Health Consultation

Exposure Investigation Report

CARPENTER LANE, MULTNOMAH COUNTY, OREGON

PESTICIDE SAMPLING AT RESIDENCES NEAR
COMMERCIAL NURSERIES

Cost Recovery Number: A728

MAY 17, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

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In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation 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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Prepared by:

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U.S. Department of Health and Human Services

Executive Summary

In late 2000, community residents in western Oregon, near Gresham, contacted the U.S. Environmental Protection Agency (EPA) Region 10 Pesticides Unit. The residents were concerned about potential harmful effects from exposure to pesticides being applied at nearby ornamental nurseries. The EPA unit referred them to the Agency for Toxic Substances and Disease Registry (ATSDR) for help in determining if pesticide drift from the nurseries could be affecting human or animal health. Pesticide spray drift is the movement of a pesticide through air at the time of application or soon after, to any site other than the one intended. ATSDR conducted a health consultation (HC) involving several properties located near Carpenter Lane in Multnomah County, Oregon. Completed in September 2002, the HC determined that insufficient information existed to determine whether community exposure to pesticide spray drift had occurred. The HC recommended that seasonal environmental sampling and analysis should be conducted to better assess the possibility of pesticide drift from ornamental nurseries in the area.

Environmental sampling for this exposure investigation (EI) was conducted February through November 2003. The EI objective was to determine if there was evidence of pesticide drift from nurseries onto neighboring residential properties, and if so, whether that drift posed a health threat to residents. Samples of soil, vegetation, water (not used for drinking), surface areas (swabs), and ambient air were collected from 12 residential properties. Samples were collected during the pre- and post-spray seasons, as well as during the spray season. Information regarding locations, dates, or types of pesticides that were applied in neighboring nursery fields was not available. Because sample collection was not exhaustive, the results from this EI represent a “snapshot in time” of levels of pesticide contamination in the area.

Overall, soil levels of pesticides were very low, well below ATSDR or EPA health-based comparison values. However, because information about pesticide application dates, locations, and concentrations was not available, we could not estimate what the levels may have been at the time the pesticides were applied. Several banned organochlorine pesticides were detected in soil samples collected from 11 properties. Although the levels from 4 properties exceeded ATSDR cancer risk evaluation guides, there is no appreciable increase in cancer risk. Noncancer comparison values were not exceeded. No pesticides were detected in vegetation samples. No pesticides were detected in the 24-hour ambient air samples. However, since no spraying was observed during the air sampling periods, these results are not representative of airborne pesticide concentrations during spray events. Pesticide levels detected in water samples were lower than the amounts allowed in drinking water, indicating that surface or ground water pesticide contamination in the Carpenter Lane area is minimal. Low levels of two pesticides were detected in swab samples from one property.

Data from this EI suggest that there may have been some degree of pesticide drift onto residential properties. However, these data are insufficient to identify the sources of pesticides that were detected on some of these properties.

ATSDR concludes that community exposure to pesticide spray drift is an indeterminate public health hazard for the following reasons.

1. At the time the soil samples were collected, the concentrations of pesticides detected in soil were unlikely to pose a health hazard to residents. However, a definitive assessment of health hazards associated with currently used pesticides detected in residential soil cannot be made because essential information is missing or incomplete.
2. Because no spraying occurred during air sampling, it is not possible to evaluate potential health hazards from exposures to airborne pesticides.

Residuals of banned organochlorine pesticides detected in soil were at levels unlikely to pose a health threat. Exposure to the surface or groundwater sources involved in this EI does not pose a health threat from the compounds included in the analysis.

ATSDR recommends that follow-up efforts to this EI focus on

- minimizing the potential for pesticide spray drift from area nurseries,
- improving understanding and communication between the community and area nurseries, and
- providing education about pesticides to community members and health care providers.

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Objectives and Rationale

The objective of this exposure investigation (EI) was to determine if there was evidence of off-site pesticide movement or *drift* from commercial nurseries onto neighboring residential properties, and if so, whether that pesticide drift posed a health threat to the residents. The EI protocol is found in Appendix A.

The Agency for Toxic Substance and Disease Registry (ATSDR) completed a health consultation in the area around Carpenter Lane near Gresham, Multnomah County, Oregon in September 2002 [1]. The purpose of the health consultation was to determine if pesticide spray drift onto adjacent residential properties from commercial nurseries was occurring or had occurred, and if so, whether that drift posed a public health hazard. The health consultation determined that community exposure to pesticide spray drift was an indeterminate health hazard [1]. Seasonal environmental sampling and analysis to better assess the possibility of off-site pesticide movement or drift from commercial ornamental nurseries in the area was recommended. As a result of that recommendation, ATSDR, in cooperation with the U.S. Environmental Protection Agency (EPA) Region 10 Office of Environmental Assessment (OEA), conducted this EI from February 27, 2003, through November 18, 2003.

Background

EPA defines *pesticide spray drift* as the movement of a pesticide through air at the time of application or soon thereafter, to any site other than the one intended. This is also often referred to as *off-target drift* [2]. Pesticide drift, in terms of potential human exposure, can be a concern wherever people live near agricultural lands. In the United States, urban development has been expanding into what were once exclusively agricultural areas. As this interface between agriculture and urban development increases, important public health issues involving pesticide drift will also increase.

In late 2000, EPA's Region 10 Pesticides Unit referred a group of concerned community members to ATSDR for assistance. The residents wanted to know if pesticides and other chemicals applied on area ornamental plant nursery fields could be affecting the health of humans or animals living nearby [3]. In response, ATSDR conducted an HC involving a group of properties (commercial ornamental nurseries, homes, and farm properties) that are located within a 1.5-mile radius of Carpenter Lane, Multnomah County, in western Oregon. This site is referred to as the Carpenter Lane (CL) site.

During that health consultation, ATSDR asked OEA to help gather existing data relating to pesticide drift complaints from residents living near commercial nurseries in the CL area. This included a review of complaint and follow-up investigation records from the Oregon Pesticide Analytical Response Center (PARC), the Oregon Department of Agriculture (ODA), and the Oregon Department of Human Services (ODHS). Court records, medical and veterinary records, and witness statements were also reviewed, as were summaries of

interviews with CL residents and individuals familiar with the area's pesticide drift concerns [4].

EPA's OEA concluded that there was insufficient information to determine whether CL residents had been exposed to pesticide drift from local nurseries. Available information was also insufficient to reach a valid conclusion about whether health concerns or property damage described by residents were due to pesticide drift or other mechanisms. OEA recommended that a field investigation with rigorous quality assurance controls was necessary to fully address the concerns raised by the residents of CL [4]. The health consultation recommendations supported the OEA evaluation and recommendations.

Methods

Exposure Investigation Design

The EI environmental sampling plan and quality assurance project plan were developed by OEA in consultation with ATSDR, EPA Region 10 Pesticides Unit, ODA, and ODHS (EPA, unpublished report, 2003). The sample collection schemes were designed in response to residents' complaints. The sampling plan called for baseline and seasonal environmental sampling for several media from at least ten residential properties located within a 1.5-mile radius of CL. A map of the CL area is provided in Appendix B. The sampling schedule was designed to capture "snapshots in time" during pre- and post-spray season baseline periods and anticipated spraying seasons. Sample media included soil, vegetation, ambient air, swabs from buildings, and surface water and/or private well water (if applicable). Pesticides selected for analyses were determined by reviewing pesticide application records for 1995–1996 from ornamental nurseries in the CL area (more recent records were not available to the investigators), input from ODA on commonly used pesticides in the area, and the EPA laboratory analytical capabilities.

Target Population

Participation in the EI was offered to residents of properties located within a 1.5-mile radius of CL that were adjacent to commercial nurseries. ASTDR recruited participants through door-to-door and phone contact.

Consent Form

The purpose of the EI and any benefit or risk were explained to at least one adult member in each household during a scheduled visit by ATSDR. Questions were encouraged and answered. Fourteen heads of households agreed to participate in the EI and signed either a resident or an owner consent form. Samples of the consent forms are found in Appendix A. Consent forms were signed approximately 3 weeks before collection of the first samples.

Sample Collection Procedures

The EPA Region 10 OEA team based in Seattle, Washington, conducted the environmental sampling in accordance with the quality assurance project plan [EPA unpublished report, 2003]. The team traveled to the CL area over a 10-month period for several 2- to 3-day site visits. The site visits consisted of observations and baseline and interim sampling. Baseline sampling was conducted in February 2003 (pre-spray season) and November 2003 (post-spray season). Baseline sampling primarily consisted of collecting soil, water, and swab samples. Interim site visits (collected during the spray season) consisted primarily of observations and collecting air samples, although some additional environmental samples were also collected, when indicated. Site visits were scheduled based on the availability of the OEA team and air sampling equipment. Samples were collected from 12 of the 14 properties where the owner or resident had previously signed a consent form and was available to provide verbal permission at the time of sample collection.

The specific procedures for the collection of each type of sample are described below. The sampling location, collection date and time, and sample number were recorded on each sample container. Sample containers were put in plastic bags and placed in a cooler with ice for preservation. The coolers were locked and secured with custody seals during transport. The samples were transported by OEA team members to EPA's Region 10 Manchester Environmental Laboratory (MEL) in Port Orchard, Washington, for extraction and analysis.

Soil

The sampling plan called for baseline soil samples to be collected from as many properties as possible during the pre-spray (February 2003) and post-spray (November 2003) seasons. The goal was to collect both pre- and post-season samples from the same properties so the results could be compared.

For each soil sample, the OEA team collected four specimens of soil along a transect line that was determined by a global positioning system (GPS). The four soil specimens were placed in a stainless steel mixing bowl and thoroughly stirred to form one composite sample. The composite soil samples were put in clear glass sample containers (quality control- [QC] class with Teflon®-lined lids).

Vegetation

Most vegetation samples were collected during interim spray season site visits. Samples of healthy/undamaged plants were collected using a grid pattern. Plants that showed some abnormalities were collected as grab samples. Clear glass sample containers (QC-class with Teflon®-lined lids) were used to hold either type of sample.

Water

Water samples were collected from as many properties as possible that had surface or private well water sources. The water sampling was planned primarily for baseline site visits.

Surface water was collected using a clean 1-liter (L) plastic bottle on the end of an aluminum sampling pole. The sampler faced upstream and did not disturb the sediment. Water samples from an unused well were obtained with a Teflon® bailer specifically designed to collect water samples for analysis of volatile compounds. All water samples were placed in QC-class sample containers. Water samples collected for analysis of organic compounds, such as pesticides and petroleum hydrocarbons, were placed in 250-milliliter (mL) volatile organic analysis amber glass containers with septa caps. Water samples collected for analysis of carbaryl were preserved to pH < 2 with chloroacetic acid. Water samples collected for analysis of nitrates and nitrites were placed in 500-mL high density polyethylene (HDPE) containers and preserved to pH < 2 with sulfuric acid. Water samples collected for analysis of metals were placed in 1-L HDPE containers and preserved to pH < 2 with nitric acid.

Swab

Swab samples were collected from as many properties as possible during the baseline and interim site visits. Swab samples were obtained using two sterile cotton swabs moistened with methanol as the solvent. These were used to wipe a surface approximately 100 square centimeters in area. Preseason and post-season baseline sampling included vinyl floor tile or concrete surfaces at the most commonly used entrance to each residence. Swab samples collected during interim site visits were from window surfaces. The swabs were placed in new, clean 250-mL clear glass sample containers, QC-class, with Teflon®-lined lids.

Air

Twenty-four hour ambient air samples were collected from as many properties as possible during the interim site visits. Specific dates for air sampling were based on when pesticide spraying was anticipated, the availability of OEA team members, and the availability of air sampling equipment.

Air samples were collected on polyurethane foam (PUF) plugs housed in glass tubes that were connected to low-volume Airfiltronics® sampling pumps with Tygon® tubing. The pumps were set to collect air samples at 5.2–6.5 liters/minute (L/min) for 24 hours. The low-volume pumps were calibrated with a Gillian® electronic soap film meter. Sampling stations were staged on residential properties at locations where buildings and other obstructions such as trees and bushes would not influence air flow around the samplers. Samples were collected in accordance with the compendium of *Methods for Toxic Air Pollutants TO-10A*. After sampling, PUF plugs and glass tubes were wrapped in methanol rinsed aluminum foil and were placed in coolers with ice. The samples were transported by OEA team members to the MEL.

Analyses

Preparation and analyses of all environmental samples were conducted at EPA's Region 10 MEL and are described in the analytical data report for samples collected by OEA (EPA unpublished report, 2004). The specific target pesticides for all media analyses included carbaryl, chlorothalonil, diazinon, chlorpyrifos, and isoxaben. Some additional compounds were targeted for specific media. These are described in the media sections, if applicable. Internal standard multipoint calibration curves were used for the targeted compounds. During

the course of the analysis, several unanticipated pesticides were detected in some of the samples. Preliminary identification of these non-target compounds was determined by matching test results to reference data in national and commercial mass spectral libraries. Subsequent standard analysis was used to confirm the identifications and estimate the concentrations. These non-targeted compounds are described in the corresponding "Results" section of this report. The specific methods used and limitations regarding the analysis of non-targeted compounds are described in the analytical data report for samples collected by OEA (EPA, unpublished report, 2004).

Soil

Soil samples were prepared and analyzed for heavy metals and semi-volatile organic compounds, including selected fungicides, insecticides, herbicides, phenol and hydroquinone. Triclopyr and 2,4-D were included as target pesticides, in addition to the other targeted pesticides previously listed.

The acid herbicides were extracted using EPA SW-846 Method 3545, modified by using 1 phosphoric acid /20 methanol /80 MTBE instead of methylene chloride/acetone. The other targeted pesticides were extracted by EPA SW-846 Method 3540 using unmodified sample and 100% acetone. The extracts were treated with Florisil® and analyzed with guidance from SW-846 Method 8270C (decafluorotriphenylphosphine [DFTPP] criteria from Method 525.2 were used to verify the mass spectrometer's tune). Phenol and hydroquinone were extracted according to EPA Method 3540 using unmodified sample and 100% acetone, and analyzed using EPA SW-846 Method 8270C.

Soil samples collected from Location 2 in June were also analyzed by SW-846 Method 8081 using gas chromatography/electron capture detector (GC/ECD) for DDT analogues, chlordane, and dieldrin, to provide more accurate data since these compounds were found in significant quantities in earlier samples. Therefore, these compounds are considered target pesticides for those June soil samples.

Heavy metal analysis included arsenic, copper, lead, and mercury. Soil samples were prepared for arsenic, copper, and lead analysis using EPA Method 200.2. Samples were prepared for mercury analysis using EPA Classical Chemistry Analysis (ESD-095A). All analyses were performed according to laboratory MEL guidelines.

Vegetation

Vegetation samples were extracted using a modified EPA Method 3545 (pressurized fluid extraction). The extracts were treated with Florisil® using a modified EPA Method 3620 (Florisil), and analyzed for the target pesticides using a modified EPA Method 8270C. DFTPP criteria from Method 525.2 were used to verify the mass spectrometer's tune.

Water

Water samples were prepared and analyzed for triclopyr and 2,4-D, in addition to the other targeted pesticides previously listed. Nitrate/nitrite, heavy metals, and diesel range organic compounds were also included as target compounds. Water samples were extracted for pesticides using EPA SW-846 Method 3511. A modified version of EPA SW-846 Method 8270 was used as guidance for analysis. The acid herbicides were extracted according to Method 515.3, but analyzed using a modification of EPA SW-846 Method 8270C. DFTPP criteria from Method 525.2 were used to verify the mass spectrometer's tune.

Heavy metals (arsenic, copper) were prepared using EPA Method 200.2 (hydrochloric acid was omitted to achieve a lower detection limit for arsenic). Analysis for lead was inadvertently omitted. Samples were prepared for mercury and nitrate/nitrite analysis using EPA's *Classical Chemistry Analysis* (ESD-095A). Analyses for heavy metals and nitrate/nitrite were performed according to MEL guidelines.

Swab

Swab samples were extracted using a modified EPA SW-846 Method 3580A. The extracts were treated with Florisil® and analyzed for the targeted pesticides, with guidance from EPA SW-846 Method 8270C. DFTPP criteria from Method 525.2 were used to verify the mass spectrometer's tune.

Air

Air samples that were collected in June 2003 were extracted using EPA SW-846 Method 3545 using 50:50 methylene chloride–acetone (volume-to-volume). Analysis was performed using a modification of EPA SW-846 Method 8081. These samples were also screened using Method 8085 because several of the pesticides in that screening method had been detected in other media samples previously analyzed. Samples collected in July 2003 were extracted using a modification of EPA SW-846 Method 3545. The extracts were treated with Florisil® and analyzed with guidance from EPA SW-846 Method 8270C. These samples were only analyzed for targeted pesticides.

Quality Assurance/ Quality Control

Quality assurance and control assessment was based on the quality control specifications outlined for the specific analytic method used and MEL's quality assurance manual standard operating procedures for the specific analysis. Details regarding the quality assurance and control assessments are found in the EPA Region 10 OEA analytical report of the 2003 environmental monitoring project for Carpenter Lane (EPA, unpublished report, 2004).

The assessments for each sample included holding times, initial calibration, system performance check, internal standards, method blanks, surrogates recovery, matrix spike samples, fortified blanks and other quality assurance samples, target compound identification, and non-target compound identification. From these assessments the overall quality and usefulness of the data were assessed and data qualifiers were assigned, as needed. In cases requiring more than one data qualifier, the most restrictive qualifier was assigned. Data that were assessed to be without restriction were not assigned a qualifier. In the "Results" section of this report, results that required assignment of a qualifier are designated as "estimated results." Examples of qualifiers used in the analytical report include the following:

J – Identification of analyte is acceptable; reported value is an estimate.

N – There is presumptive evidence the analyte is present; analysis is reported as an identification.

NJ – There is presumptive evidence the analyte is present; analysis is reported as a tentative identification. Reported value is an estimate.

U – The analyte was not detected at or above the reported value.

UJ – The analyte was not detected at or above the reported value. Reported value is an estimate.

Results

The OEA team collected samples from the CL site in February, April, June, July, and November of 2003. Table 1 below shows the months when samples were collected, the type of samples collected, and from how many different properties they were collected.

Table 1. Month and Number of Properties From Which Soil, Water, Vegetation, Swab, and Air Samples Were Collected— Carpenter Lane Community; 2003

Month samples collected	Number of properties from which specified samples were collected				
	Soil	Water	Vegetation	Swab	Air
February 2003	10	4	1	11	0
April 2003	2	4	4	0	0
June 2003	1	0	0	2	6
July 2003	0	0	0	6	6
November 2003	8	3	0	5	0

More details, such as the number of samples collected during each sampling event, which property they were collected from, compounds for which the samples were analyzed, and pertinent information regarding the circumstances of the sampling are provided in the following sections specific to each type of media.

Soil results are given in the standard notation of parts per million (ppm), meaning the number of milligrams (or parts) of the chemical in 1 kilogram (or million parts) of soil. Water results are given in the standard notation of parts per billion (ppb), meaning the number of micrograms (or parts) of the chemical in 1 L (or billion parts) of water.

To assist in interpreting the significance of the sampling results, health-based comparison values for the specific sampling media are provided, if available. These include ATSDR health-based comparison values (ATSDR, unpublished data, 2004), EPA Region 3 *risk-based concentrations* (RBCs), or EPA Region 9 preliminary remediation goals (PRGs) [5,6].

The ATSDR comparison values include *environmental media evaluation guides* (EMEGs), *reference dose media evaluation guides* (RMEGs), and *cancer risk evaluation guides* (CREGs). Comparison values are established for child and adult exposures. When both types are available, values for children are referenced, because they are lower than the values for adults. CREGs, if established, are listed because these values are much lower than EMEGs or RMEGs (ATSDR, unpublished data, 2004).

The EPA guidelines (comparison values) have been developed for noncancer effects and cancer effects, if applicable. These are denoted by an "nc" for noncancer effect, and "ca" for cancer effect [5,6]. Appendix C lists the definitions of the ATSDR comparison values and EPA guidelines (referred to collectively as *comparison values* [CVs] in this report).

Soil

Soil samples were collected from all 12 properties that participated in the EI. The sampling teams attempted to collect samples during the pre- and post-spray seasons (February and November) from each property. However, this was not always possible because every property resident was not available during both sampling periods. Interim samples during the spray season were collected from three properties. They were collected in April from Location 9 because the property owner alleged recent pesticide drift from an adjacent nursery field during the site visit. April samples were also collected from Location 12 because the property owner had not been available during the preseason baseline sampling, and also alleged recent pesticide drift from an adjacent nursery field. Interim samples were collected in June from Location 2 for better analysis of elevated concentrations of banned organochlorine pesticides that were detected in preseason samples. Table 2 shows the months during 2003 when composite soil samples were collected from each property.

Table 2. Months Composite Soil Samples Were Collected From Locations 1–12, Carpenter Lane Community; 2003

Sampling Period	Location											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Preseason (February)	x	x	x	x	x	x	x	x	x	x		
April									x			x
June		x										
Post-season (November)	x			x		x	x	x	x		x	x

Heavy Metals

Table 3 summarizes the results of the heavy metal analyses for Locations 1–12. The highest concentration detected is listed if heavy metal analysis was conducted for more than one composite sample from the same property. Typical background levels for this region of the country are provided for comparison [7].

Table 3. Highest Heavy Metal Concentrations in ppm Detected in Composite Soil Samples from Locations 1–12 and Typical Regional Background Levels, Carpenter Lane Community; 2003

Metal (ppm)	Location												Typical Regional Background Levels
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
Arsenic	ND	ND	ND	5.7	7	5.8	ND	7.8	8.4	ND	5.1	6.7	5.4-6.3
Copper	23.8	19.1	22	25.2	18.7	21.6	16.8	22.2	17.8	12.1	23.3	48	34.7-44.1
Lead	15	11	10	12	11	15	12	11	12	13	28.1	13	16.6-19.8
Mercury	0.0503	ND	0.0513	ND	0.0551	0.054	0.0674	0.0585	ND	ND	ND	ND	0.129-0.147

ND = not detected

Targeted Compounds

Concentrations of the targeted pesticides and phenol are listed in Table 4 along with ATSDR comparison values (child EMEGs or RMEGs). All comparison values are for noncancer health effects because none of the compounds listed have been identified as carcinogenic (ATSDR, unpublished data, 2004). The highest concentration that was detected for each compound is listed in Table 4. Table 5 shows the months when samples were collected from each property where at least one target pesticide was detected, along with the concentrations detected in each composite sample. Only the preseason (February) samples were analyzed for phenol; those results are only shown in Table 4.

Table 4. Highest Concentrations in ppm of Targeted Pesticides and Phenol[*] Detected in Composite Soil Samples for Locations 1–12, Carpenter Lane Community; 2003

Compound (ppm)	Location												ATSDR Comparison Value
	1	2	3	4	5	6	7	8	9	10	11	12	
2,4-D	ND	0.17	0.067	ND	0.021	ND	ND	ND	ND	0.027	ND	ND	6,900
Carbaryl	ND	0.0053	0.019	0.021	ND	ND	ND	0.0039	ND	ND	ND	ND	5,000
Chlorothalonil	ND	ND	ND	0.0013	ND	ND	ND	ND	ND	ND	ND	ND	800
Chlorpyrifos	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	50
Diazinon	ND	ND	0.0047	0.02	ND	ND	3.4	ND	ND	ND	ND	ND	10
Isoxaben	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	31,000[†]
Triclopyr	ND	ND	0.041	ND	ND	ND	ND	ND	ND	ND	ND	ND	none
Phenol[*]	ND	0.02	ND	0.017	0.01	0.02	0.0073	0.024	0.0097	0.013	NA	NA	20,000

[*] Phenol is a substance in many consumer products [13]; only February samples were analyzed for phenol
[†] EPA Region 9 PRG
ND = not detected; NA = not analyzed

Table 5. Concentration of Target Pesticide Detected in Composite Soil Samples from Locations 2–10 and Months Samples Were Collected, Carpenter Lane Community; 2003

Pesticide (ppm)	Location								
	2*	3*	4[†]	5*	6[†]	7[‡]	8[†]	9[§]	10*
2,4-D	0.17	0.067	ND	0.021	0.0038	ND	ND	ND	0.027
Carbaryl	0.0053	0.019	0.021	ND	ND	ND	0.0039	ND	ND
Chlorothalonil	ND	ND	0.0013	ND	ND	ND	ND	ND	ND
Diazinon	ND	0.0047	0.02	ND	ND	3.4	ND	ND	ND
Triclopyr	ND	0.041	ND	ND	ND	ND	ND	ND	ND

* Samples collected in February 2003, only.
[†] Samples collected in February and November 2003; pesticides only detected in **February** sampling.
[‡] Samples collected in February and November 2003; pesticide only detected in **Novembe**r sampling.
[§] Samples collected in February, April, and November 2003.
ND = not detected

Non-Targeted Compounds

Non-targeted compounds were also identified in several soil samples during screening. These include pesticides and other compounds that are currently used, plus several organochlorine pesticides that were banned several years ago. As discussed in the "Analyses" section of this report (p. 4), the results for non-targeted compounds are estimates because the analytical methods used for non-targeted compounds are less precise those used for targeted compounds. These estimated results are summarized in Tables 6–8.

Table 6 summarizes the estimated concentrations of the current-use, non-targeted compounds that were detected in composite soil samples collected from Locations 1–12. The available ATSDR comparison values (EMEG or RMEG) for children are provided (ATSDR, unpublished data, 2004). The highest value is listed if a pesticide was detected in more than one sample from the same property. 2,6-Dichlorobenzonitrile, simazine, and trifluralin were detected in samples from more than one sampling period for Locations 4, 6, 7, and 9. Table 7 lists the estimated concentrations of these pesticides and months the samples were collected.

Table 6. Highest Estimated Concentrations in ppm of Current-Use, Non-Targeted Compounds Detected in Composite Soil Samples from Locations 1–12—Carpenter Lane Community; 2003

Pesticide (ppm)	Location												ATSDR Comparison Values
	1	2	3	4	5	6	7	8	9	10	11	12	
Atrazine	ND	ND	ND	ND	ND	ND	ND	ND	0.016	ND	ND	ND	3*
1,2-Dichloro-4-isocyanatobenzene	ND	ND	0.15	ND	ND	ND	ND	ND	0.088	ND	ND	ND	none
2,6-Dichlorobenzonitrile	ND	ND	ND	0.22	ND	0.028	0.11	ND	0.099	ND	ND	ND	none
Dinoseb	ND	0.045	0.018	ND	ND	ND	ND	ND	ND	ND	ND	ND	50
Endosulfan Sulfate	ND	0.022	0.023	ND	ND	ND	ND	ND	ND	ND	ND	ND	100
Eptam (EPTC)	ND	ND	ND	ND	ND	ND	ND	0.003	ND	ND	ND	ND	3*
Fonophos	ND	0.017	0.014	ND	ND	ND	ND	ND	ND	ND	ND	ND	100
Lindane ‡	ND	0.017	ND	ND	ND	ND	ND	ND	0.007	ND	ND	ND	0.4*
MCPA	ND	ND	ND	0.5	ND	ND	ND	ND	ND	ND	ND	ND	61
MCPP	ND	ND	ND	0.13	ND	ND	ND	ND	ND	ND	ND	ND	5†
Napropamide	ND	0.033	0.027		ND	ND	ND	0.015	ND	ND	ND	ND	61,000†
Pentachlorophenol§	ND	ND	ND	ND	ND	0.1	ND	ND	ND	ND	ND	ND	6*
Pentachloroanisol¶	ND	ND	ND	ND	ND	0.013	ND	ND	ND	ND	ND	ND	¶
2,3,4,5-Tetrachlorophenol¶	ND	ND	ND	ND	ND	0.0045	ND	ND	ND	ND	ND	ND	¶
Simazine	ND	ND	ND	ND	ND	ND	ND	ND	0.016	ND	ND	ND	300
Terbacil	ND	ND	0.004	ND	ND	ND	ND	ND	ND	ND	ND	ND	700
Trifluralin	ND	0.01	0.075	0.44	ND	ND	0.093	ND	ND	ND	0.0004	ND	90*

ND = not detected; none = ATSDR or EPA comparison values have not been established

* cancer risk evaluation guide (CREG)

† EPA Region 9 preliminary remediation goal (PRG)

‡ Lindane, a persistent organochlorine, is not used as an agricultural pesticide, but may still be used as a pest control agent for animals, but is severely restricted [8]

§ Pentachlorophenol was commonly used as a wood preservative, and most likely is residual from fence posts or other treated wood [9]

¶ Pentachloroanisol and 2,3,4,5-tetrachlorophenol are metabolites of pentachlorophenol [9]

Table 7. Estimated Soil Concentrations in ppm of 2,6-Dichlorobenzonitrile, Simazine, and Trifluralin for Locations 4, 6, 7, and 9 and the Months When Samples Were Collected—Carpenter Lane Community; 2003

Pesticide (ppm)	Location 4		Location 6		Location 7		Location 9		
	Feb	Nov	Feb	Nov	Feb	Nov	Feb	Apr	Nov
2,6-dichlorobenzonitrile	0.22	0.12	0.28	0.01	0.47	0.11	0.01	0.099	ND
Simazine	ND	ND	ND	ND	ND	ND	0.012	0.016	0.0099
Trifluralin	1.6	0.44	ND	ND	ND	ND	ND	ND	ND

ND = not detected

Table 8 shows the estimated concentrations of banned organochlorine pesticides detected in composite soil samples collected from Locations 1–12. The highest value is listed if a pesticide was detected in more than one sample from the same property. ATSDR comparison values (EMEG and CREG) are provided. Values that exceed a comparison values are **bolded.**

Table 8. Estimated Concentrations in ppm of Banned, Persistent, Organochlorine Pesticides Detected in Composite Soil Samples from Locations 1–12—Carpenter Lane Community; 2003

Pesticide (ppm)	Location												ATSDR	
	1	2	3	4	5	6	7	8	9	10	11	12	EMEG	CREG
Chlordane, technical grade	ND	0.11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	30	2
Chlordane, Alpha*	ND	ND	ND	0.003	ND	ND	0.003	0.0023	ND	ND	ND	ND	30	2
Chlordane, Gamma*	ND	0.25	ND	0.002	ND	ND	0.001	0.003	ND	ND	ND	ND	30	2
Nonachlor, - Cis*	ND	0.11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	30	2
Nonachlor, - Trans*	ND	0.25	ND	ND	ND	ND	0.002	0.001	ND	ND	ND	ND	30	2
Dieldrin	**0.11**	ND	0.026	ND	ND	ND	0.023	**0.11**	**0.19**		0.023	0.029	3	**0.04**
Heptachlor*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3	0.2
Heptachlor Epoxide*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.7 †	0.08
O,P'-DDD‡	0.008	ND	0.015	ND	ND	ND	0.004	0.009	ND	ND	ND	ND	30	3
O,P'-DDE‡	0.002	ND	0.013	ND	ND	ND	ND	0.006	ND	ND	ND	ND	30	2
O,P'-DDT	0.028	0.026	0.019	ND	ND	ND	ND	0.1	0.008	ND	ND	ND	30	2
P,P'-DDD‡	0.019	0.009	0.039	0.005	ND	ND	0.011	0.1	0.048	ND	0.038	0.007	30	3
P,P'-DDE‡	0.21	0.014	0.52	0.01	0.012	0.007	0.036	0.37	0.74	ND	0.029	0.047	30	2
P,P'-DDT	0.15	0.15	0.98	0.018	0.023	0.015	ND	0.57	0.75	ND	0.13	0.086	30	2
Dichlorobenzo-Phenone‡	0.011	0.031	0.059	ND	ND	ND	ND	0.007	ND	ND	ND	ND	‡	‡

ND = not detected
* Components of technical chlordane
† reference dose media evaluation guides (RMEG)
‡ DDT metabolites

Technical grade chlordane, along with several compounds that make up technical grade chlordane (alpha chlordane, gamma chlordane, and cis- and trans-nonachlor, heptachlor) were detected in the preseason (February) soil samples from Location 2. DDT and several metabolites were also detected. Because of those, additional surface and subsurface soil samples were collected from Location 2 in June. The analyses for those samples treated DDT analogues, chlordane and dieldrin as target pesticides to provide more accurate analysis than the initial screen that identified those compounds. Table 9 shows the results of the June sample collection, along with the estimated results from the samples collected in February. The values that exceed the CREGs are **bolded**. EMEGs are included for comparison, but were not exceeded (ATSDR, unpublished data, 2004).

Table 9. Concentrations of Banned Organochlorine Pesticide in ppm Detected in Surface and Subsurface Soil Samples Collected in February and June from Location 2—Carpenter Lane Community; 2003

Analyte (ppm)	Surface soil		Subsurface soil	ATSDR EMEG	ATSDR CREG
	2/27/03 (estimated)	6/4/03	6/4/03		
Chlordane, Technical grade	0.11	**2.3 / 9.7**	ND	30	**2**
Chlordane, Alpha*	ND	0.58	0.15	30	2
Chlordane, Gamma*	0.25	0.15 / 0.59	ND	30	2
Nonachlor, -Cis*	0.11	ND	ND	30	2
Nonachlor, Trans*	0.25	ND	ND	30	2
Dieldrin	ND	**0.52**	**0.82**	3	**0.04**
Heptachlor*	ND	0.023	ND	3	0.2
Heptachlor Epoxide*	ND	0.056	ND	0.7†	0.08
O,P'-DDT	0.026	ND	ND	30	3
P,P'-DDD‡	0.0088	0.0023	ND	30	3
P,P'-DDE‡	0.14	0.26	0.082	30	2
P,P'-DDT	0.15	0.22	0.12	30	2
Dichlorobenzo-phenone‡	0.31	ND	ND	‡	‡
Toxaphene	ND	**1.7**	**2.2**	50	**0.6**

ND = compound was not detected
* Components of technical grade chlordane
† reference dose media evaluation guide (RMEG)
‡ DDT metablites

Vegetation

Five composite vegetation samples were collected from four different properties (Locations 1, 2, 5, and 9). Table 10 shows the months during which samples were collected from these properties. One sample was collected from Location 9 during the preseason site visit (February) because pesticides were observed being applied in an adjacent field at the time of the visit. Samples were collected in April from Locations 1, 5, and 9 because the residents reported evidence of pesticide drift. Samples were collected from Location 2 in April as part of a follow-up regarding the elevated banned organochlorine pesticides that were detected in baseline soil samples. The OEA sampling team saw no evidence of a drift pattern on the vegetation on any of these properties.

Table 10. Months and Locations Where Vegetation Samples Were Collected – Carpenter Lane Community; 2003

Month Sample Collected	Location			
	1	2	5	9
February				x
April	x	x	x	x

No targeted compounds were detected in any of the vegetation samples. No non-targeted pesticides were identified during screening.

Water

Water samples were collected from five different properties. These included surface samples from Locations 6, 8, 10, and 11, and well water samples from Location 1. None of these water sources were being used for drinking water.

Table 11. Months and Locations Where Water Samples Were Collected—Carpenter Lane Community; 2003

Month Sample Collected	Location				
	1	6	8	10	11
February	x	x	x	x	
April	x	x	x		x
November	x	x	x		

Samples were collected during the pre- and post-spraying seasons (February and November) and during the spray season (April) for Locations 1, 6, and 8. Only a preseason sample was collected from Location 10, and only an April sample was collected from Location 11 because the sampling team was unable to reach the property owner/resident during the other sampling periods.

No targeted pesticides or petroleum hydrocarbons were detected in any of the water samples.

The results for heavy metals and non-targeted compounds in parts per billion are provided in Table 12. The heavy metals were targeted compounds; results for those are actual values (did not require a qualifier). The results for the non-targeted pesticides, however, are estimates because the analytical methods used for non-targeted compounds are less precise those used for targeted compounds. The ATSDR comparison values (EMEGS or RMEGS) for drinking water are included for perspective only, because these water sources are not used for drinking or other household use.

Table 12. Concentrations of Heavy Metals and Nitrates/Nitrites and Estimated Concentrations of Non-Target Pesticides in ppb in Water Samples from Locations 1, 6, 8, 10, 11, and Months When Samples Collected—Carpenter Lane Community; 2003

Analyte	Location 1			Location 6			Location 8			Location 10	Location 11	ATSDR EMEG or RMEG (ppb)
	Feb	*Apr*	*Nov*	*Feb*	*Apr*	*Nov*	*Feb*	*Apr*	*Nov*	*Feb*	*Apr*	
Heavy Metals and Nitrates/Nitrites (in ppb)												
Arsenic	0.11	NA	2.1	0.11	NA	0.47	ND	NA	0.65	ND	NA	3
Copper	ND	NA	20.1	ND	NA	ND	1	NA	ND	ND	NA	200
Lead*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	none
Nitrate + nitrite	7,680	NA	NA	3,870	NA	NA	3,760	NA	NA	5040	NA	10,000
Pesticides (in ppb)												
Atrazine	0.0051	ND	ND	0.11	ND	0.055	0.01	ND	ND	0.008	ND	3
2,6-dichlorobenzamide	ND	ND	ND	0.13	ND	ND	0.15	ND	ND	0.19	ND	none
1,2-dichloro-4-isocyanato- benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.23	ND	none
2,6-dichloro-benzonitrile	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.022	ND	none
alpha-Chlordane	0.0044	ND	ND	ND	ND	ND	ND	ND	ND	0.001	ND	0.1
Diphenamid	0.002	ND	ND	0.009	ND	ND	0.008	ND	ND	ND	ND	0.1
Gamma-Chlordane	0.0019	ND	ND	ND	ND	ND	ND	ND	ND	0.001	ND	0.1
Metolachlor	0.049	ND	0.09	0.28	0.23	0.14	ND	ND	0.09	0.021	0.18	3
Oxydiazon	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.19	ND	100
P,P'-DDE	0.0025	ND	ND	0.002	ND	ND	0.002	ND	ND	0.0007	ND	50
Simazine	ND	ND	ND	0.032	ND	0.063	0.016	ND	ND	0.027	ND	0.1
trans-Nonachlor	0.0025	ND	ND	0.002	ND	ND	ND	ND	ND	ND	ND	4
Trifluralin	0.0038	ND	ND	0.0013	ND	0.14	ND	ND	ND	ND	ND	5

* Lead analysis was not conducted because of a laboratory oversight
NA = not analyzed; ND = not detected

Swabs

Swab samples were collected from all 12 participating properties. Each sample consisted of two moistened swabs that were used to wipe a surface approximately 100 square centimeters in area. Table 13 shows the number of samples and months when samples were collected from each property. Preseason samples (February) were collected from 11 of the 12 properties. Post-season (November) samples were collected from 5 of those 11 properties. The spray season samples collected from Locations 7 and 11 were in response to the property owners' complaints of alleged spray drift from a neighboring nursery field. The sampling team did not observe any evidence of drift when they collected these swab samples (EPA, unpublished report, 2004).

Table 13. Number of Swab Samples and Months When Samples Collected From Locations 1–12—Carpenter Lane Community; 2003

Sampling Period	Location											
	1	2	3	4	5	6	7	8	9	10	11	12
Preseason (Feb)	1	1	1	1	1	1	1	1	1	1		1
June							1				2*	
July	1	1	1				1	1	1			
Post-season baseline (Nov)	1			1		1	1		1			

* one on June 4 and one on June 12

Carbaryl and chlorpyrifos were detected on one property: Location 8. These were detected in the February sample only at levels of 8.6 µg and 2.8 µg, respectively. No target pesticides were detected in any other samples. The swab samples were only analyzed for the targeted pesticides—a screen for non-target pesticides was not done.

Air

The sampling team collected 24-hour ambient air samples from eight different properties (Locations 1–3 and 5–9). Although air samples were collected during periods when pesticides are typically applied in the CL area, specific dates for sampling had to be scheduled according to the availability of the air sampling equipment and the sampling team. The team collected as many air samples as possible. No spraying was observed by the team on adjacent nursery properties during air sampling. Table 14 shows the number of samples and months when samples were collected from each of these eight properties.

Table 14. Month, Location, and Number of 24-Hour Air Samples Collected From Locations 1–3 and 5–9—Carpenter Lane Community; 2003

Sampling Month	Location							
	1	2	3	5	6	7	8	9
June	2	2	1	1	2			2
July	1	1	1			1	1	1

Samples from June and July were analyzed for the targeted pesticides. No targeted pesticides were detected in any of the air samples. Samples collected in June were also screened for non-target pesticides. These non-target pesticides are listed in Appendix D. No non-targeted pesticides were detected in any of the June air samples.

Limitations

A major limitation for this EI was that most of the environmental sampling was scheduled according to the availability of OEA sampling staff (and air sampling equipment). As a result, most of the sampling results were essentially semi-random “snapshots in time.” They

do not fully represent what may have been happening on residential properties at or near the times when pesticides were applied in nearby fields. This was especially limiting during air sampling, because the window of time when the instruments can capture airborne drift is closely associated to when a pesticide is applied.

A second limitation was the selection of the target pesticides for the analyses of environmental samples. Target pesticides for this EI were not based on recent pesticide application information from nearby nurseries. ATSDR was not able to obtain that information. Instead, the selection of target pesticides was based on available records from area nurseries for 1995–1996. Nurseries do not necessarily use the same pesticides in the same field year after year because of crop rotation, changes in predominant pests, weather conditions, new products, etc. Therefore, the target pesticides that were selected may not have been the pesticides that were predominantly used by nurseries before and during the sampling periods.

Interpretation of the results of residual pesticides detected in soil, vegetation, water, and swab samples was also limited by lack of information about which pesticides had been applied, concentrations used, application methods and locations, and dates of application. As a result, many of the pesticide levels could only be interpreted in reference to when the sample was actually collected. Lacking information about initial concentrations and how many half-lives had occurred, we could not estimate what the concentration ranges may have been for a given pesticide when it first settled in a particular location.

The many potential sources from which pesticide drift could originate further complicated efforts to determine the source of pesticide drift. The ornamental nurseries named by community members who requested ATSDR assistance in 2000 are potential origins of pesticide drift. However, other nurseries in the CL area, other agricultural operations in the area, some property residents, and the county (for roadway pest management) also use pesticides. These are also potential origins of pesticides that were detected on residential properties during this EI.

Discussion

Important information for interpreting the significance of any pesticides detected on a property includes knowing what pesticides were used by the property residents. The EPA OEA sampling team questioned the residents about current or previous pesticide use on their property when the samples were collected. Their responses were recorded in the field record. Once the environmental sampling results were received, ATSDR contacted residents by telephone to verify what they had originally reported to OEA. Appendix E lists the pesticides that residents reported using on their property at the time of sampling, along with the information they provided to ATSDR during the follow-up contact.

Knowing the typical use of a pesticide that was detected on residential property is also useful information. Appendix F lists several of the currently used pesticides that were detected on residential properties. It also describes typical uses by the general public and local ornamental nurseries for those pesticides. Of the listed pesticides, napropamide and simazine are commonly used by area nurseries, but not by the general public. However, they are all

general use pesticides and are readily available to the general public. Trifluralin, the pesticide most frequently detected on residential properties during this EI, is not typically used in nursery fields. Although its use was not reported by any of the participants in this EI, it is a common component of homeowner landscape herbicides.

Pesticides (herbicides) that were used by the county for roadway maintenance in the CL area in 2002 and 2003 included Roundup Pro® (glyphosate), Oust® (sulfometuron methyl), and Garlon® 3A (triclopyr). Triclopyr, a targeted herbicide, was last used in the CL area in August 2002 for spot spraying noxious weeds [10]. The other two herbicides were not detected.

Soil

Current-Use Pesticides (Target and Non-Target)

Six of the seven targeted pesticides for soil were detected during this EI. At least one of these six targeted pesticides was detected on nine of the12 participating properties. In addition, one or more of 14 currently-used, non-targeted pesticides were detected on eight properties. Of these pesticides, two (napropamide and simazine) are commonly used by ornamental nurseries in the area, but not by the general public. The remaining pesticides that were detected are not commonly used by nurseries, but are used commonly by the general public, are commonly used by nurseries and the general public, or are not commonly used by either the nurseries or the general public.

Two property owners reported having used a targeted pesticide. These were 2,4-D (Location 4) and triclopyr (Location 8). The pesticides were not detected on the property where they were used, but were detected on some other properties that participated in the EI. However, these properties are not located adjacent to or in close proximity to the property where the pesticide was used. Triclopyr was used by the county in Aug of 2002. However, it was used only for spot treatment at least 5 months before sample collection, making it an unlikely source.

Two property owners (Locations 9 and 12) alleged recent pesticide drift during the April interim site visit. No targeted pesticides were detected in soil samples collected from either of those properties at that time. However, non-target pesticides were detected in samples from Location 9—atrazine, dichlobenil, and simazine. Of these, simazine tends to be commonly used by ornamental nurseries, but not atrazine or dichlobenil. No pesticides were detected in the samples collected from Location 12.

Trifluralin, a pesticide commonly used by the general public, but not by area ornamental nurseries, was detected on five properties. No property owners reported having used that pesticide.

Dichlobenil, commonly used by the general public, but not by ornamental nurseries, was detected on four properties. The owner of one of these properties had reported using dichlobenil (Location 7). However, the residents of the other three properties where it was

detected did not report using it. Because these properties are not adjacent to or in close proximity to Location 7, that property does not appear to be a likely source for the pesticides.

The levels of the detected targeted pesticides (and phenol) detected in residential soil were well below established comparison values at the time the samples were collected. In fact, most are several orders of magnitude below the comparison values. The exception is triclopry, for which no comparison value has been established. However, it has a low toxicity profile, so health effects from exposure to the 0.041 ppm found on Location 3 would be unlikely [11].

The soil levels of non-targeted pesticides detected on residential property were well below their comparison values at the time the samples were collected. No comparison value has been established for dichlobenil. However, because it has a very low toxicity profile, the levels of dichlobenil detected in the soil (0.028–0.22 ppm), or its metabolite, 1,2-dichloro-4-isocyanatobenzene (0.088–0.15 ppm) would be unlikely to cause health effects [12].

The soil sampling results do not suggest a likely source for any of the pesticides that were detected on residential property. Overall, soil levels of targeted pesticides and estimated levels of non-targeted, currently-used pesticides were very low, much lower than their most conservative health-based comparison value, such as the ATSDR CREG or EMEG for children. However, because essential information, such as the concentration of a pesticide and approximate date and location of application is not available, we do not know how much a pesticide may have degraded by the time soil samples were collected. Therefore, a definitive assessment of exposure and health hazard cannot be made.

Banned Organochlorine Pesticides

At least one banned organochlorine pesticide was detected on 11 of the 12 properties involved in this EI. Banned pesticides refer to pesticides for which the EPA has cancelled the registration because unacceptable risk existed that could not be reduced by other actions such as voluntary cancellation of selected uses or changes in the way the pesticide is used. The EPA maintains a list of banned, as well as severely restricted pesticides [13]. The presence of banned organochlorine pesticides in soil is not an unusual finding for an area whose extensive agricultural history predates the cancellation of those pesticides. Organochlorine pesticides, such as chlordane and DDT, were used extensively in the past in agriculture, as well as in gardens, yards, and in the home. One of the main reasons these pesticides were banned from use was because of their persistence in the environment [14,15,16,17]. On the basis of degradation rates and past uses of these pesticides, the residual soil levels detected on these properties, including Location 2, are consistent with past, legal use [14–17].

The levels of these many of the banned organochlorine pesticides were well below ATSDR health-based comparison values. The exceptions included chlordane, dieldrin, and toxaphene detected in soil samples from Location 2, where levels exceeded the CREGs. Dieldrin was also mildly elevated above the CREG in three other properties. No EMEGS were exceeded. Careful evaluation of those pesticide levels by an ATSDR toxicologist determined that no

apparent excess cancer risk was likely to result from soil exposure at these levels of contamination (Appendix G).

Simple precautions to minimize exposure to those pesticides, as well as other potential soil contaminants, are always good preventive practices. These precautions include good hand washing after working in the garden or yard, thoroughly washing all garden-grown produce, removing shoes worn during garden or yard work before entering the house, and maintaining soil cover, such as grass, on children's primary outdoor play areas.

Heavy Metals

Most, but not all, of the heavy metals detected in soil samples were within the range for typical regional background levels. Arsenic levels from several properties exceed typical background levels. However, those levels do not represent an increased health risk over the typical background levels when exposure doses are calculated using established ATSDR methods [18]. The lead level from Location 11 and the copper level on Location 12 also exceed the typical background levels. Both of these levels are well below ATSDR or EPA Region 9 comparison values, and are not a health hazard. The ATSDR intermediate EMEG for a child for copper is 1,000 ppm (ATSDR, unpublished data, 2004). The EPA Region 9 PRG for lead is 400 ppm [6].

Vegetation

No targeted or non-targeted pesticides were detected in any of the vegetation samples that were collected from Location 1, 2, 5, and 9. Samples from Locations 1, 5, and 9 were collected in response to allegations of suspected pesticide drift at or near the time of sample collection. Therefore, these results do not provide evidence to support the occurrence of pesticide drift on those properties at that time.

Water

Pesticide and nitrate/nitrite contamination of surface or ground water in agricultural areas is quite common. None of the targeted pesticides were detected in any of the water samples. Estimated levels of non-targeted pesticides were very low. In fact, the estimated levels were below federal drinking water standards. Although these levels are estimates, the results suggest that surface or ground water pesticide contamination in the CL area is minimal. Results for copper, arsenic, and nitrate-nitrites were also below drinking water standards.

Swabs

Swab samples were only analyzed for targeted pesticides. Because we do not know if the pesticides that were used near residential properties are part of that panel of targeted pesticides, the possible presence of non-targeted pesticides cannot be excluded.

Two targeted pesticides, carbaryl and chlorpyrifos were detected in swab samples collected from Location 8 during pre-spray season sampling in February. Soil samples collected during

the same sampling period yielded carbaryl, but not chlorpyrifos. Neither of these pesticides is typically used by nurseries during the winter months. Neither pesticide was among those the homeowner reported using nor was either pesticide among those reportedly used by adjacent neighbors.

Carbaryl and chlorpyrifos were not detected in swab samples collected from Location 8 during July sampling, which are periods when ornamental nurseries tend to use these pesticides. On the basis of available information, there is no likely explanation as to the origin of carbaryl and chlorpyrifos detected in the swab samples from Location 8.

The standard technique for collecting swab or wipe samples is inherently imprecise. Studies have shown that for a given compound, there is no relationship between the concentration detected from a surface swab sample and the concentration detected in an air sample. [19,20]. Because there is no accurate way of estimating human exposure from a swab sample, a health threat cannot be assessed from swab sample results.

Air

None of the targeted pesticides nor any of the non-targeted pesticides included in screening Method 8085 were detected in any of the 24-hour ambient air samples. However, screening methods for non-targeted compounds are not as precise, and do not involve the same quality control measures, as the analytical methods for targeted compounds. Most significantly, because no spraying was observed during the air sampling periods, these data do not provide information regarding the potential for pesticide drift during pesticide applications.

Conclusions

1. Data from this EI suggest that there may have been some degree of pesticide spray drift onto some residential properties. However, these data are insufficient to identify any specific source of pesticide spray drift. Pesticides could have originated from a number of potential sources. These include local nurseries, other agricultural operations, county roadside maintenance practices, and other residential property owners. In addition, it is possible that the resident of the property where a pesticide was detected unknowingly used a product that contained the detected pesticide(s).
2. ATSDR concludes that community exposure to pesticide spray drift is an indeterminate public health hazard for the following reasons:
    a. At the time the samples were collected, the concentrations of pesticides detected in soil were unlikely to pose a health hazard to residents. However, essential information, such as the original concentration of the pesticide, and location and date of application, is missing or incomplete. That prevents us from making a definitive assessment of health hazards associated with currently used pesticides detected in residential soil.
    b. Because no spraying occurred during air sampling, it is not possible to assess potential health hazards from airborne pesticide exposures.
3. Exposure to surface or ground water sources tested during this EI does not pose a health hazard from the compounds included in the analysis.
4. The concentrations of the banned organochlorine pesticides detected in soil, including from Location 2, are unlikely to pose a health hazard.

Recommendations

Follow-up efforts to this EI should focus on minimizing the potential for pesticide spray drift, improving understanding and communication between the community and area nurseries, and providing education about pesticides to community members and health care providers.

1. ATSDR recommends that ATSDR, ODHS, ODA, and EPA Region 10 work together to ensure that the following activities take place within 6 months of the release of this report:
    a. A round-table forum (facilitated and funded by the Pacific Northwest Pollution Prevention Resource Center, based in Seattle, Washington) for peer-to-peer discussion and information exchange among local ornamental nurseries to develop strategies that target the following issues:
        i. Pest management practices that reduce reliance on pesticides
        ii. Pesticide application practices that prevent or minimize the potential for pesticide spray drift
        iii. Community concerns regarding pesticide spray drift
        iv. Improved community relations

v. Enhanced community understanding about pesticide pest management practices, including pesticide application techniques and practices that have been implemented to prevent pesticide spray drift

b. A follow-up evaluation should be completed in 1 year to determine which strategies identified at the forum have been implemented by the participating nurseries.

c. Education for the community that covers the following:

i. Behaviors to minimize or prevent exposures to pesticides in general, including precautions to minimize exposures from residual pesticides or other potential soil contaminants

ii. Actions to take if pesticide exposure from drift or other sources is suspected and what local resources are available

iii. Common pest management practices (pesticide and non-pesticide) used by area nurseries

iv. State and federal regulations on pesticide application practices

d. Education on pesticides for community health care providers (HCPs), provided through the American College of Medical Toxicologists affiliated with Oregon State University.

i. HCPs for the community should be surveyed to determine what pesticide-related topics they want included in the educational program.

ii. Information about communication requirements with state agencies regarding pesticide exposures should be included.

2. Nursery and other agricultural operation owners should ensure that all pesticide applicators, including non-certified applicators, are sufficiently trained to safely apply pesticides and understand the potential health effects of pesticide exposure to others, as well as to self.

Public Health Action Plan

Actions Undertaken

- The Pacific Northwest Pollution Prevention Resource Center is working with EPA, ATSDR, and the Oregon Association of Nurseries to organize and implement the forum with the Carpenter Lane area nurseries. The forum is planned for late May 2005.
- The findings of the EI will be presented at the forum and the EI report will be distributed to attendees.

Actions Underway

- Facts sheets will be developed by ATSDR and ODHS, with assistance from EPA and ODA and will be distributed at the community meeting and information session planned for June 14, 2005.
- Issues addressed in the fact sheets will also be covered in the presentation of the EI results during that meeting.

Actions Planned

- The education program on pesticides for community Health Care Providers (HCPs) will be provided by Dr. Daniel Sudakin, MD, MPH, FACMT, FACOEM, Assistant Professor, Department of Environmental and Molecular Toxicology
  Oregon State University, Corvallis, OR. ATSDR, with assistance from ODHS, will develop surveys for HCPs to elicit their input for the program content. During the June meeting the surveys will be provided to community members, with instruction asking them to send the surveys to their HCP.
- The HCP education program is anticipated to be given within 3 months of the community meeting scheduled for June 2005.
- ATSDR will work with the appropriate entities to ensure a follow-up evaluation is completed regarding implementation by nurseries of strategies identified at the forum.

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Appendix A: Exposure Investigation Protocol

Exposure Investigation Protocol
Carpenter Lane, Multnomah County, Oregon
Pesticide Sampling at Residences Near Commercial Nurseries

January 2, 2003

Agency for Toxic Substances and Disease Registry
Division of
Health Assessment and Consultation

Rationale

One of the recommendations made in the recent (2002) health consultation for pesticide concerns at the Carpenter Lane site was to conduct seasonal environmental sampling and analysis to help better assess the possibility of off-site pesticide movement or drift from commercial ornamental nurseries in the area. [1] This sampling and analysis will help in an effort to determine if local pesticide movement is impacting neighboring properties.

Background

The Carpenter Lane site is a group of properties, commercial ornamental nurseries and residential and farm properties, which lie along Carpenter Lane in Multnomah county, Oregon. There are several large and small nurseries in and around the Carpenter Lane area. It is not uncommon for a residence to be adjacent to a nursery field. The climate in western Oregon allows for an 8- to 9-month growing season, which leads to some form of pesticide use by the ornamental plant industry in almost every month of the year. [2].

ATSDR Involvement
In late 2000, the U.S. Environmental Protection Agency (EPA), Region 10 Pesticides Unit referred a group of concerned community members to the Agency for Toxic Substances and Disease Registry (ATSDR) for assistance in determining if pesticides and other chemicals applied on area ornamental plant nursery fields could be impacting human health or the health of animals living nearby. Since this referral, one of the community members has requested ATSDR to investigate if community health concerns could be related to exposures to pesticides and other chemicals. The location where the largest number of concerns/complaints occurs is on and around Carpenter Lane southeast of Gresham, Multnomah County, Oregon.

The Oregon Department of Human Services (ODHS) and the Oregon Department of Agriculture (ODA), two of the eight agencies on the state's Pesticide Analytical and Response Center (PARC), have been documenting and responding to pesticide complaints from the Carpenter Lane area since early 1996. To date, no violations regarding pesticide applications/spray drift have been found [2]. Limited environmental sampling has been conducted for enforcement purposes to determine if pesticides drifted to residential properties. ATSDR, with assistance from EPA, ODHS, and ODA, agreed to review existing environmental data and pesticide/chemical toxicity information, and to gather community health concerns (and concerns for family pets and horses) to determine if exposures to pesticides have occurred or are occurring at levels of public health concern. [1]

In March of 2001, ATSDR requested assistance from the Region 10 EPA's Investigation and Engineering Unit of the Office of Environmental Assessment. The request focused on obtaining more information on the types and frequencies of pesticide spray drift complaints in the Carpenter Lane area. EPA gathered complaint record information from the ODA and ODHS. They also had informal interviews with a limited number of area residents and with the City of Gresham's Fire and Emergency Services. Concerns

expressed from residents are consistent with concerns expressed to ATSDR and other agencies. Fire and emergency services personnel reported that they have occasionally responded to reports of spray drift in the Carpenter Lane area. EPA investigators concluded that the information obtained in their initial effort was not sufficient to determine whether or not residents have been exposed to pesticide drift from local nurseries. [3]

A public availability session was held in August 2001 to gather additional information and to identify *community concerns*. Approximately 60 community members attended this session. About half of those attending had health-related concerns; the other half attended for informational purposes or to indicate that they had no concerns with area nursery operations. The following is a summary of community concerns. Some of these concerns were expressed by more than one community member.

General concerns:

- impact of pesticide application on private (residential) wells
- impact of pesticide application on ponds/surface water
- concerns over past applications of pesticides (aerial spraying)
- observation of equipment dripping/leaking while driving down the road
- concerns over other nurseries (not just the ones that we met with)
- observing spray drift noted while walking or jogging around the area
- concern over a pesticide applicator wearing dermal and respiratory equipment (Level C), while community members are standing 20 feet away in street cloths
- concern that community members are no longer notified prior to pesticide applications
- having to shut doors and windows due to pesticide application
- oily film on rain water that drips off of roof
- application of pesticides at night (smaller nursery)

Environmental Data
To date, six sampling events have been conducted by the ODA. These events were the result of pesticide spray drift complaints. In 1996, one soil sample from a nursery and 2 soil samples from an adjacent residential property were collected and analyzed for 2,4-D, triclopyr, 2,4,5-T, and paraquat. Results found 2,4-D and triclopyr on both the nursery property and the adjacent residential property. Low levels of paraquat were detected on the nursery property and in one of the soil samples on the adjacent property [4]. Results of this sampling are displayed in Table 1.

Table 1. Results of 1996 Oregon Department of Agriculture Soil Sampling Results [4]				
Soil Sample Location	2,4-D (ppm[+])	Triclopyr (ppm)	2,4,5-T (ppm)	Paraquat (ppm)
Nursery Property	12.41	5.36	ND[++]	0.18
Residential property, 1 to 2 feet from property line	1.73	0.72	ND	0.19
Residential property 5 feet from property line	0.22	0.10	ND	ND
[+]concentration in parts per million or ppm [++]not detected or ND; minimum detection limit for 2,4,5-T is 0.02 ppm, and for paraquat is 0.10 ppm				

The second sampling event occurred in May of 1997. Four leaf samples (each a different type of vegetation) were collected from the same residential property and analyzed for paraquat [5]. The residential property line was estimated to be 600 feet away from where paraquat had been applied approximately one week prior to the sampling event. Paraquat was detected at 0.04 ppm on one leaf sample; the other samples did not contain paraquat above the minimum detection limit (0.02 ppm) [5].

In July 1997, the ODA conducted a follow-up investigation for a pesticide spray drift complaint that occurred approximately one week prior [6]. This nursery application occurred approximately 400 to 600 feet from the resident's property line. One soil sample was taken from the treated area (nursery), one was collected from a property adjacent to the nursery site, and one was collected from the same property but closer to the complainant's property. Paraquat was detected on the nursery property at 0.91 ppm. It was not detected in any the two other samples (minimum detection limit 0.04 ppm). On the same day these samples were collected, a soil sample was collected from another nursery's field between where paraquat had been applied (in May) and the residential property line. Paraquat was not detected in this sample (less than 0.02 ppm) [6].

In July 1997, pre- and post-fungicide application samples were collected from plants that were adjacent to the area of application. Leaves were analyzed for triadimefon. The fungicide was not detected (minimum detection limit of 0.45 ppm) in any of the pre- or post-application samples [7].

In July 2000, foliage samples were collected from a resident's organic hay field and from an adjacent nursery field where Talstar (bifenthrin) had recently been applied. The two samples were analyzed for bifenthrin. The insecticide was found at 4.32 ppm on the nursery property foliage; it was not detected (minimum detection limit 0.03 ppm) on the hay field foliage [8].

The final sampling event by ODA occurred in August 2000. Samples of horse feed, hay (for horses), oats (for horses), water (for horses), and soil from a horse arena were collected. A wipe sample from the exterior of the horse barn was also collected. No analyses were specified for these samples; the chain of custody for the samples indicates

that analysis was placed on hold. In December/January (2000/2001), the horse arena soil sample and the wipe sample were screened for organophosphate, organochlorine, and carbamate compounds. None were found. No minimum detection limit was provided [9].

Investigators/Collaborators

ATSDR will work cooperatively with Region 10 EPA, Office of Environmental Assessment, the Oregon Health Division, and the Oregon Department of Agriculture to perform this exposure investigation.

Time Frame

Baseline sampling will be conducted during January 2003 and will entail the collection of samples from matrices such as surface and ground water, vegetation, soil, and air. Once the baseline is set, samples will be collected monthly from each of the participating residential properties located near Carpenter Lane between the first week of February and the last week of September. In October 2003 another set of samples will be collected from the locations sampled during the baseline in January.

Target Population

Environmental testing will be offered to residents of properties adjacent to commercial nurseries in the Carpenter Lane area. A total of 10 properties will be enrolled on a voluntary basis. ATSDR will recruit participants through both door-to-door and phone contact. Individuals may also contact ATSDR through the toll free 1-877-42ATSDR.

Methodology

Ten properties will be selected to participate in this exposure investigation. The locations of all sampling will be documented using global positioning system (GPS) equipment. At the conclusion of the investigation a set of maps showing sampling locations will be prepared, along with sampling dates and concurrent weather data.

Outdoor Ambient Air Sampling
Ambient air samples will be collected outdoors using low volume polyurethane foam sampling techniques. The Region 10 EPA, OEA will determine the methods for air sample analysis, the number of sampling stations and the distance they should be located from potential sources, the positioning of stations, and the duration of time air samples should be collected.

Surface Water and Ground Water Sampling
Surface water samples will be collected from ponds or creeks located in the area. Samples will also be collected from private wells to gather data about pesticides in ground water. The number of samples will be determined by the number of private wells identified.

Soil and Vegetation Sampling
Soil and vegetation samples will be collected at several locations on each property, with a particular focus on areas of potential contact (play areas, gardens, etc.) and along property lines adjacent to nurseries.

Indoor Air and Surface Sampling
Indoor air and surface sampling will be done primarily during the base line and conclusion phases of this study. Indoor air samples can be collected with and analyzed on filters through which a known volume of air is drawn with a hi-volume pump. Surface samples can be collected from non-porous or semi-porous surfaces such as interior glass windows, counter tops, and floors.

Consent Form

The adult who is currently the head of household (and the property owner, if different) will be required to sign an informed consent form in order to have sampling occur. Refer to the attachments for a copy of the consent form.

Quality Assurance/Quality Control

The EPA Region 10 office of Environmental Assessment (OEA) is developing a quality assurance project plan (QAPP) which will address sampling protocols, analytical methods, and quality assurance/quality control issues. The sampling plan will be based on available information such as historic pesticide use patterns, vegetation in the area, surveys of soil type, and other data such as depth and direction of ground water movement. Other considerations include meteorological patterns and topography.

OEA has reviewed a sample of pesticide application records for 1995 and 1996 from ornamental nurseries in the Carpenter Lane neighborhood. OEA has used this information to develop a database which includes pesticide application dates, product name(s), and application rates as expressed on the individual records. OEA will contact local transportation officials to determine if roadside pesticide applications are made as part of a vegetation control program. In addition, OEA will attempt to identify other sources of pesticide drift such as local homeowners, vector control programs, and industrial or agricultural users other than nurseries.

The QAPP will be developed by the Investigation and Engineering Unit in consultation with staff from the Risk Evaluation Unit and the Quality Assurance and Data Unit. A draft of the QAPP will be made available for review and comments by ATSDR, Region 10 Pesticide Unit, and participating officials from the State of Oregon.

The QAPP will define roles and responsibilities of those involved in the sampling and analysis effort. For example, the background investigation, field observations, and sampling will be conducted by investigators in the OEA Investigation and Engineering Unit, and analysis of samples will be performed by the Manchester Environmental Laboratory. If required, analysis of some samples may be done at contract laboratories.

Reporting Results

Individual monitoring results and an explanation of their significance will be provided in writing to each participant. Recommendations for follow-up actions will be made if warranted. Individual test results will not be made available to the public and confidentiality will be protected according to federal and state laws. All records and computer files will be locked and password protected, respectively. At the conclusion of the Exposure Investigation, ATSDR will prepare a report that will summarize the findings of the investigation.

References

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2. Oregon Agriculture: Facts and Figures, April 2001. Oregon Department of Agriculture Web Site: http://www.oda.state.or.us

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4. Oregon Department of Agriculture Case Number 964378. November 15, 1996.

5. Oregon Department of Agriculture Case Number 973251. August 11, 1997.

6. Oregon Department of Agriculture Case Number 974328. August 15, 1997.

7. Oregon Department of Agriculture Case Number 974342. August 15, 1997.

8. Oregon Department of Agriculture Case Number 011024. August 29, 2000.

9. Oregon Department of Agriculture Case Number 011084. October 27, 2000.

Attachment 1 (EI Protocol)

Pesticides for Analysis
(Trade Name and Chemical Name)

Herbicides

Basagran	bentazon
Devrinol	napropamide
Factor	prodiamine
Fusilade	fluazifop-butyl
Gallery	isoxaben
Garlon	triclopyr
Goal	oxyfluorfen
Gramoxone	paraquat
Pennant	metalochlor
Roundup	glyphosate
Surflan	oryzalin
Weedar 64	
or 2,4-D	(2,4-dichlorophenoxy) acetic acid

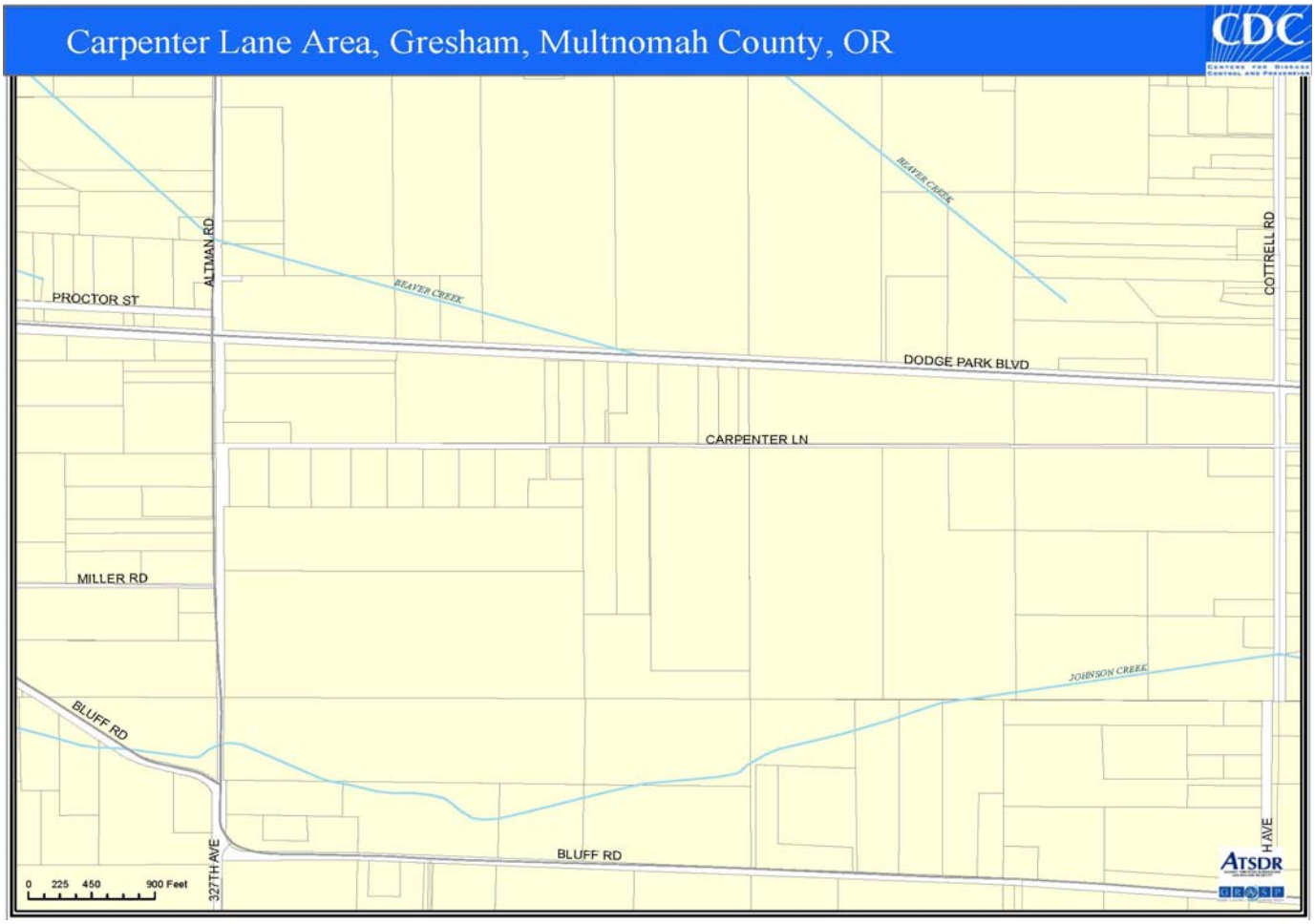
Insecticides

Avid	abamectin (aka: avermectin B1)
Diazinon	0-0 diethyl 0-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate
Dursban	chlorpyrifos
M-Pede	fatty acid (soap)
Metasystox	methyl demeton
Mocap	ethoprop
MVPII	Bt–microbial insecticide
Orthene	acephate
Topcide	lambda-cyhalothrin
Talstar	bifenthrin

Fungicides

Banner	propiconazole
Daconil	chlorothalonil
Kocide	copper hydroxide
Strike	triadimefon
Syllit	dodine
Systhane	mycobutanil

Appendix B: Map of the Carpenter Lane Area, Multnomah County, Oregon



Appendix C: Definitions of Comparison Values

Reference: *ATSDR Public Health Assessment Guidance Manual Appendix F: Derivation of Comparison Values*. Available at URL: http://www.atsdr.cdc.gov/HAC/HAGM/appf.html

ATSDR Environmental Media Evaluation Guides (EMEGs)

Definition: EMEGs represent concentrations of substances in water, soil, and air to which humans may be exposed during a specified period of time (acute, intermediate or chronic) without experiencing adverse health effects. Acute exposures are defined as those of 14 days or less; intermediate exposures are those lasting 15 days to 1 year; and chronic exposures are those lasting longer than 1 year. EMEGs have been calculated for substances for which ATSDR has developed Toxicological Profiles using information about the substance toxicity (minimal risk levels or MRLs) and default exposure assumptions. The default exposure assumptions account for variations in water and soil ingestion between adults and children. For exposure to substances in the air, EMEGs are expressed as air concentrations and are the same for adults and children.

Reference Dose Media Evaluation Guides (RMEG)

Definition: If no MRL is available to derive an EMEG, ATSDR develops RMEGs using EPA's reference doses (RfDs) and default exposure assumptions, which account for variations in intake rates between adults and children. EPA's reference concentrations (RfCs) serve as RMEGs for air exposures. Like EMEGs, RMEGs represent concentrations of substances (in water, soil, and air) to which humans may be exposed without experiencing adverse health effects. RfDs and RfCs consider lifetime exposures, therefore, RMEGs apply to chronic exposures.

Like EMEGs, RMEGs are developed assuming:

1) exposures are occurring through contact to a single medium,
2) exposures are occurring to a single substance, and
3) only noncarcinogenic health effects will occur.

Cancer Risk Evaluation Guides (CREGs)

Definition: CREGs are media-specific comparison values that are used to identify concentrations of cancer-causing substances that are unlikely to result in an increase of cancer rates in an exposed population. ATSDR develops CREGs using EPA's cancer slope factor (CSF) or inhalation unit risk (IUR), a target risk level (10^{-6}), and default exposure assumptions. The target risk level of 10^{-6} represents a theoretical risk of 1 excess cancer cases in a population of 1 million. The default exposure assumptions account for ingestion rates and body weights. CREGs are only available for adult exposures—no CREGs specific to childhood exposures are available.

Non-ATSDR Environmental Guidelines

When ATSDR values are not available, environmental guideline from other sources, such as those described below can be considered.

EPA Region 3 Risk-Based Concentrations (RBCs)

Reference: Division Risk Assessment. U.S. Environmental Protection Agency Region 3 Risk-Based Concentration Table. Available at URL: http://www.epa.gov/reg3hwmd/risk/riskmenu.htm

Definition: EPA Region 3 Risk Based Concentrations (RBCs) are guidelines used to assess the potential for harm from chemicals found at a hazardous waste site. They are developed by combining a substance's toxicologic properties with "standard" scenarios for encountering the substance. EPA's measures of a substance's toxicologic properties are the RfD and CSF. The RfD is the dose of a chemical not expected to result in noncarcinogenic health effects, and the CSF is the cancer risk per unit dose. Exposure scenarios are taken from RAGS or Superfund supplemental guidance. The exposure parameters are generic and are intended to be overly conservative and protective of most populations. EPA uses these standard exposures to determine the exposure dose equivalent of the RfD or target cancer risk level. EPA Region 3 has compiled RBCs for 400 to 500 substances in soil, air, water, and fish. RBCs are presented by EPA Region 3 in the RBC Table, which is generally updated every 6 months.

EPA Region 9 Preliminary Remediation Goals

Reference: U. S. Environmental Protection Agency Region 9 Prelimary Remdiation Goals 2004 Table. Available at URL: http://www.epa.gov/Region9/waste/sfund/prg/files/04prgtable.pdf

Preliminary Remediation Goals (PRGs) are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations that are intended to assist risk assessors and others in initial screening-level evaluations of environmental measurements. The PRGs contained in the Region 9 PRG Table are generic; they are calculated without site specific information. However, they may be re-calculated using site specific data.

Appendix D: Non-Target Pesticides Included in Method 8085 Pesticide Screen for Air Samples– Carpenter Lane Community; 2003

Pesticides	
Alachlor	Fluridone
Aldrin	Fonophos
Atrazine	Heptachlor and Heptachlor Epoxide
Azinphos-Ethyl	Imidan
Azinphos -Methyl	Lindane
2,6-dichlorobeznonitrile (Dichlobenil)	Malathion
BHC (alpha-, beta-, and delta-)	Methoxychlor
Bromacil	Metolachlor
Carbothenothion	Metribuzin
Chlorpyrfos, Methyl	Napropamide
Chlordane (Alpha- and gamma-)	Norflurazone
Coumaphos	Uxyfluorfen
Dementon-S	P,P'-DDD
Dieldrin	P,P'-DDE
Dimethoate	P,P'-DDT
Diphenamid	Parathion
Endosulfan I	Parathion -Methyl
Endosulfan II	Pendimethalin
Endosulfan Sulfate	Phorate
Endrin	Promtryne
Endrin Aldehyde and Ketone	Pronamide (Kerb)
EPN	Propachlor (Ramrod)
Ethafluralin (Sonalan)	Rennel
Ethiobn	Simazine
Ethoprop	Sulfotep
Fenitrothion (SP)	Sulprofos
Fensulfothion	Terbacil
Fenthion	Trifluralin

Appendix E: Pesticide Use Reported by Residents – Carpenter Lane Community; 2003

Location	Pesticide Use Initially Reported to OEA Staff	Additional Pesticides Reported to ASTDR and Date Contacted
1	None	Unable to reach
2	None	Unable to reach
3	None	None (6/22/04)
4	Weed/Feed w/2,4-D, Dicamba, Mecoprop (MCPP) and Moss Control w/iron sulfate	Roundup, Weed-Be-Gone (6/23/04)
5	Glyphosate	Unable to reach
6	Glyphosate	Glyphosate only. Used on thistles and tanziass, but not near house. Denied using Dichlobenile (6/24/04)
7	Pichloram, Metsulfron-methyl, Glyphosate, Cypermethrin	Casoron (dichlobenile) and Preem. Denied using trifluralin. (6/22/04)
8	Pichloram, Metsulfron-methyl, and Glyphosate;	Crossbow, tryclopyr, Roundup, Kocide (7/7/04)
9	None	None (6/7/04)
10	None	None (6/30/04)
11	Picloram, Metsulfron-methyl	Unable to reach
12	Cyfluthrin and Pyrethrins	Unable to reach

Appendix F: Summary of Detected Pesticides and Their Use by the General Public and Ornamental Nurseries in the Carpenter Lane Area, Gresham, Oregon

Pesticide	Use by General Public*	Use by Ornamental Nurseries †
2,4-D	Common	Non-crop areas only
2,6-dichlorobenzonitrile (Diclobenil)	Common	Not common
Carbaryl	Common	Moderately common (insecticide)
Chlorothalonil	Common	Moderately common (fungicide)
Diazinon	Common	Moderately common (insecticide)
Endosulfan Sulfate	Not common	Old chemistry, not commonly used
Eptam (EPTC)	Not common	No known use
Fonophos	Not available	Not used; Lost its label in 1998/1999.
Napropamide	Not common	Common (pre-emergence herbicide)
Simazine	Not common	Moderately common (pre-emergence herbicide)
Terbacil	Not common	None- highly phytotoxic
Triclopyr	Common	Non crop areas only, blackberry control
Trifluralin	Common	Moderately common pre-emergence herbicide for containers and landscapes. Too expensive for field use

*Personal communication with Christopher Kirby, Oregon Department of Agriculture, Salem, OR, April 26, 2005

†Personal communication with Sam Doan, horticulturalist, J. Frank Schmidt Nurseries, Gresham, OR, Dec 4, 2004

Appendix G: Potential Health Implications of Pesticide Residues in Residential Soils

Shan-Ching Tsai, PhD, ATSDR, DHAC, SSAB, 5/10/04, rev 3/30/05

References used:

1. ATSDR Toxicological Profile for Toxaphene, Aug 1996. http://www.atsdr.cdc.gov/toxprofiles/tp94.html

ATSDR Toxicological Profile for Chlordane, May 1994. http://www.atsdr.cdc.gov/toxprofiles/tp31.html

2. ATSDR Toxicological Profile for Aldrin and Dieldrin, Sept 2002. http://www.atsdr.cdc.gov/toxprofiles/tp1.html
3. ATSDR Toxicological Profile for DDT/DDD/DDE, Sept 2002. http://www.atsdr.cdc.gov/toxprofiles/tp35.html
4. ATSDR Public Health Assessment Guidance Manual (Update), Jan 2005. Agency for Toxic Substances and Disease Registry, Atlanta, Georgia

This report assessed potential health implication of ingesting the pesticides residues in the residential lands, which were once used heavily for agriculture, as described in the main document of this attachment.

Of the many persistent pesticides detected in this site, a few have elevated levels. They need to be evaluated further for potential health implications.

These pesticides of concerns in surface soil and subsurface soils are p,p'-DDT, p,p'-DDE, toxaphene, and cyclodienes such as dieldrin and technical grade chlordane that contains cis-chlordane and trans-chlordane. This assessment is conducted under the assumption that the only significant exposure pathway to these pesticides is through the ingestion of contaminated surface soils. If large bodies of water are nearby and area residents regularly eat fish from those waters, then potential human exposure through that path should be addressed in future.

Toxaphene

Toxaphene had a maximum concentration of 1.7 ppm in the surface soil of 1–3 inches in depth. This concentration is slightly above ATSDR's screening level of 0.6 ppm, the *cancer risk evaluation guide* (CREG) for soil-borne toxaphene. However, no apparent increase in cancer incidence is expected from this level of exposure. The estimated lifetime excess cancer risk from ingesting the contaminated soils is at the acceptable level of 3 in a million.

For the noncancer effects, soil concentration of 1.7 ppm is less than ATSDR's *intermediate environmental media evaluation guide* (iEMEG) of 2 ppm of toxaphene for pica children. This is a very conservative guideline to protect children with pica behavior, which is the ingestion of large amounts of soil (calculated as 5 g/day, compared to the

normal ingestion rate of 0.2 g/day). Therefore, it is unlikely that exposure to ingested toxaphene in soil at 1.7 ppm could result in any noncancer adverse health effects. At normal ingestion rate of 200 mg/day for a 10-kg child, the oral dose of toxaphene from this contaminated soil was estimated as 0.000034 mg/kg/day. This estimated dose is 30 times lower than the iMRL of 0.001 mg/kg/day. The estimated dose also is about 150 times lower than *lowest-observed-adverse-effect level* (LOAEL) at the dose of 0.005 mg/kg/day. This LOAEL is for the most sensitive health effect, which associated with inferior swimming and righting ability in developing rats. Based on these criteria, the ingestion of the contaminated surface soil at 1.7 ppm is not likely to cause cancer adverse health effects.

The toxaphene concentrations in subsurface soils (1,400 +/– 990 ppm) are similar to those in surface soils (1,275 +/– 601 ppm). The toxaphene in subsurface soil (12 inches depth; maximum concentration = 2,100 ppm) is not likely to have direct contact with people. Even in the unlikely events that the subsurface soil is dug up to the surface, the ingested toxaphene at the current concentration would pose no significant cancer risk or noncancer risk to people, as discussed in the preceding paragraphs for the surface soils.

Chlordane (Technical Grade)

Technical chlordane is a mixture of 26 compounds including cis- or alpha chlordane, trans- or gamma chlordane, beta-chlordene, heptachlor, trans-nonachlor, and other minor components. The commercial product consisted of 60%–75% isomers (trans- and cis-) of chlordanes and 25%–40% of related compounds including two isomers of heptachlor. The trans-chlordane made up 24% and cis-chlordane 19% in some technical chlordane preparations.

In the four soil samples at this site, the weathered technical chlordane residues contained only 12 +/– 0.6 % of cis-and trans-chlordane, compared to the 60%–75% in the fresh commercial product. Therefore, the cis- and trans-chlordane are considered as a part of the technical chlordane. They are not assessed independently here because the health guidelines in the toxicological profile are based on toxicological studies using technical chlordane.

The subsurface soils were much less contaminated than surface soils by technical chlordane, cis-chlordane, and trans-chlordane. For these three kinds of chlordane substances at location GPS A, their concentrations in subsurface soil were one quarter (i.e., 25 +/– 1.2 %) of their concentrations in surface soil. At location GPS B, the concentrations in subsurface soil were only 5.8 +/– 0.2 % of that in the surface soil. The small standard deviation of these two data sets indicated the similarity among these three chlordane substances regarding their partition rate in each of these two soil cores. Therefore, only dominant technical chlordane, as the representative of these three substances, was evaluated in this section.

Technical grade chlordane concentration in surface soils was found to be 6.85 +/– 4.0 ppm, with the maximum concentration of 9.7 ppm at location GPS A. The average concentration in subsurface soil was 1.3 +/– 1.5 ppm.

The maximum concentration of 9.7 ppm on a surface soil exceeded the cancer risk evaluation guide (CREG) of 2 ppm and has to be evaluated further. The oral dose from ingesting the contaminated soil was estimated as 0.000014 mg/kg/day. Based on the cancer slope factor of 0.35/(mg/kg/day), the estimated lifetime excess cancer risk is at the acceptable level of 5 in a million. No apparent increase in cancer incidence is expected from ingestion of technical chlordane in contaminated surface soil at this dose level.

For the noncancer effects, maximum soil concentration of 9.7 ppm is less than ATSDR's chronic oral EMEG of 30 ppm for children. Therefore, adverse noncancer health effects of ingested chlordane are unlikely to occur at this chlordane concentration at residential land with normal grass cover.

The maximum concentration of 9.7 ppm technical chlordane is above the iEMEG of 1 ppm for pica children and needs further evaluation for noncancer adverse health effects. Children with the rare condition of pica behavior pick up soil and ingest it in large amounts, estimated to be 5 g/day. The dose for pica child from ingested soils is estimated as 0.005 mg/kg/day which is 11 times below the *no-observed-adverse-effect level* (NOAEL) of 0.055 mg/kg/day and 55 times lower than the LOAEL of 0.273 mg/kg/day based on hepatocellular hypertrophy in female rats after life time exposure. Therefore, the noncancer health risk to pica children is still minimal, if any.

Dieldrin

Dieldrin was found in surface soils at the concentration of 0.25 +/– 0.11 ppm with the range of 0.17–0.33 ppm. In the subsurface soils, the average concentration was 0.37 +/– 0.20 ppm, which had no significant difference to that of the surface soils. In a follow-up sampling with an official, accurate method of chemical analysis (i.e., Method 8081), the dieldrin concentrations were found to be 0.52 and 0.82 ppm, respectively, in surface and subsurface soils. The maxima concentration in the surface soil did not exceed the ATSDR soil guideline (i.e., EMEG for child) of 3 ppm. Therefore, the dieldrin in normal residential soil is unlikely to cause noncancer health effects to the residents through soil ingestion.

In the rare situation of pica children exposed to contaminated bare ground, the intermediate EMEG of 0.2 ppm of dieldrin is comparable to the maximum concentration of 0.52 ppm in surface soil. Based on this maximum concentration of 0.52 ppm in surface soil, the maximum dose from ingesting surface soil by pica child was estimated as 0.00026 mg/kg/day, which was 39 times below the NOAEL of 0.01 mg/kg/day based on the learning deficiency in monkeys for intermediate duration of exposure. Therefore, even in pica child, noncancer health risk is minimal, if any.

At the maximum dieldrin concentration in of 0.52 ppm in surface soil, the ingested dieldrin dose was estimated as 0.0000007 (or 7×10^{-7}) mg/kg/day. At this dose level, the excess cancer risk was estimated as an acceptable level of 1 in 100,000, based on the oral cancer slope factor of 16 /(mg/kg/day). No apparent excess cancer risk is expected from a life time exposure to dieldrin in the ingested soils at this contamination level. In short, no significant cancer or noncancer health risk is expected from the exposure to dieldrin in ingested soil at this exposure level.

DDT/DDE

The surface soils contained 0.053 +/– 0.021 ppm of p,p'-DDT and 0.034 +/– 0.017 ppm of p,p'-DDE. The p,p'-DDE is a minor constituent of technical DDT and a degradation product of p,p'-DDT. Therefore, these two compounds are pooled together as technical DDT in this health assessment. The total concentrations of these two compounds in two surface soils were 0.090 +/– 0.043 ppm, with the maximum combined concentration at 0.120 ppm. Total concentrations of these two compounds in subsurface soil were 0.120 +/– 0.085 ppm, with no significant difference from that of the surface soils.

The maximum combined concentrations of DDT and DDE in surface soil (i.e., 0.12 ppm) and that in subsurface soil (i.e., 0.186 ppm) were both below the oral CREG level of 2 ppm. Therefore, the DDT and DDE is not a health concern regarding their cancer risk through the lifetime ingestion of these contamination soils.

The maximum concentration of combined DDT/DDE contaminants at 0.12 ppm in surface soil is below ATSDR's noncancer risk guidelines: the iEMEG of 1 ppm technical DDT for intermediate duration exposure to pica children and the chronic oral RMEG of 30 ppm for long term exposure to children in general. Therefore, noncancer health risk is unlikely to be caused by the oral exposure of DDT/DDE at these concentrations in these contaminated soils.

In short, the p,p'-DDT and p,p'-DDE in these surface and subsurface soils are not contaminants of concern for either cancer or noncancer health risks through the soil ingestion route of exposure.

Other Organochlorine Pesticides: Heptachlor, Heptachlor-Epoxide, and Lindane

All of these pesticides and transformed product were found only in relatively low concentrations in surface soil. Their maximum concentrations did not exceed their respective comparison values. The maximum concentrations and soil comparison values respectively, are: 0.062 and 0.2 ppm (CREG) for heptachlor; 0.057 and 0.08 ppm (CREG) for heptachlor-epoxide; and 0.008 and 0.02 ppm (pica child iEMEG) for lindane. These compounds are not contaminants of concern in the surface soils. Therefore, no further evaluation is needed for them.

We obtained limited information on the pesticide levels at two sampling locations. From that, our preliminary conclusion is that the health risk associated with the ingestion of

contaminated soil is generally insignificant. There is a remote possibility that pica children may be exposed to a low level of technical chlordane from bare, contaminated ground in residential areas. If further information indicates the presence of aquatic food chain in the contaminated areas, then the food chain pathway needs to be evaluated in the future.