California Environmental Protection Agency

Kettleman City Community Exposure Assessment Work Plan

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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Executive Summary

Purpose

On January 29, 2010, Governor Arnold Schwarzenegger directed the California Department of Public Health (CDPH) and the California Environmental Protection Agency (Cal/EPA) to take aggressive action to investigate the birth defects in Kettleman City, California. He directed the CDPH to conduct a health investigation of the families whose children were born with birth defects and Cal/EPA to assess possible environmental contaminants in the air, groundwater and soil that could potentially cause birth defects. The work plan describes the Cal/EPA portion of the investigation. It describes how samples will be obtained and analyzed from the air, soil, and water in Kettleman City.

Status

Cal/EPA formed an exposure assessment team that includes members from each of the five boards, departments and office within Cal/EPA -- the Office of Environmental Health Hazard Assessment (OEHHA), the Department of Toxic Substances Control (DTSC), the Air Resources Board (ARB), the Department of Pesticide Regulation (DPR), and the State Water Resources Control Board (SWRCB). Cal/EPA has directed OEHHA to serve as the lead entity for the community assessment. The Cal/EPA entities are working in conjunction with CDPH and the U.S. Environmental Protection Agency (US EPA).

Cal/EPA and CDPH have met with residents of Kettleman City and participated in three public meetings to provide a description of the investigation. Cal/EPA also solicited public comments on an Outline, released in March, and a Technical Support Document, released in May. This current document combines those two earlier documents into a final work plan.

Kettleman City Overview

The Kettleman City community (as of the 2000 census there are, approximately 1,500 people, 320 households and 289 families) is located in southwestern Kings County along State Highway 41 just north of Interstate 5. It is approximately 118 acres in size and consists of a commercial area along State Highway 41 immediately north of Interstate 5 and a residential area located along State Highway 41, north of the commercial area. There are two municipal wells serving the residents of the city that contain elevated levels of benzene and arsenic, although units on each well have been installed to remove the benzene. North and east of the city, the land is farmed with rotating crops, while orchards are found immediately west. Commercial properties include a gas station, two very small convenience stores, an auto parts dealer, and two towing companies. The Kettleman Hills hazardous waste management facility is located 3.5 miles southwest of the city. There are also naturally occurring petroleum deposits as well as oil pipelines, wells, pump stations, and a bulk storage facility in the

area. Finally, the California Aqueduct and local canals are located close by and is the source of fish eaten by some of the residents.

Key Questions

In developing this work plan, the technical group considered the following questions: First, 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 them? These questions and the answers developed by Cal/EPA with input from the community, outside entities and other agencies are found below:

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

Experts from OEHHA prepared a list of chemicals that are known to cause birth defects and other developmental effects – especially facial clefts. Next, OEHHA consulted with the other Cal/EPA boards and departments and added to the list additional chemicals that may be present in the area and that may cause birth defects or other developmental effects. The compiled list is included as Table ES.1.

Cal/EPA will also measure other chemicals in addition to those listed in Table ES.1. Many other chemicals are routinely collected and analyzed as part of the process of monitoring for the chemicals listed in Table ES.1 and can be found in Table ES.2. Others, like nitrogen oxides, will be measured for modeling diesel exhaust levels in the area. These chemicals will be evaluated to determine if their environmental concentrations may cause other types of health effects besides birth defects.

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:

1. Age and condition of buildings and infrastructure
2. Agricultural operations.
3. Chem Waste Management, Inc. Kettleman Hills hazardous waste storage, treatment and disposal facility.
4. Former and current commercial operations that caused contamination that might be identified through records searches.
5. Groundwater contamination from naturally occurring arsenic, or from benzene and petroleum compounds.
6. Indoor dust and air may be a source of environmental contaminants.
7. Illegal dumping of automobiles and household trash that has taken place periodically throughout the area.

8. 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:

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

The results of the CDPH health investigation may produce information indicating a need to add additional chemicals or sources to our list. At this point, preliminary results have not identified any additional chemicals or sources, although, they have identified specific locations for soil sampling.

How can we sample and analyze for these chemicals?

Methods for sample collection for the chemicals listed in Table ES.1 may differ depending on the chemical and on whether it appears in the air, soil, or water. After obtaining samples of the air, soil and water, Cal/EPA will apply standardized laboratory-approved methods to measure levels of specific chemicals. The following describes how air, soil and water samples will be obtained:

Air

ARB will conduct outdoor air monitoring for non-pesticide chemicals in the community of Kettleman City. Twenty-four (24) hour samples will be collected twice weekly from June through August 2010. ARB entered into an agreement with the Kettleman City Elementary School to set up an ambient air monitoring trailer at the school grounds. The ARB trailer will be outfitted with air monitoring instruments. Weather data and quality controls for the air monitoring sampling will be conducted according to standard operating principles.

ARB will also conduct concurrent air sampling upwind and downwind of the Kettleman Hills hazardous waste facility. In addition, ARB will assess the public's exposure to diesel exhaust in Kettleman City.

Laboratory analyses for most of the chemicals will be performed by the ARB laboratory. ARB will also collect air samples for polychlorinated biphenyl (PCBs) congeners, and polychlorinated dioxin and polychlorinated dibenzofuran congeners

that will be analyzed by the U.S. Environmental Protection Agency (U.S. EPA). The air monitoring station at the elementary school will also have a continuous monitor for nitrogen oxides (NO_x) and sulfur dioxide (SO_2).

Data on the same target analytes from the other sites in the San Joaquin Valley will be provided to OEHHA for comparison. In addition, data on other non-target metals and VOCs will be collected as part of ARB's sampling and analysis methods. For informational purposes, ARB will provide these additional data to OEHHA.

The Department of Pesticide Regulation (DPR) is analyzing records of pesticide use within five miles of Kettleman City for the years 2007, 2008, and 2009. Using these records, computer modeling, and historical monitoring data, DPR staff will estimate the airborne concentrations within Kettleman City of the pesticides listed in Table ES.1 to evaluate if any may have been high enough to raise health concerns.

DPR will also conduct limited air monitoring of several pesticides, including four pesticides listed in Table ES.1. The monitoring will take place from early June to the end of July 2010. This will enable DPR to evaluate current exposures and compare measured levels of key pesticides to its computer modeling estimates. DPR will have their equipment on the roof of one of the schools buildings and will have its samples analyzed by the California Department of Food and Agriculture Laboratory. Upon approval from the resident, DPR will also be measuring pesticides in the indoor air of homes of those families that had a child born with birth defects. These will be one time samples in each home.

Soil Sampling

DTSC plans to collect soil samples from commercial and residential properties to analyze for contaminants, including organochlorine pesticides and metals. Upon approval from the resident, soil (and soil gas) samples will be collected from the homes of those families that had a child born with birth defects.

Soil Gas Assessment

DTSC will select locations to determine if volatile chemicals are present in the soil below or near residences. Soil gas samples will be analyzed for the volatile non-pesticide chemicals listed in Table ES.1. Final locations, number and depths of sampling will be determined in the field or during a site visit. If elevated levels of volatile chemicals are detected, DTSC will estimate the concentrations of the chemicals that may be in the air inside residences.

Indoor Dust

Upon approval from the resident, the state will be conducting indoor dust sampling in homes of those families in Kettleman City that had a child born with birth defects. DPR will evaluate the data for two pesticides in Table ES.1 and for some metals in Table ES.1. Because this is new methodology for Cal/EPA, a supplemental sampling and analysis plan will be developed for this effort before it begins.

Water Sampling
DTSC plans to collect and analyze drinking water samples for the chemicals listed in Table ES.1. This includes one groundwater sample from each of two community water wells and the well at the Kettleman City Elementary School, one surface water sample each from the California Aqueduct and the irrigation canal along Highway 41, and one faucet water sample each randomly selected residential properties. Upon approval from the resident, drinking water will be collected and analyzed from the homes of families that had a child with birth defects.

The Central Valley Regional Water Quality Control Board will also be analyzing groundwater samples to determine if the benzene in the groundwater is naturally occurring from oil-bearing, sub-surface rock under Kettleman City or is the result of a leak or spill of refined petroleum.

Most of the analytical methods for the chemicals listed in Table ES.1 will pick up additional chemicals other than those identified as being associated with developmental effects. Levels of these additional chemicals detected will be reported.

Other Sampling
Cal/EPA may conduct additional sampling if our investigation or CDPH's investigation were to produce information on other potential chemical sources that merit investigation.

Sampling on residential property and in homes will occur only with the permission of the residents.

Evaluation

The sampling results and estimates of air concentrations of pesticides will be evaluated to determine if the levels of any chemicals are high enough to raise health concerns. Drinking water standards and soil-contaminant screening levels that already exist for some chemicals will likely be used in this evaluation. For other chemicals, including pesticides and other air pollutants that may be present in Kettleman City, DPR and OEHHA, respectively, will develop health criteria that will be used to evaluate the results.

As with any investigation, definitive answers to the cause(s) of the birth defects may not be found. But, when the Cal/EPA investigation is completed, Kettleman City's residents will know whether these chemicals are in their air, water and soil. The final Cal/EPA report will contain recommendations as appropriate for further actions, such as follow-up investigations or mitigation measures to reduce or prevent future chemical exposures. Community members and policymakers will also be able to use this information to discuss any other measures that may be appropriate for protection of public health and the environment in and around Kettleman City.

Achieving scientific accuracy requires time and cooperation. Cal/EPA thanks the community for its assistance, patience, and interest during this investigation.

Schedule

Week of June 7	*ARB air monitoring study set-up in Kettleman City and Kettleman Hills Facility. DPR begins air monitoring study.*
Week of June 14	*ARB begins air monitoring study. Work Plan is finalized and posted on web.*
Early July	*DTSC (Soil/Gas/Water) sampling*
July 30	*DPR pesticide monitoring ends*
August 31	*ARB non-pesticide monitoring ends*
November 1	*Draft Report of Findings released for public comment*
December 1	*End 30 day public comment period*
December 2010	*Final report on assessment*

Table ES.1: Chemicals to be investigated

Chemical	Monitored Media			Air Model[1]	Use(s)
	Soil	Air	Water		
Abamectin				X	pesticide
Arsenic	X	X	X		industrial
Azoxystrobin				X	pesticide
Benzene	X	X	X		industrial
Boscalid				X	pesticide
Bromoxynil				X	pesticide
Cadmium	X	X	X		industrial
Carbaryl				X	pesticide
Carbon Disulfide		X			industrial & pesticide
Chlorpyrifos		X[2,3]		X	pesticide
Chlorinated dibenzodixoin and dibenzofuran congeners	X	X			industrial contaminant
Chromium	X				industrial
Chromium VI		X	X		industrial
Clethodim				X	pesticide
Diazinon		X[2,3]		X	pesticide
DDT (Dichlorodiphenyl-trichloroethane), DDE	X				pesticide
Diflubenzuron				X	pesticide
2,4-D				X	pesticide
Endrin	X				pesticide
Ethylbenzene	X	X	X		industrial
Flumioxazin				X	pesticide
Lead	X	X	X		industrial
Maneb				X	pesticide
MCPA ((4-chloro-2-methylphenoxy)acetic acid)				X	pesticide
Mercury and mercury compounds	X				industrial
MITC (methyl isothiocyanate)		X		X	pesticide
Myclobutanil (Laredo)					pesticide
Nickel	X	X	X		industrial
Oxyfluorfen		X[2]		X	pesticide
Polychlorinated biphenyl congeners	X	X	X		industrial
Propiconazole					pesticide

Chemical	Monitored Media			Air Model[1]	Use(s)
	Soil	Air	Water		
Pyraclostrobin				X	pesticide
Sulfur dioxide		X			Pollutant
Toluene	X	X	X		industrial

[1] Amounts of pesticides in the air will be estimated using computer models by DPR. This will allow DPR to estimate public exposure in Kettleman City from pesticide applications on nearby fields. If an estimated air concentration raises health concerns, DPR would likely monitor for that pesticide in Kettleman City. DPR will monitor four pesticides, chlorpyrifos, diazinon, MITC (methyl isothiocyanate), and oxyfluorfen.
[2] Pesticides to be measured in indoor air.
[3] Pesticides to be measured in indoor dust.

Table ES.2: Other Chemicals Routinely Collected and Analyzed as Part of the Process

Chemicals	
1,1,1-Trichloroethane (TCEA)	Molybdenum
1,3-Butadiene	Norflurazon
Azinphos Methyl	Ortho Xylene (o-xylene)
Bromomethane (CH3Br)	Oryzalin
Carbon Tetrachloride	Perchloroethylene (PERC)
Chloroform	Permethrin
Chlorothalonil	Phosmet
Chromium	Propanil
Cis-1,3-dichloropropene	Propargite
Cobalt	Selenium
Copper	Simazine
Cypermethrin	Strontium
Dichloromethane (DCM)	Styrene
Dichlorvos	Sulfur
Dicifol	Thioben carb
Dimethoate	Tin
Diuron	Titanium
Endosulfan	Trans-1,3-dichloropropene
Eptam (EPTC)	Tribufos (DEF)
Iron	Trichloroethylene (TCE)
Malathion	Trifluralin
Manganese	Vanadium
Meta + para Xylene (m/p-xylene)	Zinc
Metolachlor	Zirconium
Molinate	

1.0 Kettleman City Community Exposure Assessment Work Plan Technical Support Document

1.1.0 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 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 CEA outlined in this Sampling and Analysis Plan. Cal/EPA has directed OEHHA to serve as the lead entity for the community assessment. Assistance will be provided by the California Department of Public Health (CDPH) and the U.S. Environmental Protection Agency (US EPA).

Cal/EPA and CDPH have met with community members and held several meetings in Kettleman City and requested and received comments on preliminary work plan documents. 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. Reponses to the comments received will be available on the Cal/EPA website at: www.CalEPA.ca.gov.

1.2.0 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.

1.3.0 Kettleman City Area Description

Kettleman City consists of a commercial area and a residential area. The commercial area is composed of motels, restaurants, and fuel stations. 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.

1.3.1 Community 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.

1.3.2 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**).

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 this year.

1.3.4 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, however the running annual average arsenic concentration in the last quarter of 2008 and the first two quarters of 2009 were below the MCL of 10 μg/L. The five previous running annual averages were above the arsenic MCL. Benzene was not analyzed in 2008, and the last reported benzene value in 2007 was below 0.5 μg/L.

1.3.5 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.

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**)

1.4.0 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 evaluation 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:

1. Age and condition of buildings and infrastructure
2. Agricultural operations.
3. CWMI KFH hazardous waste storage, treatment and disposal facility.
4. Former and current commercial operations that caused contamination that might be identified through records searches.
5. Groundwater contamination from naturally occurring arsenic, or from benzene and petroleum compounds.
6. Indoor dust and air may be a source of environmental contaminants.
7. Illegal dumping of automobiles and household trash that has taken place periodically throughout the area.
8. 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:

1. Air pollutants originating from the Kettleman Hills waste management facility, agricultural pesticide applications, diesel trucks and motor vehicles, and other sources.
2. Drinking water contaminants, particularly arsenic.
3. 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.

2.0 Department of Toxics Substances Control's Sampling Plan

2.1.0 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 1.4.0 of the introduction. The Phase 1 assessment is available on the Cal/EPA website, www.calepa.ca.gov.

The following eight potential sources of exposure (PSE) were indicated in connection with the area around Kettleman City.

PSE #1: Age and condition of buildings and infrastructure
Explanation: The city was first developed in 1929. By 1940 the population was 600. The 2000 census showed that about 1,500 people, 320 households and 289 families resided in the city. Most of homes were built prior to 1975. For these old structures, lead from lead-based paint, organochloride pesticides (**OCPs**) from termiticide application and PCBs from electrical transformers are potential sources of soil contamination. In addition, old water pipes may contain lead. See **Figure 2** for the community boundaries.

PSE #2: Agricultural Operations - Pesticide and Sewage Sludge Applications
Explanation: The community is located adjacent to pistachio and almond orchards to the west, north and east, with only the adjacent streets or driveways, Edward Street to the north, a driveway (west to First Street) to the west, and Carter Street to the east, acting as buffer zones. Pesticides, which are commonly associated with agricultural operations, may migrate to the community due to improper application or high winds. See **Figure 2** for community boundaries.

PSE #3 Chemical Waste Management, Inc. Kettleman Hills Hazardous Waste Facility
Explanation: The residential community of Kettleman City is approximately 3.5 miles northeast from the Chemical Waste Management Kettleman Hills Facility (KHF). 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.

PSE #4: Former and current Commercial Operations

Explanation: Hazardous waste generators located within the community have been identified. These generators may contain hazardous materials in reportable quantities. Almost all of commercial businesses within the community are located along Brown Street (aka Highway 41). Among these commercial businesses, Six (6) potential areas of concern with underground storage tanks (**USTs**) have been identified within the community: five (5) former gas stations and one (1) existing gas station. The existing gas station is located at 215 Brown Street. The former Wades Union Service Station located at 407 Brown Street is currently occupied by Okie's Towing and Truck Repair. The former Marcias Service Station located at 499 Brown Street is currently occupied by Marcias Towing and Auto Repair. The former UST facility of the County Fire Station #9 is located at 85B Brown Street. The former Beacon Station is located across Brown Street from the County Fire Station #9. The former UST facility of Kettleman City Elementary School is located at 701 General Petroleum Avenue. See **Figure 3** for the locations of these six (6) commercial use areas of concern.

PSE #5: Groundwater used for Drinking Water

Explanation: Water suppliers typically provide a Water Quality reports (consumer confidence report) that indicate where the water comes from and what's in it. Kettleman City has two (2) municipal wells that have exceeded the MCLs for benzene and arsenic. Each of these wells currently has an aeration treatment system (installed in 1997) for benzene removal. On January 23, 2009, KCCSD received a Compliance Order for violation of the arsenic MCL (due to recent promulgation of a lowered MCL level). Arsenic in excess of the MCL over many years could cause skin damage or problems with the circulatory system, and may increase the risk of getting cancer. Many community residents believe the groundwater is contaminated and avoid using it for drinking and cooking. A third well is located within the KCES, does not contains aeration treatment system. The school reported that no specific contaminants were detected at its water well through a routine groundwater monitoring program. Each of these wells has a chlorination treatment unit. KCCSD and KCES are planning to construct a surface water treatment plant for treating surface water from the California Aqueduct to eliminate arsenic and benzene concerns.

PSE #6: Indoor dust and air

Explanation: Pesticides appear to persist in indoor environments due to the absence of degradation route. Dust is a primary place where pesticides from outside can accumulate and where exposure to the pesticides may occur. Indoor air can reflect pesticides that come into the house and also pesticides that may have been used in the house.

PSE #7: Illegal Dumping

Explanation: Illegal dumping of household waste and hazardous waste unfortunately occurs from time to time by people who ignore the law and safety of others. Residents have provided information of potential illegal dumping around Kettleman City. When these areas were examined the waste found was considered normal solid waste without

and evidence that paints, solvents or other hazardous chemicals were disposed of in the area.

PSE #8: Previous Oil Operations in the Community Neighborhood
Explanation: Kettleman City is located between the Kettleman City Oil Field and Kettleman North Dome oil field. The town was originally developed in 1929 as oil operations in the adjacent areas reached its peak. Several abandoned or idle oil wells from previous operations are located outside of the community. Currently three (3) oil pipelines are running outside the south boundary of the residential area. Although no oil/gas fields or oil processing facilities were noted within ¼ miles of the community, oil from previous operations and some gasoline spills may have potentially affected groundwater or soils beneath the community resulting in a potential reduction in water quality or air quality within structures due to soil gases. **Figure 4** shows a map of oil fields around the vicinity of Kettleman City.

2.2.0 Field Sampling Plan Strategy and Approach

Five PSEs, numbers 1, 2, 4, 5, and 8, were identified through the recent completion of a Phase I review of information on the Kettleman City residential area. In the Phase I review, PSEs are referred to as **recognized environmental conditions**. This sampling strategy is proposed to address those PSEs. 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 Interim Guidance for Sampling Agricultural Properties (Third Revision), dated April 7, 2008
- DTSC's Draft Interim Guidance - Evaluating Human Health Risks from Total Petroleum Hydrocarbons (**TPHs**), dated April 29, 2008
- DTSC's "Methodology for the Sampling, Handling, and Storing of Soils to be Analyzed for Volatile Organic Compounds (**VOCs**) - Method 5035" on use of EPA Method 5035A
- DTSC's Advisory – Soil Gas Investigations, dated January 28, 2003 (**ASGI**); http://www.dtsc.ca.gov/LawsRegsPolicies/Policies/SiteCleanup/upload/SMBR_ADV_activesoilgasinvst.pdf
- DTSC's Guidance – Evaluating of School Sites with Potential Soil Contamination as a Result of Lead from Lead-Based Paint, Organo-chlorine Pesticides from Termiticides, and Polychlorinated Biphenyls from Electrical Transformers, Revised June 9, 2006
- USEPA's Sampling and Analysis Plan – Guidance and Template, Version 3, Brownfields Projects, R9QA/006, June 2004 (**SAP**); http://ndep.nv.gov/bca/brownfield/qp_appendix_c.pdf
- USEPA's Field Sampling Guidance Document #1215 – Sediment Sampling, Rev. 1, USEPA Region 9 Laboratory, 9/99

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

- Soil Gas Survey to collect soil gas samples to evaluate the impact on subsurface soil gas from past gas station operations or oil field activities at or near the community.

- Soil Matrix Sampling to collect soil samples to evaluate the impact on soil from past operations or activities in the community.

- Water Sampling to collect water samples from water well heads, California Aqueduct, irrigation canal, and faucets at residential homes to assess water quality in the community.

- Sediment Sampling to collect sediment samples from bottoms of irrigation canals or California Aqueduct.

- Field Screening for gamma radiation monitoring to address the community's concern over radiation, using LudLum 19 Micro R Survey Meter or Gamma RAE.

2.2.1 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 residential community for workers of the oil fields (**Figure 3**) which were being developed in the Kettleman Plains. Three (3) oil pipelines are currently running near the south boundary of the community. However, no oil/gas fields or oil processing facilities were noted with 1/4 miles of the community. There are six (6) gasoline stations (with USTs) identified within the community – one (1) is still in business and the other five (5) have been closed (see **REC #4**). In addition, onsite groundwater water contains elevated levels of benzene (a VOC).

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 20 primary soil gas samples from 20 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.

    - 12 borings at 10-foot BGS – with two (2) borings at each of six (6) identified UST gas stations;

    - Six (6) borings at 5-foot BGS – one each grid in a 6-grid system over the entire community; and

    - Two (2) borings at 5-foot BGS in areas to be determined in the field or during the community visit.

- 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.

2.2.2 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. The California Human Health Screening Levels (CHHSLs) for inorganic chemicals (except for arsenic) in residential soils will be used as baseline screening numbers to ensure analytical detection limits are sufficiently below the CHHSLs. DTSC has established a risk management level of 12 milligrams per kilogram (mg/kg) for arsenic in California soil.

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 0-6 inches below native soil 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. 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 – 6 x 3 = 18 surface samples

The community is immediately bound by agricultural lands on the west, north and east. OCPs and sewage sludge are commonly applied in these agricultural lands.

DTSC plans to collect 18 surface soil matrix samples from 18 borings and analyze for OCPs, and heavy metals – six (6) borings spaced evenly on each of the west, north and east boundaries of the community. At each soil boring, soil matrix samples shall be collected from one (1) depth, surface (0 to 6 inches below native soil) only.

Residential Property Assessment – 4 x 6 + 2 = 26 surface samples

The Kettleman City community was first developed in 1929. Most of homes were built prior to 1975. For these old structures, lead from lead-based paint, OCPs from termiticide application, and PCBs from electrical transformers are potential sources of soil contamination.

DTSC plans to collect 26 surface soil matrix samples from residential properties as follows:

- 24 soil matrix samples from six (6) randomly selected residences*- one residence

from each grid of the community [which is divided into six (6) grids], four (4) borings at each home and one (1) depth of surface at each boring, for analyses of Title 22 total metals, OCPs and if necessary, PCBs; and

- Two (2) soil matrix samples from two (2) locations, each within close proximity of the base of one (1) pole mounted transformer or in areas of visible staining (assumed), at one (1) depth of surface at each boring location, for analysis of PCBs.

*Upon approval from the resident, samples will be collected from the homes of those families that had a child born with birth defects.

Commercial Property Assessment – 2 x 6 + 3 = 15 surface samples

Hazardous waste generators located within the community have been identified. Six (6) commercial areas of potential concern with USTs are identified, including five (5) former and one (1) existing gas stations. See **REC #4** and **Figure 3** for their locations.

DTSC plans to collect 15 surface soil matrix samples, two (2) from each of these six (6) commercial properties plus three (3) to be determined in the field or during a Site visit, and analyze for Title 22 metals, TPHs, OCPs, PCBs and semi-VOCs. NOTE: Soil gas samples will also be collected from six (6) identified gas stations.

Soil Gas Results – 1 x 2 = 2 subsurface samples (assumed)

Based on results of the soil gas survey, DTSC plans to collect two (2 – assumed) 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.

2.2.3 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 includes 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 plans to collect 10 grab water samples and analyzed for Title 22 metals, TPHs, OCPs, PCBs, VOCs and semi-VOCs as below:

- Three (3) pre-treatment groundwater samples – one (1) from each of the two (2) well heads of community wells and one (1) from the well head of the elementary school well.
- Two (2) surface water samples – one (1) each from the California Aqueduct and the irrigation canal along Highway 41
- 10 faucet water samples – one (1) each from faucets at 10 randomly selected residential properties (one each from the 10-grid community)

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].

* Upon approval from the resident, samples will be collected from the homes of those families that had a child born with birth defects.

2.2.4 Sediment Sampling

Fishing in the irrigation canals or the California Aqueduct is a popular activity in the area. Various community members reported fishing in these locations and consuming the fish they caught. DTSC plans to randomly collect two (2) sediment samples, each from bottoms of the California Aqueduct and the irrigation canal along Highway 41, and analyzed for Title 22 metals, TPHs, PCBs, OCPs, Semi-VOCs and VOCs. If results indicate contamination, we may test the fish.

The full sampling and analysis plan is in Appendix 2.0

[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.

3.0 Air Resources Board Sampling Plan

3.1.0 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.

3.2.0 Sampling Locations

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

1. Kettleman City Elementary School (see **Figure 2**) is located at 701 General Petroleum Street, Kettleman City. ARB will install an ambient air monitoring trailer on the tennis courts located on the school grounds near the corner of General Petroleum Avenue and 6th Street. The trailer will be outfitted with ambient air monitoring instruments.

2. Kettleman Hills hazardous waste management facility is located approximately three miles to the southwest of Kettleman City. ARB will conduct ambient air monitoring at two locations:

   a) Downwind Monitoring Station 2: This site is located southeast of the facility, co-located with the facility's existing monitoring site.
   b) Upwind Monitoring Station: This site is located northwest of the facility, also co-located with the facility's existing monitoring site.

   .

3.3.0 Additional Assessment

Due to community concerns, ARB will conduct two additional types of air assessment:

1) Air stripping units are connected to the well heads of the two drinking water wells in Kettleman City to remove benzene from the drinking water prior to distribution. Air samples will be collected downwind and adjacent to these air stripping units, for subsequent analysis of benzene, to assess potential public exposure from benzene emitted into the air by the air stripping units. One air sample will be collected near each air stripping unit each month during ARB's air monitoring in Kettleman City. This air monitoring will be coordinated with the DPH and RWQCB.

2) 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.

3.4.0 Target Analytes, Sample Duration and Frequency

The specific metals, volatile organic compounds (VOCs), sulfur dioxide, polychlorinated biphenyls (PCB), dioxin, and furan congeners 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 3.1, 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).

Ambient air monitoring is planned from mid-June through late August 2010. For metals and VOCs, 24- hour samples will be collected twice weekly for 10-12 weeks. The sampling duration for PCB, dioxin, and furan congeners will be 28 days in length, for a total of three sampling periods between mid-June and late August. (The extended sampling duration for PCB, dioxin, and furan congeners 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 Environmental Chemistry Laboratory in Mississippi will conduct analyses for PCB, dioxin, and furan congeners.

All data will be provided to OEHHA for interpretation. Data on metals and VOCs from other locations in the San Joaquin Valley will be provided to OEHHA for comparison. Data will also be evaluated regarding seasonal differences at other monitoring sites in the San Joaquin Valley to assess whether there may be seasonal differences in Kettleman City.

Table 3.1: Target Analytes

Metals	VOCs	PCB Congeners	Dioxin/ Furan Congeners
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

Data on other, non-target metals and VOCs will be collected concurrently as part of ARB's sampling and analysis methods. A list of these non-target metals and VOCs is provided in Appendix 3.1. These other metals and VOCs have not been associated with birth defects. For informational purposes, ARB will provide these additional data to OEHHA.

3.5.0 Sampling and Analysis Methods

The monitoring equipment at each site includes the use of a Xontech 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 PCB, dioxin, and furan congeners. All sample inlet heights will be approximately six feet above each respective sampling platform.

The Xontech 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 total suspended particulate (TSP) 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 collect total suspended particulate (TSP) for hexavalent chromium analysis. 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 PCB, dioxin, and furan congeners, 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 at the monitoring sites in Kettleman City and near the hazardous waste facility. 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. Wind speed/direction data will be collected at the Kettleman City Elementary School from sensors set at approximately 25 feet above the ground. Wind speed/direction sensors at the two waste facility sites (Downwind and Upwind sites) will be set at approximately nine feet above the sampling platform.

3.6.0 Quality Control

ARB's Quality Assurance Section will conduct performance audits on the ambient air samplers and meteorological sensors located at the three sites. Audits will be conducted at the beginning and end of the field study. The audit gases and devices used to conduct the audits will be traceable to National Institute of Standards and Technology.

In addition, the Quality Assurance Section will conduct an in-depth site evaluation to determine compliance with Code of Federal Regulations, title 40, part 58, appendix E with regard to siting criteria of the air samplers. Photographs and GPS coordinates will also be taken.

The audits and site evaluation will be conducted using the procedures described in the ARB Air Monitoring Quality Assurance Manual, Volume V. After each audit, a copy of the audit report, including the site survey, will be provided to the Special Purpose Monitoring Section staff.

Monitoring and Analysis data quality objectives (DQOs) are listed in appendices 3.2 and 3.3.

3.7.0 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

Performance Audit Procedures for Through-the-Probe Criteria Pollutants
http://www.arb.ca.gov/aaqm/qmosqual/qamanual/vol5/v5apxe.pdf

Performance Audit Procedures for PM2.5 Samplers
http://www.arb.ca.gov/aaqm/qmosqual/qamanual/vol5/v5apxz.pdf

Performance Audit Procedures for Dioxin Flow Samplers
http://www.arb.ca.gov/aaqm/qmosqual/qamanual/vol5/v5apxaj.pdf

Performance Audit Procedures for Meteorological Parameters
http://www.arb.ca.gov/aaqm/qmosqual/qamanual/vol5/v5apxs.pdf

Site Evaluation for Ambient Air Monitoring Stations
http://www.arb.ca.gov/aaqm/qmosqual/qamanual/vol5/v5apxae.pdf

Procedures for Global Positioning System
http://www.arb.ca.gov/aaqm/qmosqual/qamanual/vol5/v5apxo.pdf

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

4.1.0 Introduction

DPR will evaluate the 19 pesticides shown in Table 4.1 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 will evaluate these pesticides because they may cause birth defects and had reported use within five miles of Kettleman City during 2007 or 2008.

Table 4.1 below lists the pesticides 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 4.1: 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 (Agri-Mek, Zephyr)	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 (Rally, Laredo)	291	65	Not monitored
Oxyfluorfen (Goal, Goaltender)	1,702	25	Monitored in CA
Propiconazole (Bumper, Orbit)	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.

4.2.0 Evaluation

4.2.1 Health Screening Levels

DPR will conduct a two-step evaluation of the 19 pesticides. For the first step, DPR will 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

To evaluate cumulative exposure to multiple pesticides, DPR will determine hazard quotients for individual pesticides, and a hazard index for multiple pesticides. The ratio of measured air concentration of a pesticide to a reference concentration or screening level for that pesticide is called the hazard quotient (HQ). In this case,

$$\text{Hazard Quotient} = \frac{\text{Air Concentration } (\text{ng}/\text{m}^3)}{\text{Screening Level } (\text{ng}/\text{m}^3)}$$

If the HQ is greater than 1, then the air concentration exceeds the screening level. Chemicals may exhibit toxic effects independently, or they may interact in an additive, synergistic, or antagonistic manner. The risk from multiple pesticides (cumulative risk) will be evaluated using the hazard index (HI) approach, by adding the HQs for the pesticides that can be appropriately grouped according to mechanism or site of toxicity.

$$HI = HQ_1 \text{ (pesticide 1)} + HQ_2 \text{ (pesticide 2)} + HQ_3 \text{ (pesticide 3)} + \ldots \text{ (and so forth)}$$

This approach assumes that toxicity and risk of monitored pesticides that are grouped according to similar mechanism or site of toxicity are additive, although only a subset of the monitored pesticides are known to act in an additive manner (including organophosphate insecticides and oxygen analog breakdown products toxic to the nervous system). As with the HQ, an HI greater than 1 indicates the need for further evaluation. If an HQ for one pesticide is greater than 1, the HI for the same period will be greater than 1, since the HQs are added together. The HI is most useful when individual HQs are less than 1. However, if the HI is greater than 1, this indicates that the cumulative toxicity of the multiple pesticides should be further evaluated and that

potential health impacts may have been missed by only considering the pesticides individually.

4.2.2 Estimation of Worst-Case Air Concentrations

After determining the health screening levels, DPR will estimate the worst-case air concentrations that occurred in Kettleman City during 2007, 2008, and 2009. When available, DPR will 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 will estimate air concentrations with an air dispersion computer model (Industrial Source Complex-Short Term model; ISCST). USEPA developed the air dispersion computer model and has validated its performance. 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 will use a tiered approach to the air dispersion computer modeling. The first tier (Tier 1) would model simple, theoretical worst-case situations for each pesticide. This theoretical situation assumes 100 percent emission 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 (Tier 2) 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 provide a more refined estimate of 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. Cumulative exposures will be estimated for days on which applications of multiple pesticides occur upwind of Kettleman City.

Both the first tier and second tier of air dispersion 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)

Representative 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 show that the proposed Tier 1 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.

4.2.3 Monitoring

DPR (with ARB assistance) will conduct limited air monitoring. This monitoring will provide an additional source of measured data to compare with the air dispersion computer modeling estimates. The effort will be in conjunction with ARB's monitoring 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, plus an additional sample for MITC). Any concentrations measured would be compared to concentrations estimated by computer modeling. The measured concentrations will be used to evaluate and, if necessary, refine the modeling procedures and assist in evaluating exposure to the community. However, this monitoring will have several limitations. The monitoring will only detect 4 of the 19 pesticides selected for evaluation, and all four will likely have low or no use at the time of monitoring. It is possible that the pesticides will not be detected at measurable levels. Even if detected, comparing the computer modeling to concentrations measured at a single location will provide a minimal comparison with the modeled air concentration estimates. If the monitoring does not detect one or more of the four pesticides selected for evaluation, the air concentrations estimated from the air dispersion computer modeling will be compared to the detection limit(s) of the air monitoring method.

Air monitoring will provide additional evidence that DPR's air dispersion computer modeling procedures do not underestimate air concentrations. The air monitoring will also provide data to evaluate exposure for other pesticides used in the Kettleman City area that can cause health effects other than birth defects. However, the maximum possible air concentrations may not be measured because monitoring may not occur during the peak use season.

The specific objective of the monitoring is to estimate the daily and monthly (seasonal) average air concentrations in Kettleman City for certain pesticides during June-July.

DPR's standard project organization and responsibilities are described in Appendix 4.1 DPR will collect pesticide air samples at the same location as ARB, Kettleman City Elementary School. Ambient air monitoring will begin on June 8, 2010, and end on or about July 30, 2010. Individual air samples will be 24 hours in duration, collected twice weekly for 8 weeks, for a total of 16 discrete sampling periods. The number of sampling locations and sampling frequency are based on an analysis of the data from the Parlier project. DPR sampled three locations in Parlier, three days each week, for 52 weeks. For the most frequently detected pesticides, there was little difference between the three locations, or between the three days (Appendix 4.2). Therefore, a single location sampled twice each week should provide sufficient data to estimate exposures.

Two air samples will be collected for each sampling period, one for MITC and one for 26 other pesticides (Table 4.2). (ARB's monitoring will detect several other chemicals with pesticidal uses including 1,3-dichloropropene and methyl bromide.) MITC samples will be collected using personal sample pumps equipped with coconut charcoal tubes (SKC Inc., #226-16-02) set at an air-flow rate of 1.5 L/min. The other pesticides will be monitored with air sampling pumps equipped with a sampling tube containing 30 mL of XAD-4 adsorbent. The sampling equipment will be calibrated to a flow rate of 15 L/min in the laboratory before delivery to the field. The samples will be collected with Andersen Series 110 Constant Flow Air Sampler Model 114 pumps. The use, operation, calibration and maintenance of air sampling pumps are described in Appendix 4.3.

Table 4.2. The common trade name, use (action), and chemical class for each pesticide monitored.

Pesticide (active ingredient)	Common trade names	Use	Chemical class
Azinphos-methyl	Guthion	Insecticide	Organophosphate
Chlorothalonil	Bravo, Daconil	Fungicide	Chloronitrile
Chlorpyrifos	Dursban, Lorsban	Insecticide	Organophosphate
Cypermethrin	Demon	Insecticide	Pyrethroid
Diazinon	Various brands	Insecticide	Organophosphate
Dichlorvos	Vapona, DDVP	Insecticide	Organophosphate
Dicofol	Kelthane	Insecticide	Organochlorine
Dimethoate	Cygon	Insecticide	Organophosphate
Diuron	Karmex	Herbicide	Urea
Endosulfan	Thiodan	Insecticide	Organochlorine
EPTC	Eptam	Herbicide	Carbamate
Malathion	Various brands	Insecticide	Organophosphate
MITC generating	Vapam, K-pam	Fumigant	Dithiocarbamate
Metolachlor	Dual	Herbicide	Chloracetanilide
Molinate	Ordram	Herbicide	Thiocarbamate
Naled (dichlorvos)	Dibrom	Insecticide	Organophosphate
Norflurazon	Solicam	Herbicide	Pyridazinone
Oryzalin	Surflan	Herbicide	Dinitroaniline
Oxyfluorfen	Goal	Herbicide	Diphenyl ether
Permethrin	Ambush, Pounce	Insecticide	Pyrethroid
Phosmet	Imidan	Insecticide	Organophosphate
Propanil	Duet, Wham	Herbicide	Anilide
Propargite	Omite, Comite	Insecticide	Organosulfite
Simazine	Princep	Herbicide	Triazine
SSS-tributylphosphorotrithioate	DEF, Folex, Tribufos	Defoliant	Organophosphate
Thiobencarb	Bolero, Abolish	Herbicide	Thiocarbamate
Trifluralin	Treflan	Herbicide	Dinitroaniline

Upon approval from the resident, DPR will collect indoor air from residences of those families in Kettleman City that had a child born with birth defects. Indoor air samples will be collected using the same multiple pesticide XAD-4 method as the outdoor samples. MITC may not be sampled due to sampler noise, and indoor air flow and space considerations. DPR will collect a single 24-hour sample in each household, on a day agreed upon by DPR and the homeowner/tenant.

Upon approval from the resident, the state will also collect indoor dust from residences of those families in Kettleman City that had a child born with birth defects. One sample will be taken once from each home. The sample will come from the area where most activity occurs. Because this sampling methodology is new to Cal/EPA, only a brief description is given in this plan. Samples will be collected from a 1-2 square meter area using a high-volume surface sampler with a cyclone that extracts particles greater than

5 microns in diameter from the air stream of a vacuum cleaner. Due to previous experience with these types of analyses for CDPH, Battelle Memorial Institute in Columbus, Ohio will analyze the dust samples, under contract to U.S. EPA. The samples will be analyzed for metals, chlorpyrifos, diazinon, and possibly other pesticides.

Field staff will measure and record sampler air flow rates before and after each sampling period. All sample pumps will be checked and initially calibrated by DPR staff prior to the study. ARB's Quality Assurance Section will perform at least one flow audit on ambient air samplers during the field study using a National Institute of Standards and Technology (NIST)-traceable flow measuring device.

Collected samples will be immediately placed on dry ice and kept frozen until they are delivered to CDFA's Center for Analytical Chemistry in Sacramento. Under contract to DPR, the CDFA laboratory will analyze the samples using validated methods and standard quality control procedures, including the use of certified analytical standards to calibrate the instruments, analyzing samples within prescribed holding times, analyzing blank samples (samples with no pesticides) to check for contamination, and analyzing spiked samples (samples with known amounts of pesticides) to measure precision and accuracy. DPR used these sampling and laboratory methods for an earlier project in Parlier. Detection limits for all pesticides included in the monitoring are less than the health screening levels. Table 4.3 shows a summary of the monitoring methods and performance. All standard operating procedures for sample handling and laboratory analysis are described in Appendix 4.4, including sample transport and tracking procedures, chain of custody, analytical methods, and quality control.

Table 4.3 Summary of monitoring methods and performance.

	Multiple Pesticide	**MITC**
Sorbent Tube Adsorbent	XAD-4	Coconut charcoal
Analytical Method	Liquid chromatography (LC) (19 analytes) gas chromatography (GC) (11 analytes)	Gas chromatography
Extraction Solvent	Ethyl acetate	0.1% CS2 in ethyl acetate
Detector	Tandem Mass spectrometer (LC/MS/MS) Mass selective detector (GC/MSD)	Thermionic specific detector (GC/TSD)
Desorption Efficiency	78-110 percent	85 percent
Storage Stability	28 days	14 days
Flow Rate (L/min)	15	1.5
Run time (min)	1440	1440

Air concentrations will be calculated as an amount of pesticide captured from a volume of air moving through the sampling media. Laboratory results are presented in micrograms per sample (ug/sample). The concentrations are converted from ug/sample to nanograms (ng) per cubic meter (m^3) of sample air using the following equation:

$$\frac{\text{Sample results } (\mu g) \text{ x } 1000 \text{ L/m}^3 \text{ x } 1000 \text{ ng/}\mu g}{\text{Flow rate of sampler (L/min) x run time (min)}} = \text{ng/m}^3$$

As with the computer modeling, measured air concentrations will be compared to DPR health screening levels. The screening levels for the pesticides included in the monitoring are described in the Parlier project report (http://www.cdpr.ca.gov/docs/envjust/pilot_proj/index.htm)

4.2.4 Possible Further Steps

If the second tier of modeling or air monitoring shows air concentrations exceeding the screening levels, DPR proposes to conduct a more refined evaluation. This may include additional air monitoring of specific pesticide applications near Kettleman City and/or ambient air monitoring within Kettleman City. DPR may also conduct additional monitoring or evaluations in consultation with CDPH staff as a result of their community interviews, such as occupational exposure, dust, or food.

4.3.0 Discussion

There are two primary reasons DPR emphasizes the estimation of air concentrations using historical data and air dispersion 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. DPR 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.

As with the air monitoring, dust monitoring has several drawbacks. This includes sampling in 2010 may not indicate exposures to pesticides applied in earlier years, methods for most pesticides of interest would take at least several months to develop, and monitoring in June and July does not capture the peak use season for most pesticides. Dust monitoring also has additional issues that make the evaluation of data difficult and uncertain. There are no standard methods to determine exposure and risk based on pesticide concentrations in dust. DPR will need to estimate the amount of dust that gets on skin and the amount of pesticide in the dust adsorbed through the skin to determine exposure. If these factors cannot be reliably estimated, DPR may use other methods to evaluate the data, such as comparison to U.S. EPA's cleanup levels for soil at Superfund sites or food tolerances. Another alternative to evaluate the data would be to compare pesticide dust concentrations from this monitoring to concentrations detected in other studies. Because of these uncertainties, it is unlikely that the monitoring results and evaluation of pesticide concentrations in dust will yield clear conclusions about the exposure and risk.

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 aid in providing representative air dispersion computer modeling for 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 associated with specific pesticide applications.

DPR will also evaluate pesticide use reports of the 19 pesticides listed in Table 4.1 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.

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

5.1.0 Introduction

During the 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 5.1) 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 5.1: 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 congeners		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 congeners	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.

5.1.1 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.

5.2.0 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.

5.3.0 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. The methodology to be used is described in Section 4.2.1 above.

5.4.0 Population Characteristics

An increasing body of scientific evidence has demonstrated that certain characteristics of a population influence its ability to resist disease and other adverse effects of

exposures to environmental contaminants. These characteristics include both intrinsic biological traits and socioeconomic attributes. Intrinsic factors such as age, genetic factors and health status are known to make certain individuals sensitive to the toxic effects of chemicals. Socioeconomic factors such as income level, cultural practices, access to health care and educational attainment can affect vulnerability to pollutants. As part of its evaluation, OEHHA will try to take into account the presence of sensitive populations and socioeconomic factors that can play a role in the in Kettleman City community's response to chemical exposures as part of our discussion of uncertainties in the evaluation.

Cal/EPA recognizes the need to address cumulative impacts, that is the collective impacts of exposure, public health or environmental effects of pollution from all sources in a given geographic area, along with the population characteristics discussed above.

Figures

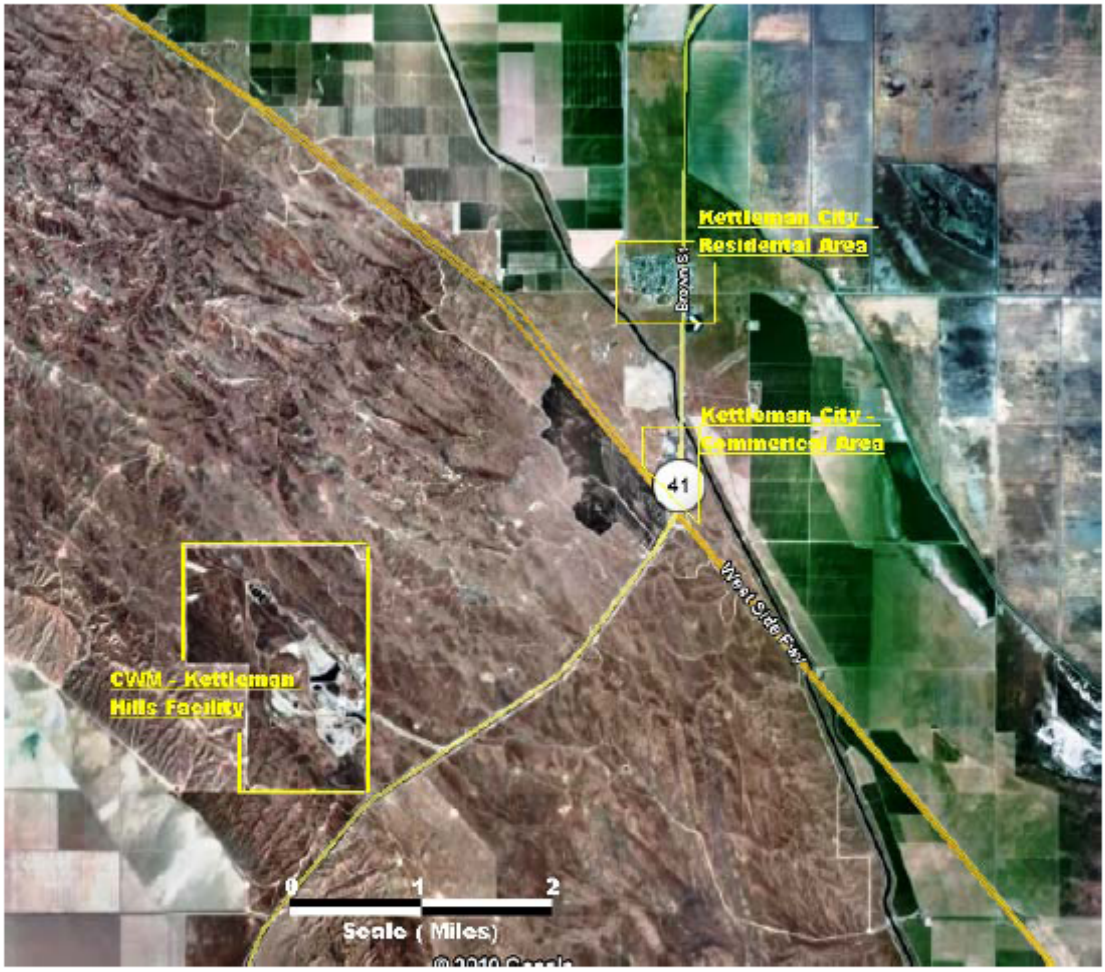


Figure 1 – Vicinity Map

Figure 2 – Map of Kettleman City

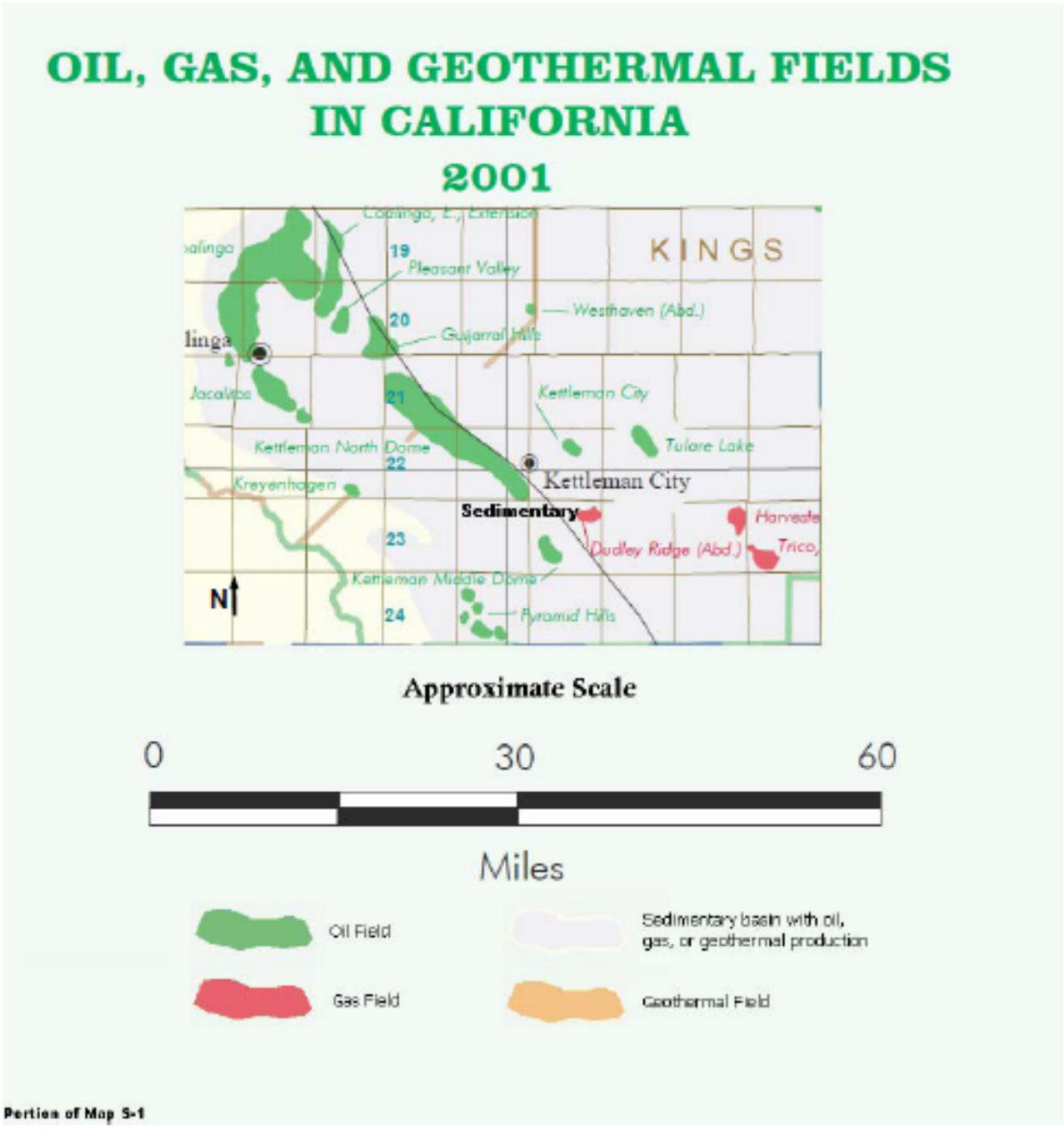
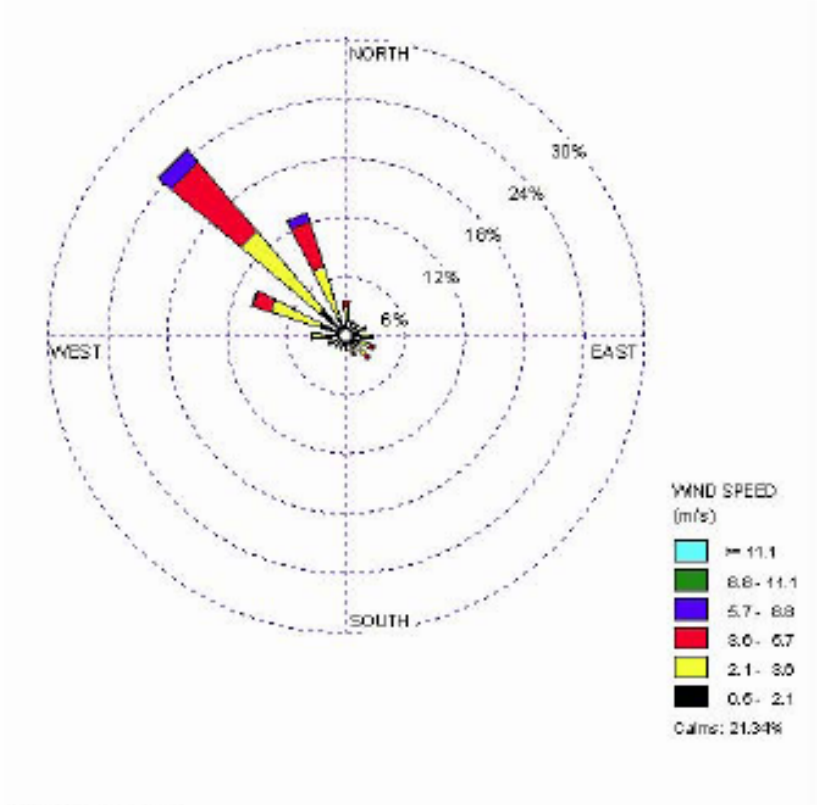


Figure 3 – Regional Oil/Gas/Geothermal Fields Map
(Source: California Department of Conservation)



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)