ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

# Public Health Assessment for

**CASMALIA RESOURCES SUPERFUND SITE**
**CASMALIA, SANTA BARBARA COUNTY, CALIFORNIA**
**EPA FACILITY ID: CAD020748125**
**SEPTEMBER 28, 2005**

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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# PUBLIC HEALTH ASSESSMENT

CASMALIA RESOURCES SUPERFUND SITE

CASMALIA, SANTA BARBARA COUNTY, CALIFORNIA

EPA FACILITY ID: CAD020748125

Prepared by:

California Department of Health Services
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry
U.S. Department of Health and Human Services

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## List of Acronyms

ALL—Acute Lymphocytic Leukemia
ATSDR—Agency for Toxic Substances and Disease Registry
bgs—below ground surface
CARB—California Air Resources Board
CDHS—California Department of Health Services
COCs—contaminants of concern
CR—Casmalia Resources
CREG—Cancer Risk Evaluation Guideline for one in a million excess cancer risk
CRSS—Casmalia Resources Superfund Site
CUP—Conditional Use Permit
DHHS—U.S. Department of Health and Human Services
DTSC—California Department of Toxic Substances Control
EHIB—Environmental Health Investigations Branch
EMEG—Environmental Media Evaluation Guide (ATSDR)
GAC—Granulated Activated Charcoal
IARC—International Agency for Research on Cancer
kg—kilogram
LOAEL—Lowest Observable Adverse Effect Level
MCL—Maximum Contaminant Level for drinking water (state and federal)
mg—milligram
MRL—Minimal Risk Level (ATSDR)
NA—not analyzed or not applicable
NAPL—non-aqueous phase liquid
ND—not detected
NPL—National Priorities List (USEPA)
NS—not sampled
NTP—National Toxicology Program
OEHHA—Office of Environmental Health Hazard Assessment (of the California Environmental Protection Agency)
PAHs—polycyclic aromatic hydrocarbons
PCBs—polychlorinated biphenyl compounds
PCE—tetrachloroethylene
PHA—public health assessment
PIDs—photo ionization detectors
ppm—parts per million
ppb—parts per billion
PRGs—preliminary remediation goals (USEPA)
PRP—potentially responsible party
RCRA—Resource, Conservation, and Recovery Act
RAD—reactive airway diseases
REL—Reference exposure level (OEHHA)
RfC—Reference concentration (USEPA)
RfD—Reference dose (USEPA)
RI—remedial investigation
RI/FS—remedial investigation/feasibility study
RMEG—Reference Dose Media Evaluation Guide (ATSDR)
ROD—Record of Decision (USEPA)
RWQCB—Regional Water Quality Control Board
SBCAPCD—Santa Barbara County Air Pollution Control District
SBCHCS—Santa Barbara County Health Care Services
SVOC—semi-volatile organic compound
TCE—trichloroethylene
TRI—Toxic Release Inventory (USEPA)
USEPA—United States Environmental Protection Agency
VAFB—Vandenberg Air Force Base
VOC—volatile organic compound

## Summary

The California Department of Health Services (CDHS) has prepared this Public Health Assessment (PHA) for Casmalia Resources Superfund Site (CRSS) under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). The site was nominated and placed on the National Priorities List (NPL). A PHA is required for all sites nominated for the NPL. The purpose of the PHA is to investigate past and current practices associated with the facility and to determine whether health effects are likely on the basis of exposure to site contaminants. If exposures are identified, recommendations are made to reduce or eliminate these exposures.

CRSS is an inactive hazardous waste management facility located in the northwestern corner of Santa Barbara County, California. The site lies approximately 4 miles from the Pacific Ocean, 1.4 miles north of the town of Casmalia, and 10 miles southwest of the city of Santa Maria. The site is currently inactive and no longer accepts wastes; the majority of the on-site landfills are capped and the others covered; there is no exposed waste at the site. The only site activities that occur include site maintenance and site remediation work.

The facility began operations in 1973. It was originally used to treat and dispose of wastes from the oil industry. Between 1973 and 1989, the facility grew from 61 acres to 252 acres and expanded to include over 90 individual waste management units, including hazardous waste ponds, evaporation pads, burial trenches, injection wells, and several landfills. During its operation, the facility accepted approximately 5.6 billion pounds of waste, including acids, bases, organic solvents, pesticides, and oil drilling sludges. The facility stopped receiving wastes in 1989 and since that time, the ponds are no longer receiving wastes and four of the six landfills have been capped. The Casmalia Disposal Site Steering Committee (CSC) (responsible parties), under oversight of the U.S. Environmental Protection Agency (USEPA), is conducting a Remedial Investigation/Feasibility Study (RI/FS) to perform additional investigations and propose a final remedy for containment and/or remediation of wastes for the entire site. Some activities already underway include defining the extent of contamination associated with the operation of the site, the collection and treatment of a portion of subsurface runoff water, and continued maintenance to the landfill caps to ensure their integrity.

Community health concerns in Casmalia relating to the facility first became widespread in 1984 when the principal of the elementary school in Casmalia closed the school as a result of odors suspected of coming from the facility. It was determined that the odors were associated with the evaporation of liquid wastes in the hazardous waste ponds. Community concerns regarding exposure to site contaminants were further fueled by allegations that the drinking water supply for the region had been impacted by the facility. On the basis of these concerns, both the county and state initiated several studies in the mid-1980s to investigate the impact the facility may be having on the local communities, including the populations of the town of Casmalia, Tanglewood, Orcutt, and Santa Maria. The results of these studies were inconclusive; it could not be determined whether the exposure may have resulted in health effects. Despite this finding, community members still feel that they are being exposed to contaminants from the site via several routes of exposure. A review of these potential routes of exposure is included in more detail in the body of this report.

In preparing this PHA, CDHS reviewed previous health and environmental studies of the community and land in the vicinity of the landfill. The studies reviewed by CDHS for this PHA include:

- Studies on the incidence of respiratory irritation in the community living near the facility;
- Incidences of cleft palate in the community living near the facility;
- Cancer rates for the community living near the facility;
- Worker health studies for employees that worked at the facility;
- Previous risk assessments performed for the facility;
- Two hydrogeological studies of the geology of the area;
- Two meteorological assessments of the region;
- Results of drinking water tests performed on the community's drinking water;
- Results of groundwater monitoring of wells both on and off site; and
- Results of air analysis of samples taken on site.

Based on a review of these studies, CDHS identified six potential routes (pathways) of exposure. The potential routes of exposure evaluated in this PHA include 1) past exposure to vapors emanating from the site; 2) current and future exposure to vapors emanating from the site; 3) past, current, and future exposure to sediment and surface water in the vicinity of the site; 4) past, current, and future exposure to surface soils in the area; and 5) past and current exposure to site-related contaminants in drinking water and; 6) future exposure to site-related contaminants in drinking water.

CDHS determined that past exposures (1973 – 1986) to vapors from the site posed a public health hazard for those living in the town of Casmalia, as well as for local ranchers while the landfill was operating. Modeled concentrations, based on air samples taken on site suggest the presence of contaminants in the Casmalia community at levels above health concern. Hydrogen sulfide alone was detected in the community at nearly 1,000 times above the health comparison value. However, because of a lack of relevant data that characterizes the duration of the exposure, it is not possible to determine if adverse health effects would be expected.

Based on a review of municipal water quality data, no site-related contaminants have been detected in the municipal water supply drawn from the local groundwater basins. It is unlikely that site-related contaminants will reach the local groundwater basin because of the geology underlying the site. If groundwater contamination from Casmalia were to migrate (improbable) into the local groundwater basin, the extensive groundwater monitoring at the site, ongoing investigations, the addition of more off-site monitoring wells, combined with ongoing monitoring of the municipal water supply would allow the identification and mitigation of contaminants in drinking water prior to it reaching the public. For these reasons, CDHS determined that there is no past or present exposure pathway to site-related contaminants in the municipal drinking water. There is a potential exposure pathway in the future. However, given the hydrogeology of the area and monitoring efforts, it is unlikely contaminants will reach drinking water that is served to the public.

Due to a lack of data, CDHS was unable to evaluate the following potential exposure pathways: 1) past and current exposure to contaminants in surface water via skin contact; 2) skin contact and ingestion of contaminants in surface soil; and 3) current and future exposures to vapors emanating from the site. These exposure pathways represent an indeterminate public health hazard.

On the basis of these findings, CDHS recommends several measures to fill the data gaps to ensure that the community will not be impacted by the residual contamination associated with the site. One of these recommendations calls for enhanced monitoring of the groundwater around the site, as well as air monitoring in the town of Casmalia.

## Background

This public health assessment (PHA) was prepared by the California Department of Health Services (CDHS), under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). In this document, CDHS and ATSDR determine whether health effects are likely to occur because of exposure to site contaminants and recommend actions to reduce or prevent possible adverse health effects. ATSDR, located in Atlanta, Georgia, is a federal agency within the U.S. Department of Health and Human Services. ATSDR is authorized by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 to conduct PHAs at hazardous waste sites. The conclusions of this PHA for the Casmalia Resources Superfund Site (CRSS) are based on a review of available environmental data, community concerns, information obtained from site visits, and consultation with involved agencies and the public. The U.S. Environmental Protection Agency (USEPA) first proposed the CRSS to the National Priorities List (NPL) in June 2001. CRSS was granted NPL status in September 2001.

## Site Description and History

CRSS (also referred to as “site” or “facility”) is an inactive hazardous waste management facility located in the northwestern corner of Santa Barbara County, California. The site lies approximately 4 miles from the Pacific Ocean, approximately 1.4 miles north of the town of Casmalia, 10 miles southwest of the city of Santa Maria, approximately 16 miles north-northwest of the city of Lompoc, and 1.5 miles southwest of the towns of Orcutt and Tanglewood (Figure 1). The treatment/disposal facility consists of a parcel of 252 acres within a total holding of 4,650 acres owned by Casmalia Resources (CR), the current and past operators of CRSS. CR began waste management operations in 1973. The facility was originally a 61 acre hazardous waste disposal facility, with 15 evaporation ponds or surface impoundments, and a landfill area (1). During its operation, CR accepted all types of commercial industrial wastes, including but not limited to petroleum wastes, acids, bases, organic chemical solvents, petroleum solvents, paint sludge, pesticides, infectious wastes, septic tank pumping, and sewage sludge. Between 1973 and 1989, CR accepted approximately 5.6 billion pounds of waste at its 92 individual waste management units, which included hazardous waste ponds, evaporation pads, landfills, and liquid waste injection wells. More than 10,000 companies and government entities sent waste to the CR facility during this period. Prior to closure in 1989, the CR operated a total of six landfills, 43 ponds, 15 evaporation pads, seven burial/disposal trenches, 11 shallow injection wells, six oil waste spreading areas, as well as treatment systems including a wet oxidation unit, a hydrogen peroxide unit, and an acid/alkaline neutralization facility (Figure 2) (1).

CR stopped receiving wastes for the Resource Conservation and Recovery Act (RCRA) and polychlorinated biphenyl (PCB) landfills in 1986, and stopped accepting liquid wastes for the ponds in 1988. Solid wastes were accepted and placed in the four remaining landfills until 1989. In 1991, the owners and operators abandoned efforts to properly close and clean up the site. At that time, USEPA deemed that conditions at the site presented imminent and substantial endangerment to human health and the environment. From 1992 to 1996, USEPA used Superfund authorities to take emergency actions to stabilize the site. These actions included

installing an operating system for collecting, treating, and disposing of contaminated subsurface liquids; controlling the flow of storm water; and determining the best means to stabilize the landfills.

In March 1993, USEPA notified a group of approximately 65 Casmalia waste generators of their potential liability. Approximately 50 of the waste generators notified formed the Casmalia Disposal Site Steering Committee (CSC). In 1996, USEPA filed a legal agreement referred to as the Consent Decree, which formally defines CSC's roles and financial commitment in the maintenance and remediation of the site. Under the Consent Decree, all work to remediate the site was divided into two stages. Phase I activities includes routine site maintenance, the collection and treatment of subsurface waters, and other routine maintenance work, regardless of the cost, for a period of time of 3 to 6 years (2). Phase II work includes the above work (Phase I activities) in addition to other post-remedy maintenance operations, including other landfill cap construction and the routine maintenance of the site.

Additional materials have not been placed in the landfills since 1991, and the site has been performing closure and maintenance operations since that time. Between 1998 and 2002, four landfill covers were constructed. Current operations include continued management of contaminated groundwater directly below the site. Several trenches strategically located around the site collect groundwater and either treat it on site by granulated activated charcoal (GAC) vessels or send the water off site for treatment. Many of the site activities are monitored with a handheld photoionization detector (PID) to protect workers from toxic vapors. In November 2003, an air monitoring system consisting of two PIDs was installed at the perimeter of the site. In the future, PIDs should be able to provide some relative level of vapors emanating from the site. In May 2005, the initial startup phase of recording background concentrations for 1 year concluded. The USEPA and the CSC are developing an action plan to address any potential releases. According to the USEPA, this could include potential chemical-specific sampling and additional air monitoring closer to the town of Casmalia. USEPA will coordinate with the community as these protocols are developed and implemented.

## Agency History

### *State and County Permits for the Operation of the Facility*

The CR was initially granted a Conditional Use Permit (CUP) for a waste disposal facility in August 1972 by the Santa Barbara County Planning Commission. The waste disposal facility was permitted to operate on 61 acres of the Goodwin Agricultural Preserve. Actual waste disposal operations did not begin at the project site until April 1973. Originally, the facility accepted primarily oil drilling wastes derived from central and southern California (Figure 3).

The Regional Water Quality Control Board (RWQCB) of the Central Coast Region issued the original Waste Discharge permit to CR in 1972. The original permit was amended twice, once in 1976 when the site was expanded to 179 acres, and again in 1980 when the site was expanded to 252 acres. Requirements of the RWQCB permit included a prohibition of off-site discharge beyond site boundaries and a specification of other operational and maintenance procedures.

In 1976, Santa Barbara County amended the original CUP to expand the disposal facility to include a total of 179 acres. Santa Barbara County determined that the expanded waste disposal facility would have no significant environmental effect and issued a negative declaration to the environmental review board for the expansion. In 1978, USEPA issued the facility a permit allowing it to accept PCBs. On May 3, 1979, the Toxic Substances Control Program of CDHS issued CR a State Hazardous Waste Permit necessary for the continued operation of the facility. The Toxic Substances Control Program was part of CDHS until the California Environmental Protection Agency (CalEPA) formed in 1991, and it became the Department of Toxic Substances Control (DTSC) within CalEPA.

In January 1986, the Santa Barbara County Planning Commission acted to revoke the CUP because of alleged violations pertaining to an interpretation of the waste disposal boundary restrictions of the 1976 CUP amendment. The dispute centered on the development and operation of two landfills designed to receive RCRA and PCB wastes. Although CR had obtained the necessary state and federal permits to operate the landfills, it did not obtain from the county an amendment to its CUP to expand the facility. In April 1986, the dispute was resolved with the acceptance of a "settlement agreement," which permitted CR to continue to receive RCRA and PCB wastes. The agreement contained several specific operational provisions that related to site boundaries, the pretreatment of certain types of wastes, and traffic issues (3).

### *Federal Permits for the Operation of the Facility*

Beginning in 1980, CR operated the facility under a Part A interim status Federal Hazardous Waste Permit under the federal authority of USEPA and RCRA. In 1983, to comply with new state and federal regulations, the facility was required to apply for a Part B Permit. However, the Part A permit granted by USEPA "grandfathered" the site to operate and dispose of liquids into the unlined waste ponds while applying for the Part B Permit. The Part B Federal Permit was originally submitted to USEPA in 1983. Notices were issued in order to correct problems identified in the application, and numerous revisions were made to the Part B Permit. In accordance with the Hazardous and Solid Waste Amendments of 1984, a completed Part B of the Federal Permit was required by 1988. Despite several revisions to the Permit, in July 1988, USEPA issued a Notice of Intent to Deny Permit for the Casmalia landfill. CR requested a panel hearing regarding USEPA's decision, but the hearing was cancelled when CR withdrew its appeal. USEPA also withdrew its notice. In November 1989, CR stopped accepting off-site wastes for disposal (3, 4). The facility continued to revise the Part B permit application until September 1991, when DTSC denied the permit application and USEPA revoked the facility's interim status authorization to operate.

### *Consent Decree Related to Clean Up*

The Consent Decree is a legal agreement between USEPA and the CSC that was filed in September 1996, under the authority of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). The Consent Decree defines the responsibilities of the CSC and identifies USEPA as the lead regulatory agency at the site. According to the Consent Decree, the CSC will perform all Phase I work, regardless of cost, and will perform Phase II work, pending the availability of

funds. The Consent Decree also required for a discrete time period that the CSC support USEPA in the implementation of community relations efforts required by RCRA (2). This requirement includes support of USEPA in the preparation of a Community Relations Plan, maintenance and storage of Casmalia landfill records, and notices of document availability.

Presently, under a USEPA approved workplan and USEPA oversight, the CSC is conducting a Remedial Investigation/Feasibility Study (RI/FS) to perform additional investigations (collection of environmental data), which will be used to conduct baseline risk assessment and propose a final remedy for containment and/or remediation of wastes for the entire site (2). The RI is scheduled for completion in late 2005. The information collected during the RI process will address a number of the data gaps identified in this PHA.

**Overview of Casmalia Site Features**

CR operated 43 hazardous waste ponds (40 of the ponds were used for RCRA-regulated waste and three ponds for non-RCRA purposes), 15 evaporation pads, six landfills, seven disposal trenches, and 11 shallow injection wells (Figure 2). The pond construction began in 1972, and new ponds were added through 1986. The ponds were used to store, treat, and evaporate liquid wastes, as well as to store runoff and seepage from the landfills. For the purpose of accelerating evaporation of the content of the ponds, liquids were often sprayed into the air. The county stopped the process in 1985, when it was linked to odors in the community. The ponds at the facility can generally be divided into five categories on the basis of the type of waste they received. These categories are runoff control, acids and alkalines, treatment ponds, oil field waste ponds, and washout ponds (4).

The evaporation pads at the facility were flattened areas used for enhanced evaporation of liquids. Of the 15 evaporation pads, 14 were constructed by excavating high sides of sloped areas and by placing and compacting the excavated material on the downslope side to create a level pad. The pads were constructed with 3-foot-high dikes on their downstream edge. All pads were unlined and constructed in native claystone.

Six solid waste landfill units were constructed within individual natural canyons in the upper watersheds of the site (Figure 2 and Figure 6). At the time the landfills were constructed, it was not deemed necessary to install man-made liners because of the low permeability characteristics of the underlying claystone. All the landfills were equipped with surface water bypass drains to prevent surface water entry and to control runoff (4).

The pesticides/solvents landfill occupies approximately 10.6 acres located on the north-central portion of the site. The landfill was constructed with a clay barrier along the southern border of the site to prevent leachate migration. The barrier is 12 feet thick, with a leachate collection well and a sump pump on the upstream side. The landfill also has a leachate collection well and sump pump located on the upgradient side of the clay barrier. Wastes typically disposed of in this landfill include organic solvents, paint, pesticides, asbestos, and infectious waste (4).

Between 1999 and 2002, the CSC constructed a final cover system, called a cap, over four of the six landfills, including the pesticide/solvent landfill, the acid landfill, the heavy metals landfill,

and the caustics/cyanide landfill. After the construction of the cap for the pesticide/solvent landfill cap portion in 2000, USEPA deemed that the cover system in its initial configuration was unacceptable and corrective actions were taken to address construction deficiencies. The CSC also placed permanent and temporary erosion control measures at and around the landfill area, and around the pesticides/solvents landfill area to prevent any potential damage from occurring during the intervening winter season of 2000 (5). Additional caps have also been placed on the interstitial space between the landfills. All the caps at the site have consisted of an impermeable synthetic layer over the foundation, covered by at least 2 feet of new soil and vegetative cover.

The RCRA landfill is situated within a natural canyon on the northwest side of the facility. According to the USEPA Project Manager, the "RCRA Canyon Landfill was originally intended to receive RCRA wastes but never did so. This landfill received wastes from other onsite areas in late 1983 to early 1984 that were subsequently removed in 1989 (1,300 cubic yards of waste and interim cover material along with 1,500 cubic yards of underlying soil and rock) and placed in the Pesticides/Solvents landfill in June 1989. The RI/FS work will characterize the RCRA Canyon Landfill and assess potential needs for remediation" (6).

The PCB landfill was constructed in excavated knolls in the northwest corner of the site, between the RCRA and pesticide/solvents landfills. The PCB landfill has been used for the disposal of non-liquid PCB wastes and has accepted items such as drained transformers, contaminated soil, and other non-liquid debris. Waste disposal operations were discontinued in 1986. The PCB landfill remains uncapped and will presumably be capped as part of future remedial activities at the site (4).

Seven burial/disposal trenches were constructed for the disposal of both liquid and solid wastes (Figure 2). The trenches consisted of cells of varying sizes—between 15 and 40 feet—that were excavated and then back-filled with waste material. Wastes disposed in the trenches consisted of bulk wastes, containerized liquids, and sludges that included acid and alkaline sludges, paint sludges, waste paints, and ink and epoxide polymers. CR operated the trenches between 1974 and 1980 (4).

Eleven shallow injection wells were operated between 1977 and 1982. Ten of the injection wells were used to dispose of 1.3 million pounds of solvents, pesticides, and acid wastes. The eleventh well was never placed in service. The wells were 4 feet in diameter and 40 feet deep (4).

Subsurface containment structures were constructed at key points within the facility where the control of subsurface liquids was found to be necessary. In some cases, these structures were built to control and collect on-site surface water runoff. Along the southern border of the site, containment structures (Perimeter Control Trenches) were constructed in order to control contaminants from migrating off site. These structures consist of compacted clay barriers and gravel-filled collection trenches. Several of these structures are equipped with gravel drainage galleries and pumps to allow collection and extraction of accumulated fluids for treatment. Current maintenance operations at the site include the capture and treatment of liquids from these extraction points. These subsurface containment structures include:

- Subsurface barriers and containment trenches downgradient of the pesticide/solvent landfill;

- Subsurface (clay) barrier under the PCB landfill;
- Gallery well along the southern end of the pesticide/solvent landfill;
- A Perimeter Source Control Trench installed in 1990 that traverses 2,600 feet along the central portion of the site;
- Sump 9B, located 200 feet downgradient of the Gallery Well; and
- Perimeter Control Trenches A, B, and C located along the A, B, and C drainages on the southern border of the site.

From 1992 to 1996, extracted liquids from the Gallery Well and Sump 9B were sent offsite for disposal, while USEPA contractors built an onsite treatment system for the liquids. Once the on-site treatment system was operational, the liquid waste collected via these wells and trenches were treated and released to an on-site pond for storage and disposal. The CSC dismantled the system in 1998, and liquids from the Gallery Well were once again sent off site for treatment and disposal. Liquids from the sumps and the Perimeter Source Control Trench are currently being treated on site and released to Pond 18 (1). Liquids extracted from the Plume Capture Trench (PCT) sumps are discharged to the Runoff Control Facility (RCF) and A-Series Pond with no treatment (6).

Other subsurface features include approximately 340 monitoring wells/piezometers on site and off site (~90 monitoring wells sampled currently), 11 extraction wells, five ponds, and four off-site water supply wells. The monitoring wells are sampled semiannually to evaluate the potential migration of site-related contaminants and monitor changes in the water table. Water levels are monitored quarterly in over 300 wells/piezometers. The number of monitoring wells/piezometers sampled may decrease from 90 to 60 once the RI/FS field work is completed in late 2005, depending on the findings (6).

**Geologic Setting**

The CR facility is located in mountainous terrain near the southern end of the Casmalia Hills. The facility occupies a southerly facing location at elevations ranging from approximately 390 feet at its southern boundary to about 836 feet at its northern boundary. The site is located along the western boundary of the Santa Maria Basin, a triangular-shaped lowland characterized by gently rolling hills and river valleys and bounded to the north, east, and south by mountains, and to the west by the Pacific Ocean. Bordering the basin are the Santa Yñez Mountains on the east and the San Rafael Mountains to the northeast (Figure 4) (7).

The site and surrounding areas are underlain by an extensive layer—between 900 and 1,200 feet—of claystone, referred to as the Todos Santos Claystone Member of the Sisquoc Formation. The Sisquoc formation is divided into two units, an upper weathered claystone unit and a lower unweathered claystone unit.

The weathered claystone forms the exposed surface across 90% of the site. Previous studies indicate that the weathered claystone ranges in thickness from 15 to 65 feet (7). The weathered claystone is much more fractured and porous than the unweathered claystone, thus allowing for freer movement of water, as well as migration of the contaminants.

The unweathered claystone is exposed to a much lesser degree and is present below 65 feet throughout the rest of the site. It is approximately 1,500 feet thick and continuous throughout the region. The unweathered claystone is much less fractured than the weathered claystone.

An analysis of the fracture patterns helps to predict what direction contaminants may migrate into the claystone; thus, the orientation of the fractures is important for an assessment of the contaminants' potential migration pattern. Hydrogeological studies of the claystone beneath the site have shown that the majority (about 75%) of the fractures are vertical fractures with steeply dipping orientations (8). These fractures show dominant patterns of steeping back toward the site, rather than toward either of the water basins. Northeast to east-northeast fractures steep deeply toward the northwest and southeast, and west-northwest fractures steep to the northeast and southwest. Current investigations are looking into whether there is sufficient continuity within the fractures for contaminants to one day migrate through the unweathered claystone to the adjacent water basins. Implications regarding this possibility will be discussed later in this PHA.

**Groundwater**

The site is located within the Shuman Creek drainage sub-basin, which is located between, and influenced by, two groundwater basins, the Santa Maria Groundwater Basin and the San Antonio Groundwater Basin. The Santa Maria Groundwater Basin is within 0.5 miles to the north and east of the site, and the San Antonio Groundwater Basin is 2.5 miles south of the site. The Santa Maria Basin covers an area of about 180 square miles. Groundwater flow in the basin tends to follow the topography. Near the Casmalia Hills, water flows northward, away from the hills, then west toward the Pacific Ocean (Figure 5) (8). Groundwater from the Santa Maria and San Antonio basins has been used for agricultural and domestic purposes since the mid-1800s, and the Santa Maria Basin continues to be a source of drinking water for Casmalia, Santa Maria, Tanglewood, and Orcutt.

The uppermost layer of groundwater below the site can be characterized as a layer of brackish water sitting on layers of soils and gravel and in the cracks of bedrock that blankets the Casmalia Hills. The relatively small amount of groundwater in the Casmalia Hills is produced from the accumulation of rain water that percolates through the soil and accumulates in sediments and in cracks in the underlying bedrock (4). Although this upper water layer is not potable for humans, cattle and other livestock can use it, especially when it is mixed with other water sources. This bedrock underlies the Casmalia Hills and then drops downward to form the Santa Maria Valley, which is filled with gravel and sand deposits.

Some geologists originally believed that the shallow layer of soil and fractured low-waterbearing rock that overlies the Casmalia Hills had no connection to the deep water of the Santa Maria and San Antonio Water basins, from which the towns of Casmalia, Santa Maria, and Tanglewood draw their water (Figure 5). However, to date, no study has definitively proven that the groundwater present beneath the site is completely disconnected from the Santa Maria and San Antonio Water basins. Although the possibility is remote, it is possible that a continuous chain of fractures below the Casmalia Hills may allow the migration of contaminants to reach the lower

water basins (9, 10). Implications regarding the uncertainty of the potential connectivity between the regional groundwater beneath the site and the Santa Maria and San Antonio Water basins will be discussed later.

**Surface Water**

Surface waters in the immediate vicinity of the site include small streams, seeps, and a pond (Figure 6). The nearest streams to the site are Casmalia Creek, approximately 500 feet west of the site, and an unnamed stream located 750 to 1,000 feet northeast of the site. One mile south of the site, Casmalia Creek drains to join Shuman Creek, which flows west 4 miles into the Pacific Ocean. Another unnamed stream located to the east of the site drains southward and joins Shuman Creek about 2,500 feet north of the town of Casmalia. Three unnamed surface drainages exit the southern facility boundary; these drainages are referred to as the A drainage, B drainage, and C drainage (Figure 6) (1). Casmalia Creek and the A, B, and C drainages produce water seasonally, with more water in the spring and winter, and less in the summer.

Several seeps have been identified in proximity to the site. These seeps have been identified along the banks of the larger streams east and west of the site. Two seeps were identified within the facility along the edge of the western canyon. Most of the seeps in the area produce only minimally measurable discharge in the wet season and are dry during the summer months (8). A man-made pond is about 3,000 feet northwest of the site in the Casmalia Creek valley. The pond is apparently used for agricultural purposes; it has been constructed by placing an earthen dam across an entrenched part of Casmalia Creek. The pond measures approximately 100 feet in diameter and is approximately 6 feet deep.

Both Casmalia Creek and Shuman Creek are known to be accessed by recreationists and children. Although the creeks are not commonly known to be popular swimming areas, local residents have said children do occasionally swim or wade in the water. Other recreationists and trespassers have also been known to spend time on the streams' banks, including one migrant family that works in agricultural fields approximately 0.5 mile southwest of the site.

**Odor Complaint History**

An odor problem at the site first became apparent in December 1984, when the principal of Casmalia Elementary School closed the school because of strong odors that were suspected to be coming from the facility. Investigations performed by the Santa Barbara County Air Pollution Control District (SBCAPCD) and CDHS identified Pond 3 at the facility as the source of these odors. The odors were subjectively characterized as a "rotten egg" and "permanent wave solution" type of smell. As a result, in February 1985, CDHS directed CR to immediately cease discharges into or out of Pond 3 until the odors were abated (11).

After an 8-month period with relatively few odor episodes, a major odor episode occurred in September 1985. Several hundred odor complaints were recorded over a 2-week period. According to the results of subsequent microbiological tests from the site's pond liquids, the odors are believed to have resulted from the prolific growth of sulfate-reducing anaerobic bacteria that produce hydrogen sulfide and other sulfur compounds (12, 13). CDHS ordered CR

to take immediate action by capping Ponds 4 and 9. Oil caps were placed over the liquids to reduce off gassing. The caps were completed in September 1985, and the number of odor complaints steadily declined. Although an exact number of total odor complaints about the site could not be ascertained through site documents, CDHS believes that between 1984 and 1986, at a minimum, several thousand odor complaints were filed with state and county regulatory agencies (11).

**Hearings Related to Community Concerns**

In 1986, CDHS' Epidemiological Studies and Surveillance Section (ESSS), the predecessor to EHIB, initiated a series of hearings in response to a number of community complaints about odors emanating from the site. Residents in the surrounding communities of Santa Maria and Casmalia alleged that operations at the facility were impacting the health of the local community. The residents wanted the facility to cease operations. However, according to state law, in order for the county to shut down operations at the facility, it needed to determine that the site presented an imminent and substantial endangerment to human health and the environment.

The purpose of the hearings, referred to as the 501 hearings, and subsequent investigations was to determine whether sufficient evidence existed to show that the continued operation of the facility presented an imminent threat to the community. During the hearings, numerous allegations were made by the community regarding the threats posed by the continued operation of the facility. Among the claims made by the community were:

- Drinking water in the towns of Casmalia and Santa Maria was alleged to be contaminated by the site;
- Surface seeps in the hills near the site were alleged to be contaminated by the facility;
- The hydrogeology of the surrounding area is such that drinking water supplies for the towns of Casmalia and Santa Maria were in immediate danger of being contaminated from the site;
- Occupational air standards were alleged to have been exceeded as far as 5 miles from the site, according to air modeling performed for the Santa Barbara Grand Jury;
- A series of individual cases of illness and some deaths were alleged to have been caused by exposure to chemicals from the site;
- Hospitalizations for asthma and other respiratory illnesses had allegedly increased during 1985, compared to earlier years, because of the site;
- The levels of chemicals reaching the town of Casmalia and the Santa Maria area from the site were alleged to be sufficient to cause the individual illnesses and deaths mentioned above, and to produce other serious health effects; and
- The facility was alleged to have caused excessive odors and resulting symptoms.

All the claims were investigated by CDHS to determine if there was an imminent threat to the health of the surrounding community (14). At that time, it was concluded that all of the claims could not be substantiated and the facility was allowed to continue to operate.

**Previous Public Health Study Activities**

In 1985, ESSS took a preliminary look at reactive airway diseases (RADs) as an indicator of potential exposure to inhaled irritants emanating from the site. This task involved examining emergency room visits at a local Santa Maria Hospital. A comparison was made of consecutive RAD visits when 605 site-related odor complaints were filed in September 1985, compared to the previous September when only one complaint was filed. The preliminary study determined the number of RAD visits to the Santa Maria Hospital increased compared to the previous year. ESSS took this as a preliminary indication that RAD hospital admissions patterns in Santa Maria might possibly be related to site emissions (14).

On the basis of this finding, in January 1985, an interagency study was initiated to assess the impact the facility may be having on the air quality of the local communities. At the request of Santa Barbara County Health Care Services (SBCHCS), a panel of experts investigated health effects associated with the site. This group of investigators was called the Blue Ribbon Panel. The Blue Ribbon Panel consisted of state and local scientists, physicians, and technical experts. The Blue Ribbon Panel initiated several investigations including a more comprehensive study of the occurrence of RAD(s), and reviewed health statistics on regional childhood cancer rates and developmental reproductive data. In addition to the health study reviews, they also discussed the plausibility of biological monitoring, but this was never initiated.

On the basis of the initial findings of the RAD study, in December 1985, the Director of SBCHCS issued an order that Casmalia cease accepting solvent-containing liquids into surface ponds (15, 16). Despite this action, the direct connection between airborne emissions from CR and the rate of RAD admissions in the Santa Maria Hospital was never proven to the satisfaction of the ESSS investigators.

An updated RAD study was performed in 1986, by the Blue Ribbon Panel in conjunction with ESSS using information from two local hospitals in Santa Maria. The updated study attempted to correlate increased RAD hospital admissions during 1985 – 1986, using as a comparison a baseline period of 1981 – 1984, when there was a lower level of odor complaints. This study found an absolute increase in RAD hospital admissions for the month of December 1985 and a relative increase for the months of September and November 1985. However, several months hypothesized to have higher RAD admissions showed a significant decrease. Also, despite the increase in RAD admissions during the period studied, those admissions did not correlate to the reported symptoms and odor complaints received from the community during that period. Because ESSS could not see evidence of an overall excess in the number and proportion of RAD admissions, and because there did not appear to be consistent peaks of exposure during the months hypothesized to have higher admissions, ESSS found no reason for the continuation of the study (17).

In 1986, the California Occupational Health Surveillance and Evaluation Program (OHSEP) of CDHS was asked by CDHS to evaluate the health of employees at the facility. The study examined the results of both self-reported illness and laboratory diagnostic tests of workers from the facility as well as municipal landfill workers in Santa Barbara County. It was hypothesized that if exposure to contaminants were producing health effects, it would be most noticeable in

workers who were exposed to significantly higher levels of chemicals than municipal landfill employees who worked nowhere near the landfill. No differences in pulmonary function or laboratory results were observed between the hazardous waste workers at Casmalia and the municipal waste workers. Biological and personal monitoring did not show any significant occupational exposure to benzene, xylene, or methyl chloroform. However, due to the limited scope and short duration of the study, biological and personal monitoring was unable to address long-term health effects such as cancer; rather, it focused on more immediate short-term outcomes, such as pulmonary function, skin conditions, and neurobehavioral symptoms (17).

In 1987, ESSS issued the draft report "Acute Lymphocytic Leukemia—Santa Maria". In the report, ESS considered Acute Lymphocytic Leukemia (ALL) diagnoses among children in Santa Maria and Casmalia over a 5-year period. ESSS estimated the number of expected cases by using 1980 census information and by applying expected ALL rates from both the San Francisco/Oakland area and several U.S. reporting areas. The observed number of new cases of ALL in the Santa Maria Area for the 5-year period was five, whereas the expected number was either 3.45 (San Francisco/Oakland area) or 2.6 (pooled U.S. reporting areas). The probability of seeing five or more cases purely by chance with these two expected numbers was about one in four for the San Francisco rates, and one in eight for the other pooled U.S. locations. Even though the number of ALL cases in Santa Maria and Casmalia was higher than expected, ESSS did not find the increase to be statistically significant. Furthermore, the cases were scattered geographically throughout the Santa Maria area, with no clustering around the facility. ESSS could find no environmental hypotheses that could credibly explain the pattern of occurrence of these cases (14).

In 1986, ESSS assembled a group of experts to examine whether toxicological or biological monitoring of residents in the vicinity of the site would help to determine whether people were being exposed. The experts concluded that urine tests for exposure to airborne toxics would not reliably detect whether residents were exposed. The group advocated the use of expired air (breath) test measurements, a relatively new technique at the time, as a tool in the determination of whether the community was exposed. However, because of the experimental nature of the new measurement technique and because of the inability of SBCHCS to gain the cooperation of Casmalia residents for the study, no further work was done on this project. Instead, ESSS concentrated on providing technical suggestions for environmental air monitoring for the Interagency Air Study. These suggestions will be discussed later in the document.

In April 1988, ESSS released the findings of a reproductive study that attempted to compare rates of cleft palate—a congenital birth defect—to expected rates in Santa Maria. Researchers visited all hospitals in Santa Barbara to identify children from the Santa Maria and Casmalia areas who were born with cleft lip or cleft palate between January 1, 1984, and February 28, 1987. In that time period, researchers identified nine Santa Maria children with cleft lip or cleft palate. On the basis of this number, ESSS determined that the rate of cleft lip and palate for all years combined equaled 1.59 per 1,000 live births, a rate that was similar to the expected prevalence of 1.63 in the San Francisco area according to 1983 – 1984 data. ESSS found no evidence that cleft palate births were higher among Santa Maria residents, nor did ESSS discern an increasing trend between 1982 and 1985 (17).

**Site Visits**

On October 15, 2002, CDHS staff visited the site and the neighboring towns of Casmalia, Orcutt, Tanglewood, Santa Maria, and Santa Barbara. The purpose of the visits was to tour the facility and to speak with community members regarding their perceptions of the impacts that the facility has had on the neighboring communities.

Driving to the site on Black Road, CDHS staff noticed one sign referring to the facility. Just past the sign, a private road continued for 0.25 mile to the fence and the security gate of the facility. CDHS staff were required to sign in at the security gate, then directed to the site operations trailer.

At the site operations trailer, CDHS staff met with the Site Operation Manager, as well as with USEPA's Regional Project Manager. The Site Operation Manager provided CDHS staff with an overview of current activities at the facility and offered to give a site tour. However, because CDHS staff were not wearing steel-toed boots, the tour was restricted to driving and only limited walking.

The tour of the site included a drive around the runoff ponds, the RCRA, and PCB landfills, as well as a brief visit to the previously capped landfills for acids, pesticide/solvent, and caustic substances. CDHS observed a thick black liquid oozing from the ground in the Burial Trench Area. The Site Operation Manager said that this liquid was very common in that area but was unaware of the composition of the liquid.

CDHS staff drove around the vicinity of the facility to identify any other visible sources of local contamination. Close to the site, CDHS staff observed a former mine, several oil production fields, and several agricultural production fields. Staff members also toured the well head for the Casmite well (located in the Santa Maria Groundwater Basin north of the site and the town of Casmalis), which provides the town of Casmalia with drinking water.

After touring the site, CDHS staff met with several community members in the town of Casmalia. CDHS staff questioned the community members about their alleged historical exposures, as well as their current concerns about the site. A more detailed description of this meeting is covered in the Community Concerns section of this PHA.

CDHS also visited the Santa Barbara County Department of Health Services office. Staff met with the county drinking water program engineer and received data on drinking water analyses to review for this report. CDHS staff also briefly met with the county environmental health director to inform him that this PHA was being prepared.

In November 2003, CDHS staff went back to the community to gather additional community concerns.

**Land Use**

Land uses in the vicinity of the facility consist of cattle grazing, land farming, and oil field development. Several oil fields are close to the site. The town of Casmalia is designated an urban area that consists of residential, commercial, and industrial permitted zones. The town consists of approximately 30 individual residential houses, an elementary school, and a general store. There are no nursing homes, daycares, or other known sensitive populations in the vicinity of the site. The town is approximately 1.4 mile south of the facility, slightly longer when driven. The majority of the land surrounding the facility is zoned for agricultural use under the Santa Barbara County Comprehensive Plan, which sets forth the rules and permits for county land use. The towns of Orcutt and Tanglewood, approximately 3.5 miles northeast of the site, are also designated residential and agricultural zones. Several oil fields operated by Unocal are in Orcutt.

Prior to the development of the disposal facility, the land use in the vicinity of the site was livestock grazing. The three original assessor parcels on which the site was constructed were primarily zoned as agricultural (100 acre minimum parcel size). The operation of a waste disposal facility required the approval for a Conditional Use Permit (CUP). The purpose of the CUP is to provide land uses that are essential or desirable to the county but that cannot readily be classified as principal permitted uses in a zone district because of their special character or possible effect on the environment or surrounding land uses. Such a permit is issued by the Santa Barbara County Planning Commission, provided it can make the findings specified in the county codes (3).

The Comprehensive Plan designation for the land surrounding the facility remains an agricultural preserve, with special provisions allowing for oil production. The purpose of the designation is to maintain the land use for the cultivation of plant crops and the raising of animals. Grazing of farm animals still occurs on the land surrounding the facility.

Vandenberg Air Force Base (VAFB) is approximately 3 miles south of the town of Casmalia and extends southwest to the ocean. VAFB is home to several Air Force wings as well as to the Air Force Space Command and the Civilian Air Patrol. The base covers 154 square miles, including over 30 miles of coastline.

**Demographics**

According to the 1990 census, 371 persons live in the census block that includes the community of Casmalia. Of this total, 54% is Latino, and the remaining is white, with the exception of 3 people. The population of this area is divided into 116 households, and 56% of the population is male, a reflection of the large proportion of the population working as agricultural field labor (5).

The population surrounding Casmalia within a radius of 10 miles is 9,680. Nearly two-thirds of this population is Latino and primarily Spanish-speaking. In addition to the counted population, a population of uncounted and undocumented immigrants varies with the harvest season and the intensity of the Immigration and Naturalization Service presence (5). The nearby presence of VAFB and the area oil production fields adds a technically oriented and highly educated element to the area’s population.

The city of Santa Maria, whose center is approximately 11 miles from Casmalia, has about 67,000 people in its incorporated area. The city's ethnic breakdown is approximately 46% Latino, 6% Asian/Pacific, 2% African American, and 46% white, non-Hispanic. Another 30,000 people live adjacent to Santa Maria to the south and east in unincorporated county territory, 5 to 15 miles from Casmalia. This population is about 14% Latino and 84% white, with the balance from other ethnic groups.

**Toxic Release Inventory Search**

The Toxic Release Inventory (TRI), maintained by USEPA, contains information about estimated annual releases of toxic chemicals from active industrial facilities from 1987 to the present. TRI data can be used in forming a general idea of the current environmental emissions occurring at or around a site, and the extent to which such emissions pose an additional environmental burden to the community. TRI contains information on estimated annual releases (emission rates) of toxic chemicals to the environment (via air, water, soil, or underground injection), whether these releases are routine releases, spills and other accidental releases, or occasional releases from normal operation. A facility must report its releases of toxic chemicals to TRI if the facility meets four criteria: 1) it must be a manufacturing facility; 2) it must have the equivalent of 10 full-time workers; 3) it must either manufacture or process more than 25,000 pounds (lbs) of a chemical or use more than 10,000 lbs during the year; and 4) it must manufacture or process a chemical that is on the TRI list of 350 specific toxic chemicals or chemical categories.

No permitted releases were identified for the zip code for the town of Casmalia, 93429.

**Community Health Concerns**

Community health concerns about the site first came to the attention of CDHS in December 1984, when Casmalia Elementary School was closed because of strong odors (described as a "rotten egg smell") that were thought to originate at the site. Between 1984 and 1988, the Santa Barbara County Air Pollution Control District (SBCAPCD) logged a few thousand odor complaints, including several hundred complaints during a 2-week period in September 1985. At that time, CDHS ordered the landfill operators to remedy the situation immediately. Pond liquids were tested, and it was found that certain bacteria in the ponds were producing and emitting hydrogen sulfide and other sulfur compounds, causing the sulfur odors. In addition to the sulfur producing "rotten egg" odors, other chemical odors were also commonly reported in the town. Oil caps were placed over the ponds, and the odor complaints significantly declined.

In addition to odors, residents of Casmalia reported seeing brown clouds emanating from the site on several occasions during the same time when odors were present. When asked about the origin of the brown clouds, former employees confirm that vapor clouds occasionally occurred when trucks unloaded incompatible liquid wastes into the holding ponds.

In late October 2002, CDHS staff met with a small group of residents and business operators of Casmalia for the purpose of discussing health concerns related to contaminants from the Casmalia landfill. One of the business operators has been outspoken and highly involved with the site. This business operator coordinates the Casmalia Community Group and serves as the

lead community contact for USEPA (though not funded by USEPA). The Casmalia Community Group monitors site activities and meets informally to discuss issues related to the site. In the past, the community received a small amount of funding appropriated through a Consent Decree that required the CSC to pay for technical assistance to the community. The people with whom CDHS met expressed the belief that even more technical help was needed.

Many of their comments were made on behalf of other community members. The community members' main exposure concern was about the safety of the community's drinking water. A source for much of these fears was from a resident of nearby Santa Maria who published a book on the contamination of the drinking water supply by the facility. In the book, he purported to have several water samples taken from various public portals that showed evidence of PCB contamination. This claim is discussed in further detail later in this report. Community members who spoke to CDHS believed the assertions in the book that their municipal well has been/is contaminated by chemicals from the site. Because of this fear, many residents drink filtered or bottled water.

Unocal operates the municipal drinking water well for the town of Casmalia. Residents would like this well tested by someone other than Unocal and tested more frequently to ensure that it is not contaminated. In general, there is a low level of trust of Unocal. Residents stated that this lack of trust has caused some mental stress in the community. Residents also wanted to know if they could be affected by contaminated groundwater via vapor migration from the site.

Specific health concerns raised by the community included liver cancer, blood disorders, and other diseases. Liver cancer was cited as a community concern because several cases have occurred in the community. There was also mention that some community members had both contracted and died from blood disorders, but no specifics were forthcoming. Miscarriages, frequent nosebleeds, itching skin, anxiety, non-malignant cysts, migraine headaches, diabetes, and cancer were cited as health effects believed to be attributable to the site. Residents are dismayed that some community members have moved away because of their health concerns.

In addition to their health concerns, residents expressed concerns that the costs of remediation were given priority over the health of Casmalia residents. There was also concern about the operation of the landfill, equipment malfunctions, and improper disposal and containment of wastes. Residents mentioned that there was a seemingly high staff turnover rate of USEPA employees at the site, including site managers. In addition, there was concern that leaks at the site were not being reported to the community, and that not enough air monitoring was being done in the direction of the town of Casmalia. Finally, residents believed that the CSC and others make decisions that may affect community members without input from the community.

Casmalia residents expressed the belief that they would benefit from technical assistance in interpreting the scientific data generated from the site. Residents were worried about and wanted to know to what extent contamination is present in the shallow soil in the vicinity of the town. Additional concern was expressed that local contamination in the subsurface soils may infiltrate the aging water supply lines and contaminate their drinking water. Many in the community believed that the water quality should be tested from local portals such as household faucets.

CDHS has held two public availability sessions in Casmalia to listen to the community and collect their concerns. CDHS has also attended two USEPA public meetings held in Casmalia. USEPA meetings were focused on the progress of the remediation efforts and did not address public health concerns. CDHS is planning on holding further public availability sessions when this PHA is released to the public. The public availability sessions are planned to address the findings of the PHA and assess future needs of the community, such as continued technical assistance.

## Environmental Contamination/Pathways Analysis/Public Health Implications

*Summary: This section examines the pathways for exposure to contamination in off-site areas from the Casmalia Resources facility. CDHS examined each of the media (soil, surface water, air, and groundwater) to determine whether contamination was present and whether people in the community were exposed to (or in contact with) any contamination. This report does not attempt to assess on-site exposures because the site is fenced and access to the premises is controlled. If exposure to contamination in any of the media is identified, CDHS evaluated whether the levels of contamination pose a hazard to people in the community. This analysis systematically evaluates each of the media.*

Exposure occurs only when people come into contact with a chemical and it enters the body. For a chemical to pose a human health risk, a completed exposure pathway must exist. A completed exposure pathway consists of five elements: 1) a source and mechanism of chemical release to the environment; 2) a contaminated environmental medium (air, soil, or water); 3) a point at which someone contacts the contaminated medium (known as the exposure point); 4) an exposure route, such as inhalation, dermal absorption, or ingestion; and 5) the person or people exposed. Exposure pathways are classified as either completed, potential, or eliminated. In completed exposure pathways, all five elements exist. Potential exposure pathways are either 1) not currently complete, but could become complete in the future, or 2) indeterminate as a result of a lack of information. Pathways are eliminated from further assessment if one or more elements are missing and are never likely to exist.

A time frame given for each pathway indicates whether the exposure occurred in the past, is occurring, or is likely to occur in the future. For example, a completed pathway with only a past time frame indicates that exposure did occur in the past, but exposure is not occurring now and is not likely to occur in the future.

To screen the contaminants for evaluation, CDHS compared contaminant concentrations to health comparison values. Health comparison values are media-specific contaminant concentrations used to screen contaminants for further evaluation. Two types of noncancer health comparison values for soil and water are called environmental media evaluation guides (EMEGs) or reference dose media evaluation guides (RMEGs); those guides are, respectively, based on ATSDR's minimal risk levels (MRLs) or USEPA's reference doses (RfDs) (see Appendix A for a glossary containing these terms). Health comparison values used for air include reference exposure levels (RELs) developed by the California Environmental Protection Agency's (CalEPA) Office of Environmental Health Hazard Assessment (OEHHA), and USEPA's reference concentrations (RfCs). USEPA's Preliminary Remediation Goals (PRGs) are also used

to screen contaminants in the soil, air, and water. CDHS uses the most health protective value in screening for contaminants of concern.

Cancer risk evaluation guides (CREGs) are based on USEPA's chemical-specific cancer slope factors and an estimated excess lifetime cancer risk of one in a million persons exposed for a lifetime.

These comparison values allow an investigator to quickly sort the contaminants into groups that are either not likely to cause health effects or that should be further evaluated. Contaminants that receive further evaluation exist at concentrations that exceed the comparison values and are called "contaminants of concern" (COCs). Exceeding a health comparison value does not indicate that a contaminant represents a public health threat; rather, it suggests that the contaminant warrants further consideration.

When there are COCs identified in a medium, CDHS evaluates the pathway by which people are being exposed to the COCs. For the purpose of determining whether adverse health effects are possible as a result of exposure to a contaminant, an exposure dose must be estimated for each pathway. This exposure dose can then be compared to appropriate toxicity values as a means of evaluating the likelihood that adverse health effects will occur. Toxicity values used to evaluate noncancer adverse health effects include ATSDR's MRLs and USEPA's RfDs for ingestion, and USEPA's Reference Concentrations (RfCs) and CalEPA's REL for inhalation (18, 19). The MRL, RfD, RfC, and REL values are estimates of daily human exposure to a contaminant below which noncancer adverse health effects are unlikely to occur.

The National Toxicology Program (NTP), the International Agency for Research on Cancer (IARC), and USEPA have reviewed available information from human and/or animal studies to determine whether certain chemicals are likely to cause cancer in humans. The potential for cancer to occur in an individual or a population is evaluated by estimating the probability of an individual's developing cancer over a lifetime as the result of exposure. USEPA and/or OEHHA have developed cancer slope factors (for ingestion) and unit risk values (for inhalation) for many carcinogens. The cancer slope factor and unit risk value are estimates of a chemical's potential for causing cancer.

CDHS evaluated six potential exposure pathways related to CRSS (Table 1): contaminants in the air, drinking water, contact with local soil, and contact with sediment and surface water. Data in this section are presented in tables located in Appendix B. Figures used in this section are presented in Appendix C. A brief summary of the toxicological characteristics of the chemicals that CDHS evaluated is contained in Appendix D.

**Current and Past Exposure to Groundwater if It Were To Be Used as Drinking Water**

*Summary: Currently, no evidence exists that chemicals known to be present in the groundwater beneath the facility have ever impacted any domestic water system. CDHS reviewed several hydrogeological studies of the surrounding area and has consistently found no evidence that the limited groundwater beneath the facility has impacted the Santa Maria and San Antonio water basins. A review of all available drinking water analysis for the communities in the region for*

*the last 20 years has not identified any contaminants that can be attributed to the facility. In addition, CDHS investigated claims alleged in a book that PCBs were detected in the public water system and determined that these claims could not be substantiated. Because the water basins to date have not been impacted by site-related contaminants, and municipal drinking water is monitored, CDHS concludes there is no health hazard from past or current ingestion of drinking water. This is considered an eliminated exposure pathway.*

During the time period when the Casmalia facility received wastes, all the domestic water systems in the surrounding areas derived their water from groundwater sources, specifically wells in the Santa Maria and San Antonio basins. The groundwater beneath the site has never been used as a source of drinking water.

Several hydrogeological studies of the underlying bedrock in the area confirm that the Santa Maria and San Antonio water basins are isolated from the groundwater beneath the site by thousands of feet of claystone rock (7, 8). This claystone layer is generally impermeable to liquid contamination, although cracks and fractures in the claystone may permit some limited penetration. However, the likelihood that a continuous fracture or fractures exist that would allow the contaminants to travel completely through the claystone is very remote.

Further safeguards against the threat of contamination of the regional aquifers include regular testing by the county and state at the well heads each year for the entire Santa Barbara County water system. The county regulates domestic water systems having fewer than 200 service connections, and the state regulates water with 200 and more connections. Both the state and the county are required to monitor the water every 2 years to comply with state and federal drinking water standards. If contaminants are detected additional monitoring and safeguards are implemented to ensure water quality and protect public health.

CDHS conducted a comprehensive review of all available water sampling performed by the state and county for the towns of Casmalia, Santa Maria, Tanglewood, and Orcutt since 1981. The review revealed no evidence of contamination that can be attributed to the facility (Table 2). Some isolated analyses of domestic wells in the city of Santa Maria and the town of Casmalia have detected low concentrations of certain organic chemicals (20). Trichloroethylene (TCE) was detected in a well head sample at a level of 10 micrograms per liter (µg/L) in 1984, twice the MCL for drinking water. Perchloroethylene (PCE) was detected in well head samples in both Santa Maria in 1985 and in the town of Casmalia in 1986, at levels of 1.6 and 0.99 µg/L respectively; both of these detections are below the drinking water MCL of 5 µg/L. Methylene chloride was detected in a well head sample in May of 1984 at a concentration of 11 µg/L, twice the drinking water MCL. A thorough review of these detections determined the hits to be more likely associated with other industries, or are suspected to be laboratory error or post-sampling contamination (20-22).

There have been allegations in a book written by a community member of Santa Maria that PCBs and other toxic chemicals from the site have entered the Santa Maria aquifer and have been detected in school drinking fountains and other portals (23). These claims have attracted significant media attention in the past, and they continue to make many of the residents of Casmalia and Santa Maria wary of drinking tap water.

To investigate the claim that PCBs have been detected in the Santa Maria domestic water system, CDHS reviewed summaries written by ESSS of the sampling results that the book's author had turned over to the state. The actual results from the laboratory were not available for review; thus, CDHS cannot be sure exactly what analyses were run on the samples. Laboratory results were not available for many of the alleged PCB hits; thus, those claims could not be assessed by ESSS when they were investigating these claims in 1984. CDHS contacted the author of the book several times, but he declined to comment on his allegations or to provide further evidence of PCB detections. In a written letter from the laboratory that originally reported a positive PCB detection, the chief chemist could not substantiate the original technicians' analysis. Subsequent review of the sampling results from other chemists at the laboratory and from the SBCHCS scientists could not substantiate that PCBs were ever detected in any of the samples reviewed. Further sampling by the city, the state, and the county at the same portals allegedly sampled by the book author failed to detect PCBs in the water.

CDHS concludes that the domestic water systems in the vicinity of the Casmalia landfill meet federal and state guidelines for drinking water. Furthermore, no contaminants have ever been detected in Casmalia, Santa Maria, Tanglewood, and Orcutt water systems that may be attributed to the landfill. CDHS has eliminated past and current ingestion of drinking water derived from the regional groundwater basins as an exposure pathway to site-related contaminants.

**Future Exposure to Groundwater if It Were To Be Used as Drinking Water**

*Summary: Previous hydrogeological studies have shown that the groundwater beneath the site is separate from the regional groundwater basins that supply the surrounding community's drinking water. To date, there have been no sampling results that suggest the contaminated groundwater beneath the site has ever reached the adjacent water bodies. However, the possibility that a previously undetected fracture in the bedrock may connect the two bodies of water needs to be considered for future populations. Due to a lack of wells to fully characterize the migration of the contaminants towards the water basins, CDHS recommends additional groundwater monitoring wells be installed off site. CDHS considers exposure to site-related contaminants in the municipal drinking water supply to be a potential exposure pathway in the future and therefore represents an indeterminate public health hazard. However, the extensive groundwater monitoring on site, investigations currently underway, the installation of additional off-site monitoring wells, and monitoring of the municipal drinking water supply will identify potential migration of contaminants and allow for mitigation prior to any contaminated water being served to the public.*

As previously mentioned, the Casmalia Hills surrounding the facility primarily consist of weathered claystone. This claystone has many fractures and discontinuous fissures by which contaminants may migrate (8). Some of these fractures and fissures have been identified and mapped, but many have not. However, it is improbable that there could be a continuous chain of fissures and cracks that would allow the migration of contaminants the entire distance through the hills and the valley to the adjacent aquifer (24, 25). Because this water beneath the site is isolated between the layers of claystone, there is no completed exposure pathway for residents to ingest the water or breathe vapors that may be released and off gassed into the air.

Since 2004, sampling and laboratory analysis of 90 groundwater monitoring wells/piezometers, 11 extraction wells, 5 ponds, and 4 offsite water supply wells is performed twice a year to monitor the groundwater contamination. The majority of the monitoring wells are on site; however, 20 of the monitoring wells are off site, and six of them are to the south of the facility, towards the town of Casmalia and the Santa Maria water basin. The number of monitoring wells/piezometers sampled may decrease from 90 to 60 once the RI/FS field work is completed in late 2005, depending on the findings (6).

A review of sampling results from the Semiannual Monitoring Report for May 2001 confirms that the groundwater is contaminated by more than 25 volatile organic compounds (VOCs), 20 semi-volatile organic compounds (SVOCs), and three metals (10). Dense Non-Aqueous Phase Liquids (DNAPLs) are present in groundwater at the site and can be a source of continued contamination of the groundwater. DNAPLs occur when concentrations of organic compounds are so high that they separate and become denser than water and sink. A limited number of chemicals detected beneath the site in the groundwater have also been detected in off-site monitoring wells (Table 5). This information suggests that the Casmalia site is affecting groundwater off site, near the landfill. However, due to the limited number of wells characterizing this area, it is difficult to predict the rate and direction that the contaminants are migrating. USEPA is conducting additional investigations to better characterize the groundwater and hydrogeology at the site (1). Additional monitoring wells off site, towards the groundwater basins and to the south towards the town of Casmalia, would be useful in identifying the migration of contaminants off site. CDHS considers exposure to site-related contaminants in the municipal water supply to be a potential exposure pathway in the future. However, the extensive groundwater monitoring on site, investigations currently underway, the installation of additional off-site monitoring wells, and monitoring of the municipal drinking water supply will identify potential migration of contaminants and allow for mitigation measures prior to the contaminated water being served to the public.

**Exposure of Residents, Ranchers, and Recreationists to Contaminated Sediment and Surface Water in Streams and Seeps**

*Summary: On a basis of a review of available water quality data from Casmalia Creek, CDHS could not identify any contaminants in the water of local streams. However, the only samples available for review by CDHS were from one sampling event that, by itself, is insufficient to permit a characterization of potential fluctuations in levels of contaminants that may exist as a result of both site activities and seasonal change. In addition, to date, the creeks, streams, and seeps in the region have not been sampled for PCBs, which may have been released during non-permitted discharges in the 1970s and 1980s. Because of the insufficient water data and the fact that PCBs are known to bioaccumulate in the environment, CDHS recommends that the surface water, sediments in Casmalia Creek, and seeps in the area be tested for PCBs, as well as for other contaminants that may have migrated into the local surface waters. Until it can be shown that surface water, sediments in Casmalia Creek, and seeps in the area are not contaminated with PCBs, CDHS considers contact with these media to be a potential exposure pathway representing an indeterminate public health hazard.*

Casmalia Creek flows south of the site, and continues past the town of Casmalia, where it merges with Shuman Creek, and then flows into the Pacific Ocean. The water level in the creek is seasonal, with higher levels in the spring and winter and lower levels in the summer. There is the potential that recreationists and children may spend time on the creek's banks or wade through the water. Because of the potential for recreationists to spend time wading in the creek; CDHS has evaluated the potential exposure to contaminants from wading in the creek and being exposed to contaminants from contact and absorption of contaminants in the water and/or sediment through the skin.

Casmalia Creek is the closest natural body of water to the site and would likely be the most impacted by contaminants if they were migrating from the landfill. Casmalia Creek feeds into the other local creeks that may also be accessed by local residents. If contaminants from Casmalia Creek were reaching other streams or creeks, those contaminants would be significantly diluted when the bodies of water converge. Thus, if levels of contaminants from the facility are below levels of health concern in Casmalia Creek, CDHS could expect the same to be true for any body of water that merges with Casmalia Creek.

Over the course of the last 20 years, there have been both permitted and non-permitted releases from the facility and potentially other non-site related sources into Casmalia Creek. In 1978, and again in 1984, excessive rains caused several ponds on the western edge of the site to overflow into the creek (3). These releases were never reported or sampled but were discovered by review of aerial photographs taken during those periods. It is likely that other non-permitted releases occurred and were never identified.

In 1996, after a season of unusually heavy rain, a release to the off-site drainage areas was permitted to ease the rising levels in the runoff ponds. The water that was released came from the runoff ponds. Prior to the release, the ponds were tested for site-related contaminants, including PCBs. This was the only sampling event that was performed associated with the release of water from the retention ponds. Low levels of some organic chemicals were identified in the ponds prior to the permitted release; pond water and sediments were never analyzed for PCBs.

CDHS reviewed the stream sampling results taken before and after the 1996 release. Results from samples taken before the release, and downstream of the release point after the release, were analyzed for VOCs and inorganic constituents (26). CDHS reviewed these results and has found no significant changes in water quality that would affect human health. No organic contaminants or any other site-related contaminants were identified in the stream water before or after the release. Some minor fluctuations in inorganic levels of chemicals such as chloride and calcium were observed in the sampling results, but these changes are not considered significant to human health. All the samples reviewed were from a single sampling, which is insufficient to permit a characterization of the water quality of the creek. The post-sampling event did not include PCBs, which, although not present in the ponds during the 1996 release, are known to be present at the site and in higher levels along the western border of the facility; PCBs could have migrated to the creek during other, non-permitted discharges.

If PCBs were released during non-permitted discharges, they could still be present in the creek sediment. Because of this possibility and the lack of overall data on water quality for Casmalia

Creek, CDHS recommends the water and sediment be sampled for site-related contaminants. Sediment and surface water sampling of Casmalia Creek, and off site drainage areas (A-Drainage, B-Drainage, C-Drainage, North Drainage) will occur as part of the remedial investigation work at the site (2, 6).

Additionally, there have been reports of active seeps directly adjacent to the site, for which water analyses were not available. If seeps are found to be actively seeping water, it is likely that it is from the localized shallow groundwater beneath the site, which is contaminated by site-related chemicals. CDHS recommends that any area accessible to residents (especially children), ranchers, and recreationists be surveyed for active seeps and, if any such seeps are identified, they be sampled for site-related contaminants. Until it can be determined that surface water and sediments in Casmalia Creek and drainage areas adjacent to the site are free from all potential site-related contaminants, CDHS considers contact with these media to be a potential exposure pathway.

**Potential Exposure to Nearby Residents and Ranchers from Vapors Emanating From the Site When Ponds Received Wastes (1973 – 1986)**

*Summary: On basis of limited air sampling data, CDHS has determined there may be an increased risk of health issues related to exposure to vapors emanating from the facility from 1973 through 1986. However, because of the intermittent nature of the releases and the lack of a more complete set of data to characterize the releases when the site was operating, it is not possible to predict whether the exposures may have resulted in a health impact. In 1987, a risk assessment attempted to quantify the risk to residents breathing the vapors and predicted a negligible (below one in a million) increase in cancer risk to the neighboring community. However, a re-review of the air data used in the risk assessment, and further analysis of more recent air modeling and meteorological studies indicate that exposures, greater than those modeled in the risk assessment, likely occurred between 1984 and 1986. On the basis of this finding, CDHS believes that this site posed a public health hazard to the community in Casmalia during that time period.*

CDHS first became aware of an odor problem at CRSS in December 1984, when the Casmalia Elementary School was closed because of strong odors. Shortly after this episode, an investigation identified the facility as the source of the odors. On the basis of these findings, SBCAPCD required CR to implement several measures to control the odors, including placing oil caps over the ponds and implementing a hydrogen peroxide treatment system to treat contaminated water before it was placed in the ponds (27-29). These actions appeared to be effective for the short term; however, periodic odor episodes were still reported until the ponds were excavated in 1988 (3).

A subsequent analysis of the location and time of complaints suggested that the odor episodes were often associated with enhanced evaporation activities on site (12, 13). Enhanced evaporation refers to the process of spraying the waste-water into the air to help aerate and volatilize the contaminants in the water. The vapors created through this process would often be carried with the wind currents into the community of Casmalia, where community members were exposed to the contaminants via breathing the air in town. According to both community

members and former employees, this process was often performed at night. In addition to the odors and vapors associated with enhanced evaporation, visible vapor clouds would occasionally drift into the community. According to discussions with former CR employees, vapor clouds were occasionally created during the transfer of wastes when incompatible liquid wastes were mixed together.

In January 1985, an interagency study was initiated by SBCAPCD and CDHS to assess the impact the facility may be having on the air quality of local communities. This interagency study identified six individual tasks to produce data to be used in a final report on the impact of air emissions from the facility on local populations. The six individual tasks included several independent studies on topics, including local meteorological conditions, source assessment, identification of other sources of pollution in the immediate area, and air monitoring (30, 31).

Between September 1985 and January 1986, at least 188 air grab samples were taken on site to monitor and evaluated the effectiveness of remedial measures to reduce the odors from the ponds. Grab samples were collected in steel canisters and tedlar bags, both upwind and downwind from the site. Samples were analyzed by gas-chromatography and mass spectrometry for priority pollutants.

Additional grab samples were taken to measure sulfur-containing compounds thought to represent a significant component of the odors. The maximum on-site detection for several chemicals was approaching levels of potential health concern if the concentrations were constant over a long duration (Table 3). Hydrogen sulfide was detected on site at a maximum detection of 14,000 parts per billion (ppb); the average detection was 312 ppb.

In 1987, a risk assessment by the Epidemiological Studies Surveillance Section (ESSS) of CDHS used these on-site air samples to predict concentrations of the chemicals and corresponding health risks in the community (32). According to the risk assessment, the resulting excess cancer risk from the exposure to vapors to Casmalia was less than one in a million. However, the same risk assessment predicted the on-site cancer risk to be 0.86 per 1,000, or 860 in a million, significantly above the one in a million acceptable range. The reasons for the considerable difference in risks between the on-site and off-site locations were due to the dilution factor used in the risk assessment. A dilution factor is a number by which concentrations of contaminants are modeled to diminish by dispersion into the ambient air. Factors that influence dilution include wind currents, weather pressure, and large structures or objects such as mountains, hills, or buildings. The risk assessment assumed that the air from the facility would be diluted by a factor of 1,000 when it reached Casmalia.

CDHS reviewed two meteorological assessments of the region to determine how local climatic conditions may contribute to the dispersion of the vapors from the site (4, 18). According to a study by Radian Corporation in 1988, winds in the area have been documented as coming from all directions in the region, but the local hills and canyons in the immediate vicinity of the site disrupt many of the local and regional wind patterns. The prevailing wind direction was documented as being from the northwest, with less frequent wind events from the north, south, and southeast. Both studies found that the region is prone to inversion effects. Inversions refer to

atmospheric conditions in which a mass of hot or cold air becomes layered upon another mass of oppositely heated or cooled air. This results in uneven mixing of local air currents and inhibits the dispersion of pollutants into the atmosphere.

In another meteorological study reviewed by CDHS, Tracer Technologies in 1989, under contract to the California Air Resources Board, attempted to determine the dilution factor between the site and the surrounding community by measuring a tracer gas (33). To measure the dilution factor between the site and the town of Casmalia, a tracer (non-toxic) gas of a known concentration was released on site, and the resulting concentrations were measured when the gas reached the town. The study consisted of seven tests during a nine-day period, which focused on a short-term, worst-case envisioned meteorological scenario of low wind, night-time drainage from the site to the town of Casmalia. According to this study, the dilution rate between the site and Casmalia was determined to be between 3 and 20, with an average dilution rate of 10. This means that if a gas were released on site with a concentration of 100 parts per million (ppm), by the time the gas migrated to the town of Casmalia, the expected concentration would be 10 ppm, assuming a tenfold dilution factor.

CDHS reviewed the air study portion of the interagency report for the purpose of assessing potential exposures to the surrounding communities (11, 30, 34). Forty organic chemicals were detected in the on-site air samples. CDHS compared two sets of samples, representing both the maximum levels detected on site and the average concentrations, to health comparison values to determine the likelihood that exposure may have resulted in injury or an increased risk of cancer (Table 3). No samples were taken in the community as part of this study. CDHS re-calculated the noncancer doses and cancer risks from the 1987 risk assessment, using a dilution factor of 10 rather than the 1,000 used in the 1987 risk assessment (Tables 3 and 4).

Based on 1986 on-site sampling results, the revised estimated increased cancer risk[1] for the people living in the town of Casmalia was calculated to be between 1,500 in one million and 8.2 in one million, depending on which set of data (maximum or average concentrations) was used in the risk assessment. While the estimated increased cancer risks are higher than the “less than one in a million” predicted in the 1987 risk assessment, these estimations should be viewed as a worst-case scenario and likely represent an overestimation of the actual risk.

To determine the potential of noncancer health effects using a dilution of 10 rather than 1,000 used in the previous risk assessment, CDHS calculated the Hazard Quotients for chemicals known to have endpoints other than cancer (Table 3). The Hazard Quotient is the relative proportion of an exposure compared to the health comparison value for a single chemical. The acceptable Hazard Quotient standard is less than one; if it exceeds one, the possibility exists for noncancer health effects.

Hydrogen sulfide was estimated to be present in the town of Casmalia at a level nearly 1,000 times the health comparison value of 1.43 ppb (USEPA RfC value) for the maximum detection; the average detection limit of the samples was 24 times above the health comparison value. At this level, it is possible that exposures may have resulted in a burning or irritation of the throat

[1] Cancer risk estimates are a tool to help determine if further action is needed and should not be interpreted as an accurate prediction of the exact number of cancer cases that actually occur. The actual risk is unknown and may be as low as zero (35)..

and lungs, both of which were documented by local physicians (36). Individuals such as ranchers who work in areas near the site may have been exposed to higher levels than those estimated to be present in the town of Casmalia.

Acrolein was predicted to be present in the town of Casmalia at a level 15 times higher than the health comparison value of 0.009 ppb (RfC) for the maximum detection and over 7 times higher than the health comparison level for the average detection (37). The RfC was based upon animal studies that identified histopathological changes in the nasal cavity, lung, larynx, and trachea in rats. However, based upon the uncertainties regarding health effects of exposure to humans, in addition to the uncertainty regarding the duration of the exposures to acrolein, it is not possible to determine whether any health effects could be attributed to this exposure.

PCE was predicted to exist in the town of Casmalia at 5.8 ppb for the maximum detection and 0.19 ppb for the average detection. The maximum detection is just over the health comparison value of 5.2 ppb (REL). The REL was based on a conversion of an oral study in mice and it was a short-term study, thus its applicability to assess human exposures is limited. Due to the uncertainties associated with the REL, CDHS looked at toxicological studies to further investigate the possible effects of the estimated concentration. The only human studies that have associated noncancer effects with inhalation to PCE are two case studies that associated neurological effects, including headaches, dizziness and loss of consciousness at levels approaching 103 ppb. However, the effects of long-term exposure on other target organs is not well studied in people and it is not possible to say what health implication may be associated with long-term exposure to lower levels.

Dichlorofluoromethane was estimated to be present in Casmalia at levels above the health comparison value for the maximum detection, but not the average detection. The estimated concentration of 46 ppb in the town of Casmalia, using the tenfold dilution for the maximum detection of dichlorofluoromethane, exceeds the heath comparison value of 42 ppb (PRG). Long-term exposure at this level has been associated with decreased weight loss in animal studies. However, due to uncertainties in how these levels associated with health effects in animals translates to humans, and because of the great uncertainty regarding average daily levels and the safety factors that are assumed in developing the PRG values, it is not likely that health outcomes would be expected with exposure at this level.

To take into account additive effect from exposure to multiple chemicals, CDHS also calculated a hazard index, reflecting the sum of the hazard quotients for the chemicals combined (Table 3). Using the maximum detections, a total hazard index of 21.08 was calculated for all chemicals combined, minus the hydrogen sulfide detections. The total hazard index for the average detections of the all chemicals combined, minus hydrogen sulfide, was 4.15. This suggests that the total exposure of all chemicals combined was in excess of all of the health comparison values combined. However, just because the hazard index is over 1 does not necessarily mean that adverse effects would be expected based on the exposure. One reason for this is the safety factors that are taken into account when deriving health comparison values. Generally, on the basis of the quality and weight of evidence regarding the effects of exposure, several margins of safety are included in an estimated dose or concentration that has been associated with an observed effect.

One limitation of utilizing a hazard index to assess the potential health impacts of multiple chemical exposures is the lack of knowledge regarding how mixtures of chemicals can impact health. A hazard index only assumes additivity of the individual toxicities, but does not take into account other chemical interactions that may take place when multiple chemicals are present. In some instances, the mixture of two or more chemicals may produce a greater impact upon potential health than would be expected if we calculated the combined impact of the two chemicals separately. In such a case, the combination of chemicals is said to have a synergistic effect rather than an additive effect that would be assumed when calculating a hazard index.

The exposure estimates in the town of Casmalia were derived from air sampling results that were taken after several attempts were made to remediate the odors and eliminate the vapors drifting into the community. Because of this, CDHS believes that it may be possible that, when the facility was actively accepting wastes and using enhanced aeration to further volatilize the contaminants in the waste water, the concentrations in the town of Casmalia were much closer to the maximum detections rather than the average detections.

On the basis of a review of the air data from the 1985 – 1986 sampling, CDHS concludes that exposure to vapors from the site was a public health hazard in the past. However, due to a lack of sufficient data to confirm whether these levels, detected during the 1985 – 1986 sampling events, were constant over a long period, the applicability of these results to any health outcomes based on long-term chronic exposure is limited.

**Potential Exposure to Vapor Emanating From Site Material Area After the Ponds Were Closed and the Landfills Capped (2002 – Present)**

*Summary: The responsible parties, as ordered by USEPA, ceased accepting liquid wastes in the ponds in 1987 and there are five remaining ponds on-site, of which three received untreated storm water runoff. Since that time, remaining residual sludge has been placed into the landfills. Four of the six landfills were capped between 1999 and 2002; the two remaining landfills should be addressed as part of the future remedial work. Some site activities may release contaminants into the air, which may be carried into the town of Casmalia. Until it can be determined that the community is not being exposed to contaminants in the air due to site-related activities, CDHS has determined this to be a potential exposure pathway and represents an indeterminate public health hazard.*

Between 1999 and 2002, the responsible parties capped four (pesticides/solvent, acids/base landfills, heavy metals landfill, and the caustics/cyanide landfill) of the six landfills with a Resource Conservation and Recovery Act (RCRA)-cap. A RCRA-cap is a multi-layer cap that prevents direct contact with the contaminants, prevents generation of runoff and wind blown dust, and minimizes vapors emanating from the site where they may be breathed by the community. Control measures for the RCRA canyon and PCB landfills will be addressed during the Remedial Investigation/Feasibility Study (RI/FS) phase of the site work (1).

Currently, site operations are monitored by hand-held PIDs that are capable of detecting many of the contaminants known to be present on site, including petroleum hydrocarbons and

halogenated VOCs. The PID is not chemical-specific; rather, it detects levels of chemicals on the basis of their ionization potentials. The ionization potential of every chemical is different, and it may be additive if more than one chemical is present. The PID is generally used only as a screening tool for occupational exposures because it does not provide detailed information about the identity of the chemicals being detected.

According to conversations with the current site manager, the ambient background is below the level of detection (approximately 0.1 ppm) for most daily site activities. However, during some site-specific activities, such as changing out the carbon filter from the treatment system, detections have occurred. A recent incident involving a spill of a treatment vessel resulted in an on-site PID reading of approximately 200 ppm. However, it is impossible to know exactly what contaminant(s) was (were) being released. It is possible that at this level, several chemicals may have exceeded their short-term exposure recommendations, but because of a lack of sampling data, it is not known what chemicals were causing the high readings on the PID.

While the PID is considered to be sufficient in monitoring worker exposure at the site, it is not a sufficient monitor for community exposures in Casmalia. CDHS believes the site's normal daily activities can be conducted safely, but some of the activities periodically performed on site, such as the changing of the carbon filter and accidental releases, could result in short-term exposures to Casmalia community members. It should be noted that given the distance from the site to the town of Casmalia (~1.4 miles), it is not likely potential air exposures from intermittent releases described above would be as high as those estimated when the facility was actively receiving wastes. CSC is currently in the process of installing two PID air monitoring stations around the perimeter of the site. CDHS recommends that, in addition to the perimeter PID monitoring of the site, chemical-specific sampling take place when spills or releases are detected and a protocol developed to assess the need for additional monitoring closer to the town of Casmalia. Until it can be determined that the community is not being exposed to contaminants either on a regular basis, or periodically due to unintentional site releases, CDHS has determined that the current and future air emissions from the site represent a potential exposure pathway.

**Exposure to Surface Soils in the Vicinity of the Site**

*Summary: Contaminants from the landfill may have been transported through surface water runoff or aerially deposited over time by wind and fugitive dust onto the surface soils in the vicinity of the site. If so, people may have become exposed through several routes, including dermal contact and ingestion. Because Casmalia often receives lowland air currents down-gradient of the site, it is possible that the surface soils near the town may have been impacted. However, to date, no soil samples have been taken off site in the direction of Casmalia. CDHS recommends testing of the surface soils in the area for site-related contaminants that could have been carried into the community. Until it can be determined whether off-site soil has been significantly affected by site activities, contact with surface soil in the vicinity of the site is considered a potential exposure pathway and represents an indeterminate public health hazard.*

Over time, contaminants from the landfill may have been carried into town by the wind and deposited onto soil. Surface water runoff is another way contaminants could have been carried off site and deposited onto soil. If contamination has migrated off site either by wind or surface

water, residents and visitors could be exposed to the soil contamination in a variety of ways. Skin contact and incidental soil ingestion are likely routes of exposure to contaminated soil. Incidental soil ingestion is likely if a person eats, drinks, smokes, or participates in recreational activities near contaminated soil. For residential yards and playgrounds, soil ingestion can be an important route of exposure, especially for children under 6 years old.

To date, no surface soil samples have been taken in the direction of Casmalia. Because of the potential for residents, ranchers, and recreationists in the area to become exposed to the surface soils, CDHS recommends that the surface soils south of the site be analyzed for site-related contaminants (heavy metals and SVOCs) that could have been carried from the pesticide/solvents, PCBs, or Heavy Metals landfills and/or previous site disposal related to open ponds and impoundments, spreading areas, and waste evaporation operations. Sediment samples will be collected from four off-site drainage areas as part of the RI/FS being conducted by the USEPA (2). Until it can be determined whether the surface soils in the vicinity of the site have been impacted by contaminants released from the landfills, contact with surface soils in the area is considered a potential exposure pathway.

**Response to Health Concerns Raised at Public Availability Sessions**

In the course of gathering community health concerns as part of this public health assessment, CDHS learned that the community had numerous questions about possible contamination and exposure to contaminants from the landfill. During the public availability session, the community wanted to know whether health issues that they thought were common in their community could have been a result of exposure to contaminants from the landfill. The health issues that were mentioned most often by the community members included an excess of non-malignant cysts, migraine headaches, diabetes, cancer, nose bleeds, itching skin, and miscarriages.

Many of the health outcomes listed are ubiquitous in nature, cannot be traced to any specific events or exposures, and exist at relatively high rates in the general population. Because of this, and due to a lack of data that accurately characterizes what the community was exposed to over long periods of time, it is not possible to say whether the health outcomes mentioned at the meeting represent normal background rates or a health outcome based upon exposure to contaminants from the facility. However, based upon the finding that past exposure to vapors from the facility posed a public health hazard, CDHS cannot rule out the possibility that some of these health outcomes were a result of breathing the vapors emanating from the site during the time the facility was accepting wastes. Additionally, because three routes of exposure were determined to be potential exposure pathways, CDHS cannot completely rule out the possibility that exposures are occurring and that health outcomes may be possible due to these exposures. Future work detailed in the *Recommendations Section* includes several measures that will more precisely determine whether the community is being exposed to site-related contaminants or whether there is no exposure and therefore no public health hazard.

## Limitations of the Investigations Described in this Public Health Assessment

Limitations in the scope of an investigation and/or lack of sufficient data can be a source of uncertainty associated with any scientific investigation. It is the view of the authors of this

document that the limitations and data gaps do not compromise the conclusions of this PHA. However, a variety of uncertainties must be taken into account when one is considering the strength of the conclusions and recommendations. Of particular interest are the limitations associated with the vapor exposure pathway analyzed in this report. To predict what contaminants may have been present in the community, CDHS made use of on-site samples to predict what concentrations may have been present in the town of Casmalia. Additionally, the samples reviewed for the purposes of assessing risk were taken over a relatively short time period, thus may not accurately predict the true concentrations present in town when the facility was operating. Both of these factors, the lack of off-site air data, and the short time period when the samples were taken, may limit the accuracy of the findings. Despite these limitations, CDHS has a high degree of certainty in the conclusions and relative health risks associated with exposure to site contaminants. The recommendations presented in this document are aimed at addressing the limitations.

## Child Health Considerations

ATSDR recognizes that infants and children may be more sensitive than adults to environmental exposures. This sensitivity is a result of several factors: 1) children may have greater exposures to environmental toxicants than adults because, pound for pound of body weight, children drink more water, eat more food, and breathe more air than adults; 2) children play outdoors close to the ground, increasing their exposure to toxicants in dust, soil, surface water, and ambient air; 3) children have a tendency to put their hands in their mouths while playing, thereby exposing them to potentially contaminated soil particles at higher rates than adults (also, some children ingest non-food items such as soil, a behavior known as “pica”); 4) children are shorter than adults, meaning that they can breathe dust, soil, and vapors close to the ground; 5) children grow and develop rapidly; they can sustain permanent damage if toxic exposures occur during critical growth stages; and 6) children and teenagers may disregard “No Trespassing” signs and wander onto restricted locations. Because children depend on adults for risk identification and management decisions, CDHS and ATSDR are committed to evaluating their special interests at hazardous waste sites. In preparing this PHA, CDHS and ATSDR have taken into account that there is a population of children living in Casmalia. The report takes into consideration that children in Casmalia often are outdoors and may play in the open space between the town and the facility. Our conclusions and action items take into account all of the aforementioned scenarios.

## Conclusions

There have been many investigations to determine where and how much contamination exists on the Casmalia site. CDHS has reviewed the studies considered to be the most relevant for assessing the health impacts the facility may have had or is currently having on the local communities. Community concerns and the numerous odor complaints documented for the site were also considered. CDHS evaluated six potential pathways of exposure related to the Casmalia landfill: 1) past exposure to ranchers and residents in neighboring towns from breathing vapors emanating from the site; 2) current and future exposure to ranchers and residents in neighboring towns from breathing vapors emanating from the site; 3) past and current exposure to site-related contaminants in drinking water; 4) future exposure to site-related

contaminants in drinking water; 5) past, current and future exposure to contaminants in sediment and surface water by ranchers, recreationists, and residents (especially children); and 6) past, current and future exposure to soils in the region during recreational activities (Table 1).

CDHS conclusions are summarized below (listed in order of public health significance):

- CDHS has reviewed several air studies related to the Casmalia landfill for the purpose of assessing the potential health impacts the site may have had on the local community. Unfortunately, all of the air studies relevant to human exposures in communities were performed after the site had remediated the odor problem; thus the studies are not considered to be an accurate characterization of the exposure at the time the hazardous waste ponds were active. One study performed in 1985 and 1986 measured on-site concentrations of chemicals that were used to estimate inhaled doses to contaminants in the town of Casmalia (38). On the basis of an extrapolation of these on-site air samples, it seems that the community may have received significant exposures when the ponds were active. Because of the risks identified in this PHA, in particular the potential for noncancer health impacts such as irritation to the throat and lungs, CDHS considers the historical exposures to vapors emanating from the site to be a past public health hazard.

- The responsible parties, as ordered by USEPA, capped four of the six landfills between 1999 and 2002. Proposed capping and/or removal of the two remaining landfills (RCRA canyon landfill, PCB landfill) should eliminate the majority of current or future emissions from the landfills. Despite the caps, some site activities, such as changing the carbon in the treatment system and accidental releases may expose the community to vapors from the site. Because the only current air monitoring is performed with a screening tool, it is impossible to determine what chemicals and concentrations the community may be exposed to during these incidents. A recently installed air monitoring system is currently collecting air monitoring data to identify contributions from the site on background concentrations in the region, which will be used to establish an action level. However, the utility of the non-chemical specific detector is still in discussion. Until it can be shown that the community is not being exposed to contaminants at levels of health concern on both a regular basis, as well as during unintentional releases, CDHS concludes there is a potential exposure pathway to vapors emanating from the site, currently and in the future. CDHS classifies this exposure pathway as representing an indeterminate public health hazard.

- On the basis of limited sampling of the streams and seeps adjacent to the site, it is not possible to determine whether exposure to surface water or sediment in the area poses an increased health risk to the community. A study in 1986 by USEPA and reviewed by CDHS did not identify any contaminants in the stream that may be attributed to the site, but the samples were not tested for PCBs (26). Because there have been known permitted and non-permitted releases from the site into Casmalia Creek, it is possible that PCBs may have contaminated the soils and sediments around the creek. Additionally, seeps that may bring contaminated groundwater to the surface have been historically documented in the area. Until it can be determined that the surface water, sediments in Casmalia Creek, and seeps in the area are not contaminated with PCBs or other site-related contaminants, contact with these

media is considered a potential exposure pathway and these pathways represent an indeterminate public health hazard.

- Because of a lack of off-site surface soil samples, it is not possible to say whether people may be exposed to contaminants from the site through direct contact with the surface soils. Until it can be determined whether off-site surface soils have been impacted by site activities, CDHS considers contact with surface soils in the area to be a potential exposure pathway and this pathway represents an indeterminate public health hazard.

- Current monitoring data from the May 2001 Semi-annual Monitoring Report confirms that the groundwater under the Casmalia site is contaminated with various chemicals from the landfill. Currently and historically, no domestic wells are drawing or drew water from the contaminated groundwater; thus, no one is being or has been exposed to site-related contaminants in the municipal drinking water. CDHS concludes drinking municipal water in the past and currently does not pose a public health hazard.

- According to hydrogeological reports of the area, the contaminated groundwater plume underlying the site is separated from the Santa Maria water basin (supplies drinking water to the neighboring towns) by several thousand feet of claystone. There is a remote chance that there may be some limited connectivity between the contaminated groundwater beneath the site and the Santa Maria water basin. For these reasons, CDHS considers this a potential exposure pathway in the future and this pathway represents an indeterminate public health hazard. However, the extensive groundwater monitoring conducted at the site, on-going investigations, addition of more off-site monitoring wells, combined with monitoring of the municipal drinking water supply will identify potential migration of contaminants and allow for mitigation prior to any contaminated water being served to the public.

## Recommendations

1. To increase public confidence that vapors are not currently being released from the site, CDHS recommends that chemical-specific air sampling be conducted by the USEPA when an unintentional release is discovered on site, or when the PIDs around the perimeter of the site indicate a release. The purpose of this sampling is to characterize what chemicals are being released, and to provide increased confidence to the community that residents are not being exposed to contaminants at levels of health concern. A protocol should be developed for outlining action levels of chemical specific sampling, for interpretation of data, and for preparing a community notification plan. CDHS will work with the relevant agencies and the community to determine appropriate action levels for community notification and sampling.

2. CDHS recommends that the USEPA sample Casmalia Creek and the sediments in the creek for PCBs and other site-related contaminants that may have been released during non-permitted releases known to have occurred in the 1970s and 1980s. Land within 0.5 mile of the site should be surveyed for active seeps, which could potentially be a source of exposure to groundwater for community members, local ranchers, and recreationists. Any seeps identified should be sampled for all site-related contaminants.

3. CDHS recommends that the USEPA perform sampling of the surface soil near the town of Casmalia and adjacent to the site to ensure the community is not currently being exposed to contaminants from the landfill in either the community or during recreational activities near the landfill.

4. CDHS recommends that the USEPA install several monitoring wells north and south of the site to allow better characterization/identification of migration of contaminants off site, toward the town of Casmalia and the Santa Maria Water Basin.

**Public Health Action Plan**

The Public Health Action Plan (PHAP) contains a description of the actions taken, to be taken, or under consideration by ATSDR and CDHS or others at and near the site. The purpose of the PHAP is to ensure that this health assessment not only identifies public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment.

**Actions Completed**

1. CDHS/ATSDR gathered community concerns through community meetings.

2. CDHS/ATSDR gathered community concerns by conducting public availability sessions for the community.

3. USEPA and CR contractors continue to collect and treat runoff water that flows through the site.

4. A perimeter air monitoring system has been installed to assess the impact emissions from the site have on the community. The air monitoring system may one day serve to notify the community of unintentional releases that cause vapors to drift into town.

5. CDHS held a public meeting in April 2005 and met with community members in Casmalia to discuss the public comment draft to the PHA.

**Ongoing Actions**

1. USEPA and the responsible parties are in the process of performing site characterization at the site and issuing a Remedial Investigation/Feasibility Study and Record of Decision for the final remedy.

2. USEPA holds meetings in the town of Casmalia to provide the community with updates on ongoing site work such as the ongoing collection and treatment of runoff water, continued maintenance of the site, RI/FS, removal and enforcement actions and other site-related activities.

**Actions Planned**

1. CDHS will obtain and review air data collected during 1987 – 1989 and evaluate whether additional recommendations/public health actions are warranted.

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## Certification

This Casmalia Resources Superfund Site, Casmalia, Santa Barbara County, California, Public Health Assessment was prepared by the California Department of Health Services under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the health assessment was initiated. Editorial review was completed by the Cooperative Agreement partner.

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The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health assessment and concurs with its findings.

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