routine field and laboratory quality control practices will be followed as reference in standard operating procedures and in the Air Monitoring Quality Assurance Manual. (see Section 6.0)

6.0 References to Standard Operating Procedures and Quality Assurance Manual

The following Standard Operating Procedure will be used for the collection and analysis of ambient air samples and the collection of meteorological data. In addition, a link to the Air Monitoring Quality Assurance Manual is also provided.

Xontech Model 910A Sampler Standard Operating Procedure
http://arb.ca.gov/airwebmanual/aqsbdocs1/v2apxq.pdf

BGI PQ100 Sampler Standard Operating Procedure
http://arb.ca.gov/airwebmanual/aqsbdocs1/406sop200309.pdf

Andersen PUF Sampler Standard Operating Procedure
http://arb.ca.gov/airwebmanual/aqsbdocs1/800sop200211.pdf

Determination of Aromatic and Halogenated Compounds in Ambient Air by Capillary Column Gas Chromatography/Mass Spectrometry
http://www.arb.ca.gov/aaqm/sop/sop_058.pdf

Trace Metal Analysis of Ambient Air Particulate Samples Using Inductively Coupled Plasma – Mass Spectrometry
http://www.arb.ca.gov/aaqm/sop/mld061_fin.pdf

Extraction and Analysis of Hexavalent Chromium by Ion Chromatography
http://www.arb.ca.gov/aaqm/sop/sop039_fin.pdf

Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by HRGC/HRMS
http://www.arb.ca.gov/aaqm/qmosopas/dioxins/methods/1668a.pdf

Thermo 43C Sulfur Dioxide Analyzer Standard Operating Procedure
http://www.arb.ca.gov/airwebmanual/aqsbdocs1/v2apxc.pdf

Met One BAM-1020 PM2.5 Standard Operating Procedure
http://www.arb.ca.gov/airwebmanual/aqsbdocs1/400sop200306.pdf

Standard Operating Procedure for Wind Speed Sensors
http://www.arb.ca.gov/airwebmanual/aqsbdocs1/v2apxt.pdf

Standard Operating Procedure for Wind Direction Sensors
http://www.arb.ca.gov/airwebmanual/aqsbdocs1/v2apxv.pdf

Standard Operating Procedure for Outdoor Temperature Sensors
http://www.arb.ca.gov/airwebmanual/aqsbdocs1/v2apxaa.pdf

Air Monitoring Quality Assurance Manual
http://www.arb.ca.gov/aaqm/qmosqual/qamanual/qamanual.htm

Proposed Department of Pesticide Regulation Kettleman City Exposure Assessment Plan for Pesticides

1.0 Introduction

DPR proposes 19 pesticides for evaluation as possible causes of birth defects in Kettleman City. OEHHA and DPR developed a candidate list of chemicals to evaluate based on possible birth defects in humans or animals. DPR proposes the pesticides shown in Table 2 for evaluation because they may cause birth defects and had reported use within five miles of Kettleman City during 2007 or 2008.

Table 2 lists the pesticides proposed for evaluation. The table shows the average yearly use during 2007 and 2008 within five miles of Kettleman City, the relative rank among all pesticides used within five miles of Kettleman City during 2007 and 2008.

Table 2: Pesticides Proposed for Evaluation

Pesticide	2007-8 Avg Use Within 5 mi (pounds)	2007-8 Use Rank Within 5 mi	Monitoring Status
2,4-dichlorophenoxyacetic acid (2,4-D)	495	50	Monitored in CA
Abamectin	42	128	Not monitored
Azoxystrobin (Quadris)	336	57	Not monitored
Boscalid (Pristine)	311	61	Not monitored
Bromoxynil (Buctril)*	1,156	45 and 47	Monitored in CA
Carbaryl (Sevin)	1,374	30	Monitored in KC
Chlorpyrifos (Lorsban)	3,243	16	Monitored in CA
Clethodim (Arrow)	252	71	Not monitored
Diazinon	110	97	Monitored in CA
Diflubenzuron (Dimilin)	225	76	Monitored in CA
Fenoxaprop-p-ethyl (Puma)	60	118	Not monitored
Flumioxazin (Chateau)	149	89	Not monitored
Maneb (Manex)	319	78	Not monitored
Methylchlorophenoxyacetic acid (MCPA)	1,750	24	Monitored in CA
Methyl isothiocyanate (MITC, metam; Vapam, Sectagon)*	234,519	1 and 5	Monitored in CA
Myclobutanil (Laredo)	291	65	Not monitored
Oxyfluorfen (Goal, Goaltender)	1,702	25	Monitored in CA
Propiconazole	157	86	Not monitored
Pyraclostrobin (Cabrio, Pristine)	396	54	Not monitored

*Bromoxynil and methyl isothiocyanate are formed from more than one pesticide. The combined use is shown.

2.0 Evaluation

2.1 Health Screening Levels

DPR proposes to conduct a two-step evaluation of the 19 pesticides. For the first step, DPR proposes to determine "health screening levels" based on the available toxicology data. Health-protective screening levels are necessary because there are no federal or state standards for pesticides in air, that is, no enforceable health-based limits on pesticide emissions allowed in air. The screening levels are designed to point out potential concerns for health effects. Although they are not regulatory standards, these screening levels are useful for preliminary evaluations of air monitoring data. Environmental levels below the screening level for a given pesticide would not be considered to represent a significant health concern. Measured or modeled levels above the screening level would not necessarily signal a significant health concern but would point out the need for a more refined evaluation. For a description of DPR's method to determine screening levels, see pages 17 – 20 in DPR's report entitled "Pesticide Air Monitoring in Parlier, CA."
http://www.cdpr.ca.gov/docs/envjust/pilot_proj/parlier_final.pdf

2.2 Estimation of Worst-Case Air Concentrations

After determining the health screening levels, DPR proposes to estimate the worst-case air concentrations that occurred in Kettleman City during 2007, 2008, and 2009. When available, DPR proposes to estimate the air concentrations based on historical monitoring data from pesticide applications and communities in California. Reports of pesticide air monitoring studies are available at
http://www.cdpr.ca.gov/docs/emon/pubs/tac/tacstdys.htm

For pesticides that have not been monitored previously, or when previous monitoring may not represent the worst-case for Kettleman City, DPR proposes to estimate air concentrations with computer model (Industrial Source Complex-Short Term model; ISCST). USEPA developed the computer model and has validated its accuracy. The model is used by many government agencies and others to estimate air concentrations of toxic chemicals. As part of the validation, USEPA and others agencies compare air concentrations measured in the field to air concentrations predicted by the model. In addition, two scientific panels have reviewed DPR's modeling procedures and found them acceptable.

DPR proposes a tiered approach to the computer modeling. The first tier would model simple, theoretical worst-case situations for each pesticide. This theoretical situation assumes 100 percent flux of the pesticide off of the field or orchard, which is not a real occurrence—this is a screening tool. If the first tier modeled air concentrations exceed health screening levels, a second tier of modeling would be conducted. The second tier will use information from pesticide use reports for specific applications during 2007, 2008 and 2009, and local weather data from 2007, 2008 and 2009 to more accurately estimate historical air concentrations in Kettleman City. (The Department of Water

Resources provides weather data from a network of stations in agricultural areas, including the area around Kettleman City.) DPR will estimate air concentrations for individual pesticides as well as air concentrations for multiple pesticides combined to estimate cumulative exposure.

Both the first tier and second tier of computer modeling rely on the following key information to estimate air concentrations:

- Agricultural field information – number, dimensions, locations
- Pesticide applications – product, dates, and amount applied
- Amount of applied pesticide released to the air (emission rate or flux)
- Weather – wind speed, wind direction, atmospheric stability
- Location of people (Kettleman City)

Accurate information is available for most of the model inputs for most applications, with the exception of the emission rate. Air monitoring is needed to accurately estimate the emission rate. Since many of the 19 pesticides have not been monitored, DPR will need to make worst-case assumptions of the emission rate for several pesticides. The specific model inputs for Kettleman City may differ, but the following documents are examples of the first tier and second tier computer modeling to estimate air concentrations:

- DPR's August 21, 2008 memorandum entitled "Screening Level Air Concentration Estimates for Worker Health and Safety Exposure Appraisals" http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/analysis_memos/2071_segawa.pdf
- DPR's November 30, 2005 memorandum entitled "Estimation of Methyl Isothiocyanate Air Concentrations Associated With Priority Case Number 026-KER-05" http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/analysis_memos/1755_Goh_rev.pdf

DPR will evaluate carbaryl first to confirm that the proposed computer modeling will overestimate air concentrations. Carbaryl has been monitored in several locations for several studies, including ambient air monitoring in Kettleman City during 2007. DPR will compare the air concentrations measured during these studies to the estimated worst-case air concentrations using the proposed Tier 1 modeling procedures and Tier 2 modeling procedures.

2.3 Possible Further Steps

If the second tier of modeling shows air concentrations exceeding the screening levels, DPR proposes to conduct a more refined evaluation, likely including air monitoring of specific pesticide applications near Kettleman City and/or ambient air monitoring within Kettleman City.

DPR will monitor some pesticides listed above at the Kettleman City Elementary School monitoring station that ARB will use. The effort will be in conjunction with ARB's monitoring effort and use the methodology described in DPR's report entitled "Pesticide Air Monitoring in Parlier, CA." DPR has a multi-residue analytical screen that includes some of the chemicals of concern in Kettleman City (chlorpyrifos, diazinon, oxyfluorfen + an additional sample for MITC). Any concentrations measured would be compared to concentrations developed by modeling in the Tier 1 and Tier 2 modeling procedures. The Tier 2 modeling procedure involves a more involved estimate of flux that considers the vapor pressure, water solubility, and Koc properties of the chemicals of interest, along with actual pesticide application information. The measured concentrations will be used to validate the modeling procedures and evaluate exposure to the community. http://www.cdpr.ca.gov/docs/envjust/pilot_proj/parlier_final.pdf

3.0 Discussion

There are two primary reasons we propose to initially estimate air concentrations using historical data and computer modeling:

- Any air monitoring conducted in 2010 may not show the potential exposures to pesticides applied in earlier years, when reported birth defects actually occurred. Monitoring can only provides a snapshot of air concentrations of pesticides at a specific location and specific time. This is particularly true for the Kettleman City area where pesticide use patterns have changed in recent years as orchards and other crops have replaced cotton fields. Different pesticides are used now than those used just a few years ago. We can model air concentrations for earlier years using information from pesticide use reports and data from nearby weather stations.

- Air monitoring would take several months or possibly more than one year for many of the pesticides we propose to assess. Those pesticides have not been monitored in air previously, and no methods exist to analyze air for these pesticides. Developing analytical methods for a single pesticide normally takes several months.

In addition, if there are several pesticides to sample, it can take several months to a year or more, since different pesticides are used throughout the growing season. That is, one pesticide may be applied only in the summer while others are used only in winter. Other pesticides may not be used at all one year, if the pest the chemical is targeting is not a problem. Complete results of air monitoring would not be available until 2012.

Pesticide use reports provide a key source of information for DPR's evaluation. Under California law, all agricultural pesticide use must be reported. DPR maintains a database of all reported agricultural pesticide applications in California. The pesticide use report database contains information on all agricultural pesticide use and some nonagricultural use in California. The database includes information on the pesticide product used, the application date, the application amount, crop/site treated, and application location to a square-mile section.

To accurately model Kettleman City, the Kings County Agricultural Commissioner's office will provide maps showing the locations of agricultural fields identified in pesticide use reports, enabling DPR to estimate air concentrations for specific pesticide applications.

DPR will also evaluate pesticide use reports of the 19 pesticides listed in Table 2 to determine if the applications in the Kettleman City area during 2007-2009 are unusual. This evaluation will include a comparison of the application rates and field sizes in the Kettleman City area to application rates and field sizes in other areas of the state.

DPR will also compare Kettleman City to other communities in the San Joaquin Valley for the total pounds applied of the 19 pesticides and evaluate trends over time for the 19 pesticides, comparing use during 2007-2009 with earlier years.

The Office of Environmental Health Hazard Assessment Evaluation Plan of Contaminants Found in Environmental Samples from Kettleman City

1.0 Introduction

During the spring and early summer of 2010, Cal/EPA will sample the air, water and soil in and around Kettleman City and analyze the samples for 15 chemicals that can cause birth defects. The Office of Environmental Health Hazard Assessment (OEHHA) will evaluate the chemicals or chemical classes (listed in Table 3) to determine if the levels found in the air, water and soil are higher than levels that are considered safe or normal for the area.

Additionally OEHHA will consult with the Department of Pesticide Regulation (DPR) in its evaluation of 19 currently used pesticides, to see whether the measured and estimated environmental levels may threaten the health of Kettleman City residents.

Table 3: Chemicals to be Evaluated by OEHHA

Chemical	Will be monitored in		
	Soil	Air	Water
Arsenic	X	X	X
Benzene	X	X	X
Cadmium	X	X	X
Carbon Disulfide*		X	
Chromium VI	X	X	X
DDT (Dichlorodiphenyl-trichloroethane)	X		
Dioxin/Furan		X	
Endrin	X		
Ethylbenzene	X	X	X
Lead	X	X	X
Mercury and mercury compounds	X		
Nickel and Nickel compounds	X	X	X
Polychlorinated biphenyls	X	X	X
Sulfur Dioxide		X	
Toluene	X	X	X

* Carbon disulfide is both a pesticide and an industrial chemical and will be evaluated by both DPR and OEHHA.

1.1 Chemical Selection

The Kettleman City CEA technical work group chose chemicals from a larger list of chemicals that are known or suspected to cause developmental toxicity. The chemicals were first categorized based on whether they were known to affect people or if they have solely been shown to affect laboratory experimental animals. The chemicals were then evaluated based on the likelihood of known past or current activities in the Kettleman City residential area that may have caused their release. In some cases, while no known activities in the residential area would cause their release, a chemical was added because the environmental concentration can be measured with the same test used to measure the environmental concentrations of other chemicals on the list.

A number of chemicals on the list are also known to be carcinogenic. Because the community is interested in exposures to carcinogens, these chemicals will also be evaluated based on their carcinogenicity. Additional chemicals that may be analyzed as part of the standard analytical methods may be evaluated further if there appears to be a need because of their environmental concentrations.

2.0 Evaluation of Individual Contaminants

OEHHA has previously evaluated the toxic effects of many of the chemicals listed in Table 3. These evaluations result in the establishment of toxicity criteria. Toxicity criteria are set to ensure that exposures at or below those levels will not cause any of the health effects that higher exposure levels may produce. OEHHA is reviewing all of its past evaluations of these chemicals to be sure that they reflect the most current toxicity data. While this evaluation is focused on exposures that may cause birth defects, the toxicity criteria and health-based environmental exposure levels may have been developed for other toxic effects that occur at lower exposure levels.

If the measured levels in Kettleman City are lower than established health-based environmental exposure levels, then no health effects would be expected from the chemical exposures in Kettleman City. However, if the measured levels in Kettleman City exceed the health-based environmental exposure levels, then further evaluation will be needed.

As part of the additional evaluation, OEHHA will determine whether the measured environmental levels are above or below normal environmental levels (also called background levels). This is important because the normal background levels may exceed the environmental exposure levels that OEHHA considers safe. Background levels may be naturally occurring (as in the case of arsenic in groundwater) or they may be from human activities (as in the case of the air pollutant benzene).

OEHHA will compare the levels of contaminants found in the soil and air of Kettleman City to levels in other areas in the region, such as Fresno. If the environmental levels in Kettleman City are similar to the normal levels found in other regions, OEHHA will conclude that residents of Kettleman City are not exposed to unusual levels of contaminants.

If the environmental levels of any of the chemicals exposure exceed those in similar areas, further evaluation will be directed towards specifically developing an interim toxicity criterion for reproductive and developmental effects of the chemical. It will be an interim value because there is not sufficient time to develop a value through the normal process. OEHHA's interim value is likely to be even more health protective than a fully developed value. Any environmental levels above the interim health based environmental exposure levels will be noted as a concern. Follow-up strategies will then be developed where such levels are noted.

The final Cal/EPA assessment report will identify the presence of any chemical at levels that are of concern. The report could recommend further investigation of the chemical and its possible sources, or it could recommend appropriate actions (or the development of appropriate actions) to expeditiously reduce exposures to those chemicals.

3.0 Multiple-Chemical Exposure

Although chemical toxicity is normally evaluated one chemical at a time, people typically are exposed to multiple chemicals. Exposure to many chemicals at the same time can affect the toxicity of each one in different ways. Here is how scientists explain the interactions between these chemicals:

- No effect—one chemical does not change how the other one works.
- Antagonistic effect—one chemical reduces or prevents the toxicity of the other chemical.
- Additive effect—one chemical adds to the toxic effect of the other chemical.
- Synergistic effect—one chemical increases the toxicity of the other one so that the combined toxicity is more than additive.

Unfortunately, scientist usually lack information about how two or more chemicals act together. It is difficult to study how one chemical will interact with all the other chemicals because each combination of chemicals needs to be tested. Studies that have been done have shown all those interactions above are possible where exposure to multiple chemicals occurs.

The general approach to evaluating exposures to multiple chemicals has been to assume that they act additively. While this approach may not always fully show how the chemicals interact, this assumption has worked well over the last 30 years in multiple chemical exposure evaluations. For the Kettleman City evaluation, chemicals with similar toxic effects will be evaluated this way. It may show that even though exposures to individual chemicals are not high enough for a concern, two or more exposures together are enough to raise a concern.

Figures

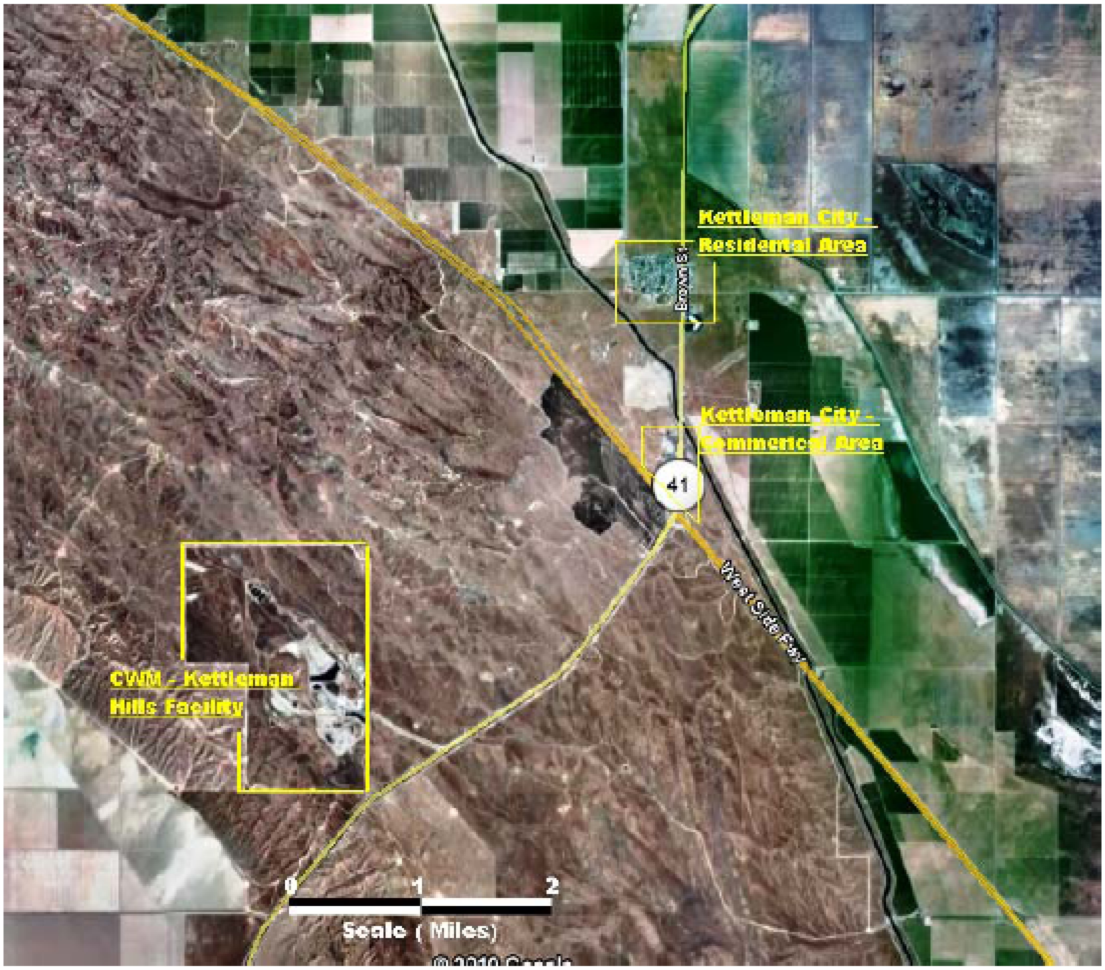


Figure 1 – Vicinity Map

Figure 2 –Map of Kettleman City

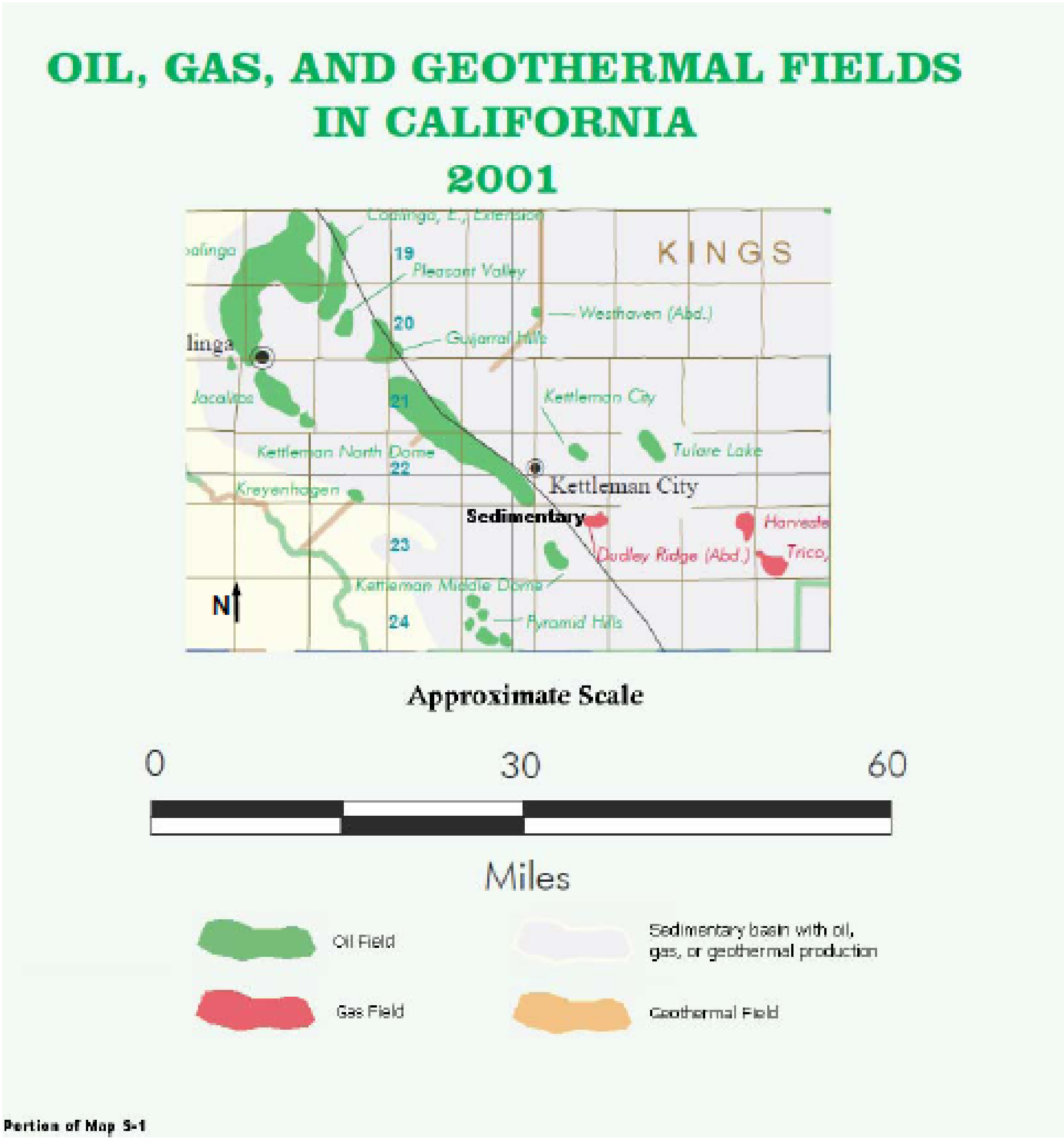
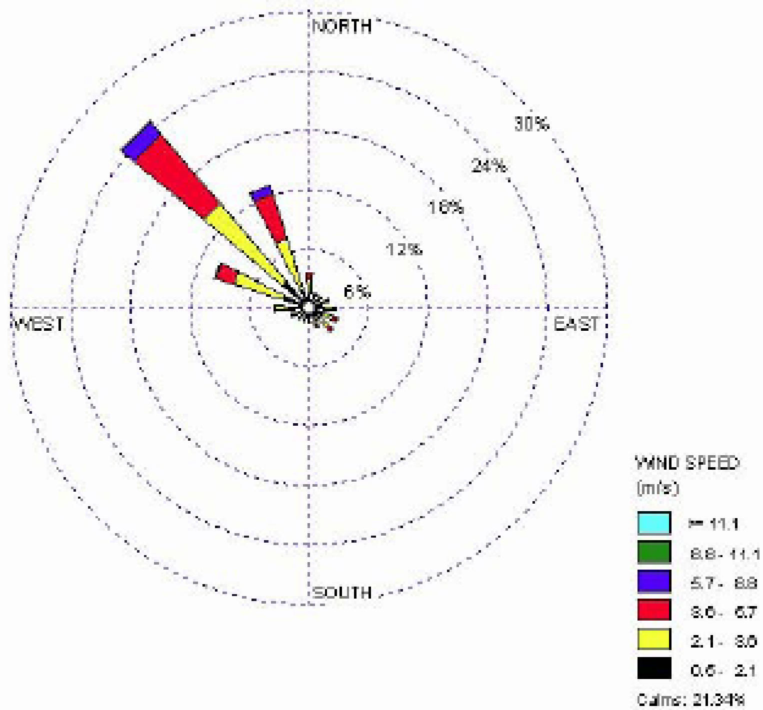


Figure 3 – Regional Oil/Gas/Geothermal Fields Map
(Source: California Department of Conservation)



Annual Windrose
2000-2004 Annual Meteorological Data from Hanford, CA Meteorological Station

Displays wind speed, direction (blowing from)

Average wind speed: 2.51 m/s

Figure 4 – Wind Rose
(Source: Hanford, CA Meteorological Station)