Public Comment Release

Public Health Assessment
Highway 36 Corridor Exposure Investigation

May 9, 2013

Prepared by the

Environmental Health Assessment Program
Oregon Health Authority
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

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Public Comment

This report is being released for a 60-day public comment period, and is distributed solely for the purpose of obtaining public comment under applicable information quality guidelines. Comments submitted by July 9, 2013 will be addressed in the final version. To submit public comments, send them via email to ehap.info@state.or.us, or via postal mail addressed to:

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Foreword

The Oregon Health Authority (OHA), in cooperation with state and federal partners, prepared this Public Health Assessment (PHA). Funding and other resources to conduct this Public Health Assessment and associated Exposure Investigation (EI) were contributed by all state and federal agencies involved.

This EI was initiated in response to concerns from citizens about potential exposures from local pesticide application practices. OHA serves as the lead agency for coordinating and implementing this investigation. Three other state agencies, which are members of the Oregon Pesticide Analytical Response Center (PARC), and two federal agencies are fully involved in this effort. These agencies are:

- Oregon Department of Agriculture (ODA); Administrator of PARC
- Oregon Department of Forestry (ODF); PARC Member Agency
- Oregon Department of Environmental Quality (DEQ); PARC Member Agency
- Centers for Disease Control and Prevention (CDC)
    - ATSDR headquarters (Atlanta, GA) and Region 10 office (Seattle, WA)
    - National Center for Environmental Health (NCEH) laboratory (Atlanta, GA)
- U.S. Environmental Protection Agency (EPA)
    - EPA Region 10
    - EPA Office of Pesticides Programs (Washington, DC)
- PARC consultants from the Oregon Health and Science University (OHSU) and Oregon State University (OSU) also provide technical assistance and consultation for this investigation.

PHAs are evaluations of environmental data and information about a community. ATSDR and its state cooperative agreement partners conduct public health assessments to determine if a community is exposed to environmental contaminants at levels that could harm human health. If the evaluation concludes that people have been or are being exposed to environmental contaminants, ATSDR then evaluates whether the exposure is harmful or potentially harmful, and whether it should be stopped or reduced.

PHAs are not the same as a medical exam, community health study, or epidemiological study. Because a PHA is focused on a specific site or affected members of a community, its findings are not intended to be generalizable to other sites or communities. **Sometimes critical data needed for a PHA are missing or not available. In such cases, ATSDR may conduct an Exposure Investigation (EI).** EIs involve

the collection and analysis of environmental contamination data and biologic tests (when appropriate). The purpose of an EI is to determine whether people have been exposed to hazardous substances. An EI is one of several possible approaches to characterize past, current, and possible future human exposures to environmental contaminants. An EI is not an epidemiological study or experiment. As such, some components of other types of studies, such as control groups, are not included in an EI.

This PHA is an interim report in the Highway 36 Corridor EI and evaluates information and data collected between April 2011 and September 2012. The purpose of the Highway 36 Corridor EI is to collect environmental and biological data to fill an important data gap that will allow us to determine if people are being exposed to pesticides in the Highway 36 corridor, and if so, the health implications of these exposures.

Purpose and Statement of Issues

The Oregon Health Authority (OHA) prepared this interim report as part of an ongoing Public Health Assessment and Exposure Investigation (EI) for the Highway 36 Corridor site in Lane County, Oregon. The Highway 36 Corridor EI is a multi-agency effort to respond to several community members' requests to investigate possible exposures to pesticides and herbicides used in applications in the Highway 36 corridor. The purpose of this EI is to fill important data gaps by collecting and analyzing environmental, human biological and other data to answer the following questions:

1. Are residents in the Highway 36 Corridor being exposed to pesticides from local application practices?
2. If residents are being exposed:
    a. To what pesticides are they being exposed?
    b. To what levels are they being exposed?
    c. What are potential source(s) of the pesticides to which they are exposed?
    d. What are potential routes (pathways) of residents' exposures?
    e. What health risks are associated with these exposures?

As described in the Background and Community Concerns sections of this report, some Highway 36 corridor residents are concerned about the application of herbicides. Therefore, this EI focuses on collecting and evaluating data on herbicides used in the Highway 36 corridor. Because "pesticide" is a more inclusive and commonly understood term, we use "pesticide" from this point forward to refer to herbicides, insecticides, fungicides, rodenticides and similar products regulated under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

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Tables and Figures

List of Abbreviations and Acronyms

2,4-D – 2,4-dichlorophenoxy acetic acid
ATSDR – Agency for Toxic Substances and Disease Registry
BE – Biomonitoring equivalent
CDC – Centers for Disease Control and Prevention
CS&R – Central Shipping and Receiving (at Emory University)
DACT – Diaminochlorotriazine, a metabolite of atrazine
DAAM – Di-dealkylated atrazine mercapturate, a metabolite of atrazine
DEA – Desethyl atrazine, a metabolite of atrazine
DEET - N,N-diethyl-meta-toluamide is common ingredient in insect repellent
DEQ - Department of Environmental Quality
EI – Exposure Investigation
EPA – U.S. Environmental Protection Agency
g - gram
L – liter
ODA – Oregon Department of Agriculture
ODF – Oregon Department of Forestry
OHA – Oregon Health Authority
OHSU – Oregon Health Sciences University
OSU – Oregon State University
ng – nanogram
NCEH – National Center for Environmental Health
NHANES – National Health and Nutrition Examination Survey
µg – microgram
mg - milligram
mL – milliliter
PARC – Pesticide Analytical Response Center
PHA – Public Health Assessment
PHLAN – PeaceHealth Laboratory Accession Number
ppb – parts per billion
ppm- parts per million
PR – Pitchfork Rebellion
RfC – Reference Concentration
RfD – Reference Dose
SWG – Siuslaw Watershed Guardians

Summary

The Oregon Health Authority (OHA), in cooperation with state and federal partners, prepared this interim report as part of an ongoing Public Health Assessment (PHA)/Exposure Investigation (EI) for the Highway 36 Corridor under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). Funding and other resources to conduct the Exposure Investigation were contributed by all state and federal agencies involved.

ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases-related to toxic substances. OHA prepared this PHA in accordance with ATSDR's approved methods, policies and procedures existing at the date of publication.

Questions
The purpose of this EI is to answer the following questions:

1. Are residents in the Highway 36 Corridor being exposed to pesticides from local application practices?
2. If residents are being exposed:
    a. To what pesticides are they being exposed?
    b. To what levels are they being exposed?
    c. What are potential source(s) of the pesticides to which they are exposed?
    d. What are potential routes (pathways) of residents' exposures?
    e. What health risks are associated with these exposures?

Methods

OHA and its agency partners used qualitative and quantitative methods to carry out this PHA and EI . OHA analyzed information gathered from community meetings, interviews with residents in the course of sample collection, review of news stories and media coverage to describe the broad themes of community concerns.

OHA and its agency partners also collected samples of urine, drinking water, soil and homegrown foods from residents in the area in August and September of 2011. Participants were recruited using community meetings, flyers, a toll-free number and a listserv. To be eligible to participate volunteers needed to live within 1.5 miles of a timber unit that had been harvested in 2010 or 2011, and not have worked as pesticide applicators. These samples were tested for pesticides known to be used in the area.

Some members of the community in this area conducted sampling of urine, surface water, and ambient air independently of government agency oversight and at their own expense. Urine samples were collected in the spring of 2011, and the water and air samples were collected at various times throughout 2011. These samples were analyzed by privately contracted analytical laboratories at Emory University in Atlanta, Georgia. Because these samples were collected by community residents and analyzed by non-governmental entities, quality control procedures of the sample collection and analysis were examined and compared against standards used by OHA and its agency partners for work performed as part of this assessment. The quality control procedures for the sample collection and analysis by the

community were determined to meet the standards used by OHA and its agency partners for its sample collection and analysis. Therefore, the conclusions and recommendations expressed here are based on data generated by both the EI team and the affected community members themselves.

Urine samples were analyzed for the presence of 2,4-D and atrazine. Results of laboratory analyses for the pesticide 2,4-D were compared against data from the National Health and Nutrition Examination Survey (NHANES), a nationally representative sample of the non-institutionalized US population conducted by the federal Centers for Disease Control and Prevention (CDC). No national comparison data are available for Atrazine. The potential for health effects of 2,4-D at levels detected in urine samples was determined by comparison against the acute and chronic biomonitoring equivalents (BE). The BE is the concentration of pesticide metabolites in urine that corresponds to the daily oral dose at which there is no known harm to health. No BE is available for atrazine.

Water, soil and food samples were analyzed by the Oregon Department of Environmental Quality (DEQ) laboratory and the Oregon Department of Agriculture (ODA) laboratory. OHA compared measured concentrations of pesticides in water, soil, and homegrown foods against established health-based comparison values.

Results

Urine samples collected by the community in the spring of 2011 were tested for 2,4-D and atrazine only since methods to test for the full range of chemicals used in the areas were not available at the laboratories where the biologic analyses were performed. The urine samples tested had levels of 2,4-D higher than the general US population. Samples collected by the investigation team in the fall of 2011 had levels of 2,4-D that, while not statistically significant, were higher than levels found in the general US population. In all samples, however, levels of 2,4-D were below health-based comparison values.

Urine samples collected by the community in the spring of 2011 had detectable levels of atrazine. None of the 66 urine samples collected by the investigation team in the fall of 2011 had detectable levels of atrazine. There are no national reference values for atrazine available for the general population. There are also no Biomonitoring Equivalents (BE) for atrazine; a standardized measure that compares biologic concentrations of a chemical to known health-based thresholds in environmental media. Therefore, it is not possible to compare the levels of atrazine found in the samples to levels expected to harm human health.

Three of the 36 drinking water samples collected had detectable amounts of DEET, fluoridone, or hexazinone. Three of 29 soil samples collected had detectable amounts of 2,4-D and/or glyphosate. The concentrations of pesticides found in both soil and water samples were not at levels high enough to cause harm to human health, including for children and other population groups who may be especially sensitive to pesticide exposure. No pesticides were detected in any of the homegrown food products sampled in the fall of 2011.

The analysis of community concerns showed that there is a wide and divergent range of viewpoints regarding the uses and safety of pesticides within the Highway 36 community. Some are confident that governmental requirements for pesticide labeling are protective of health. Others are skeptical and want

the government to do more to protect their health. Some community members have requested an aerial spray buffer zone established around homes and schools, while others are calling for a complete moratorium on all uses of pesticides.

Conflict between and among community members stemming from these divergent views have escalated to a level where community cohesion is negatively affected.

Conclusions

As a result of this Exposure Investigation, OHA reached *twenty* important conclusions addressing the questions that serve as the framework for this investigation about the presence, type and source of exposure to pesticides in the Hwy 36 investigation area.

OHA reached *one* conclusion related to the question:
Are residents in the Highway 36 Corridor being exposed to pesticides from local application practices?

> **Conclusion 1:** This investigation found evidence that residents of the investigation area were exposed to pesticides or herbicides in spring and fall 2011. However, it was not possible to confirm if these observed exposures occurred as a result of local application practices or were from other sources.

OHA reached *four* conclusions related to the question:
To what pesticides are they being exposed?

> **Conclusion 2:** Residents in the Highway 36 investigation area had urinary biomarkers for exposure to 2,4-D in spring and fall 2011, and atrazine in spring 2011. We were unable to determine if participants in the investigation had urinary biomarkers for exposure to pesticides other than 2,4-D and atrazine in spring or fall 2011.
> *Basis for Decision:* OHA was unable to identify a laboratory that had the technical capability to test human urine samples for pesticides that are used in the area other than 2,4-D and atrazine.
>
> **Conclusion 3:** Some Highway 36 investigation area residents may have been exposed to very low levels of DEET, fluoridone, or hexazinone in their drinking water.
> *Basis for Decision*: DEQ detected very low concentrations of DEET, fluoridone, or hexazinone in 3 out of the 36 drinking water samples collected.
>
> **Conclusion 4:** Some Highway 36 investigation area residents may have been exposed to very low levels 2,4-D or glyphosate in their soil.
> *Basis for Decision:* ODA detected 2,4-D and/or glyphosate in 3 out of 29 soil samples collected.
>
> **Conclusion 5:** Some Highway 36 investigation area residents may have been exposed to very low levels of clopyralid in the air.

Basis for Decision: One out of 16 air samples collected by community members in May of 2012 contained a low but detectable amount of clopyralid.

OHA reached *three* conclusions related to the question:
To what levels are they being exposed?

This investigation documented the presence of 2,4-D and atrazine in the urine of residents. There was a drop in those levels between the spring and fall 2011 for reasons that are currently unknown.

Conclusion 6: In the spring of 2011, Highway 36 investigation area residents had higher levels of 2,4-D exposure than the general U.S. population.
Basis for Decision: The concentrations of 2,4-D measured in the urine of participating Highway 36 investigation area residents were statistically higher than those measured in the 2003-2004 NHANES population. The NHANES population is representative of the general, non-institutionalized population of the United States.

Conclusion 7: In the fall of 2011, Highway 36 investigation area residents had urinary 2,4-D levels that were not statistically different than the general U.S. population.
Basis for Decision: The concentrations of 2,4-D measured in the urine of participating Highway 36 investigation area residents in fall 2011 were similar to those of the 2003-2004 NHANES population. However, there were a slightly greater than expected number of participants whose urinary 2,4-D levels were greater than the NHANES 75th percentile. The difference approached, but did not attain, statistical significance.

Conclusion 8: In the spring of 2011, urine samples from Highway 36 investigation area residents also had detectable levels of atrazine, but it is unknown how these levels compare to the general U.S. population.
Basis for Decision: The CDC did not test NHANES populations for the same metabolites of atrazine measured in participants of this EI. Without a reference population, it is not possible to determine how Highway 36 investigation area residents compare with other people with respect to urinary atrazine metabolite levels.

OHA reached *one* conclusion related to the question:
What are potential source(s) of the pesticides to which they are exposed?

Aerial and ground applications of 2,4-D, atrazine and other pesticides did occur in the investigation area in 2011.However, this investigation could not confirm if those applications were the specific source(s) of the pesticides detected in participants' urine, or if there were other sources.

Conclusion 9: There is insufficient information to confirm that local pesticide applications are the source of pesticides found in the urine of participating Highway 36 investigation area residents. However, available evidence suggests it is possible that reported applications may have contributed to the levels detected in participants' urine.
*Basis for Decision***:** Pesticides are regularly applied within the investigation area, and OHA confirmed that the pesticides detected in participants' urine samples were applied in the vicinity of the homes of participants and which were collected after local aerial applications of atrazine.

Urine samples collected after known atrazine applications contained statistically higher levels of atrazine metabolites than samples collected before any known atrazine applications. However, because we did not have site- and time-specific information about atrazine persistence and distance traveled, we were unable to confirm a specific source for the pesticides that were detected in residents' urine.

OHA reached *four* conclusions related to the question:
What are potential routes (pathways) of residents' exposures?

Low but detectable levels of DEET, fluoridone, or hexazinone were found in 8% of the drinking water samples. Glyphosate and/or 2,4-D were found in 10% of the soil samples. This suggests that in some cases incidental swallowing or absorption of pesticides from water or soil may be a path of exposure. No pesticides were found in the homegrown foods sampled, suggesting that this is an unlikely route of exposure.

Conclusion 10: We were unable to determine whether air is a pathway of exposure to pesticides in the Highway 36 investigation area.
Basis for Decision: Neither OHA nor the EI team members have had the capacity to monitor air for the pesticides used in the area. Community-collected air samples were too few in number to provide the basis for eliminating or confirming air as a relevant exposure pathway.

Conclusion 11: Drinking water can be eliminated as an exposure pathway for the 2,4-D and atrazine detected in Highway 36 investigation area residents' urine.
Basis of Decision: No 2,4-D or atrazine or their breakdown products were detected in any of the water samples collected.

Conclusion 12: Soil sampled in the fall of 2011 can be eliminated as an exposure pathway for the 2,4-D and atrazine detected in Highway 36 investigation area residents' urine.
Basis for Decision: Concentrations of 2,4-D measured in two soil samples were far too low to explain the levels of 2,4-D found in Highway 36 investigation area residents' urine. Also, most EI participants had detectable 2,4-D in their urine but no 2,4-D detectable in their soil.

Conclusion 13: Homegrown food sampled in the fall of 2011 can be eliminated as an exposure pathway.
Basis of decision: No pesticides were detected in any of the homegrown food samples collected.

OHA reached *five* conclusions related to the question:
What health risks are associated with these exposures?
This investigation did document the presence of 2,4-D and Atrazine in the urine of residents. However, the levels of 2,4-D found in residents' urine are below the levels currently known to be harmful to health; no levels expected to cause health effects were documented in this investigation.

Conclusion 14: The levels of 2,4-D measured in Highway 36 investigation area residents' urine in spring and fall 2011 were below levels expected to harm people's health.

Basis for Decision: The concentrations of 2,4-D measured were lower than the biomonitoring equivalent (BE) for 2,4-D. The BE is a calculated urine concentration that corresponds to an oral dose of 2,4-D associated with no harm to health.

Conclusion 15: We cannot determine whether the levels of atrazine metabolites measured in Highway 36 investigation area residents' urine in spring 2011 could harm people's health.
Basis for Decision: Unlike 2,4-D, there is no BE for atrazine metabolites. Without a BE against which to compare urinary atrazine metabolite levels, it is not possible to determine how measured urinary concentrations relate to doses that cause harm to health.

Conclusion 16: Drinking or contacting domestic water with the concentrations of pesticides detected in some Highway 36 investigation area properties is not expected to harm people's health.
Basis for Decision: Only three of 36 drinking water samples collected in fall 2011 within the Highway 36 investigation area had detected concentrations of pesticides. The concentrations measured at the time of sampling were thousands of times lower than health-based comparison values. The measured levels were too low to harm the health of people who drink the water, including sensitive population such as children.

Conclusion 17: Contact with soil containing pesticides at the concentrations detected in the fall of 2011 in some Highway 36 investigation area soil is not expected to harm people's health.
Basis for Decision: Only three of 29 Highway 36 investigation area soil samples had any measurable amounts of pesticides at the time of sampling. The concentrations measured at the time of sampling were thousands of times lower than health-based comparison values. Measured concentrations were too low to harm the health of people contacting the soil, including sensitive populations such as children.

Conclusion 18: Handling or consuming garden vegetables, berries, eggs, milk or honey from the Highway 36 investigation area from fall 2011 will not harm people's health.
Basis for Decision: No pesticides were detected in any of the wild or homegrown food products sampled in the fall of 2011.

OHA reached *two* additional conclusions related to the impacts to the EI and to the health of community members from community conflict.

Conclusion 19: Divisions and hostility among community members, fueled by cultural and values differences over land use, pesticide use and property rights, are creating significant stressors on many individual community members and on the community as a whole.
Basis for Decision: OHA staff and other members of the EI team have observed, documented and responded to a high volume of complaints from a broad range of Highway 36 community members who express anger, frustration, mistrust, and fear. Community members express concerns about the intentions, motives and actions of others with opposing views on land use, pesticide use and property rights within and outside of their community. Many community members express these sentiments and describe the stress they experience due to the conflict in their community.

Conclusion 20: Leadership activity within the community has been oriented toward debating issues of land use, pesticide use, and property rights. No formal or informal leader has yet emerged who has a mediating influence on these differences. Formal mediation services for the Hwy 36 community may be necessary for both the successful completion of the EI and for the important progress needed to reduce community stress and improve community cohesion in the longer term.

Basis for Decision: Many community members have expressed frustration and concern about the degree and persistence of the conflict within their community. Regardless of the outcome of the EI, resolving these differences may be necessary to restore community cohesion.

Uncertainties and Limitations

As with any scientific investigation, there are uncertainties and limitations to our conclusions about exposure and health risks.

- **While community-collected urine and environmental samples are of sufficient quality to include in this PHA, these samples were not collected or analyzed with the same level of oversight as the fall 2011 samples collected by government agencies.** This difference in oversight resulted in some difficulties obtaining information about how and why participants were recruited, how and why sampling locations and times were selected, and creatinine levels in urine samples.
- **Conclusions can only be drawn about the pesticides that were tested for in urine and environmental samples.** The urine samples collected in spring and fall 2011 were only tested for atrazine metabolites and 2,4-D. The environmental samples collected in fall 2011 were tested for a wider range, but not an exhaustive panel, of pesticides. We do not know if people were exposed to other pesticides at the time of sample collection. We also do not know what the health implications of any unknown pesticide exposures may be.
- **Conclusions about exposure and health risks only apply to the times when samples were collected by community members or the investigation team.** All urine and environmental samples represent a snapshot in time. Because 2,4-D and atrazine rapidly clear from the body, the levels of these chemicals in urine can only be used to assess recent (within 24-48 hours) exposures. The levels of pesticides detected in environmental samples only indicate the amounts present at the time of sampling, and do not indicate whether these levels have changed over time. We also cannot conclude if Highway 36 corridor residents had past exposures to pesticides, if past or current exposures were from acute (short-term) or chronic (long-term) contact with pesticides, or if residents have had repeated exposures to pesticides over time.
- **It is not known if the Exposure Investigation resulted in changes to pesticide application practices in the investigation area, and therefore if exposure conditions have changed for Highway 36 corridor residents.** It is not known if pesticide applicators changed their pesticide application practices (i.e., application methods, locations, or types of pesticides used) after the Exposure Investigation was initiated. Any changes in local application practices will also change exposure conditions within the investigation area, and will make it difficult to fully answer the EI questions.
- **There is insufficient scientific evidence to determine the effect of exposure to multiple pesticides at low doses.** There is a limited but growing body of scientific evidence on the health effects from exposure to multiple pesticides, which indicates that multiple chemical interactions may pose an unknown but potentially greater risk than exposure to single chemicals; however

current methods do not allow for a determination of risk resulting from exposure to multiple chemicals.

Next Steps

Pertaining to the Exposure Investigation underway, OHA recommends that:

1. US EPA work with the Exposure Investigation team on developing a sampling and analysis plan designed to evaluate exposures to pesticides in air and to address gaps in the data needed to answer Exposure Investigation questions. At the time of publication of this report, passive air monitoring over several application seasons appears to be the best option to collect community-wide air data.
2. ODA and ODF continue to provide pesticide application data as needed to interpret air sampling (or other) data collected as part of this investigation.
3. State and federal agencies involved in the ongoing Exposure Investigation develop an implementation plan that includes identification of necessary resources to carry out activities appropriate for each agency's role in this effort.

Pertaining to broader and/or longer-term issues identified by the Exposure Investigation, OHA recommends that:

1. ODA and ODF work with pesticide applicators to develop consistent pesticide application record-keeping processes to ensure that application record data are accurately maintained and usable.
2. State agencies explore the feasibility of implementing a system that would allow sensitive populations to be notified of imminent pesticide applications in such time and with such specificity that they could take action to avoid exposure to those applications. Such policies could include adoption of systems developed by other jurisdictions, or modification of existing regulatory systems designed to monitor pesticides applications.
3. State and federal agencies involved in the ongoing Exposure Investigation develop an implementation plan to address these recommendations, including the identification of resources to carry out activities appropriate for each agency's role in serving the communities of Oregon. That plan should include a recommendation on how the agencies should coordinate, collaborate and share resources.
4. Community members, including local government representatives and other community leaders, consider seeking the assistance of a professional mediation group to address immediate and long-term conflicts among community members and identify actions to move these conflicts toward resolution.

OHA will:

- Review and respond to all public comments received, and release a final version of this interim report upon completion.
- Work with state and federal partners, community members, and other stakeholders to implement the recommendations in this report.
- Continue to maintain and provide updates through the Highway 36 web page and listserv.

- Compare application records from 2011 to application records from 2009 and 2010 to determine if there were noticeable (substantial) changes in pesticide application practices after the EI was initiated in 2011.
- Review air sampling data once it is collected by the EPA.
- Develop and release a final Public Health Assessment report which will include all previous sampling data, pesticide application data from 2009-2011 and air sampling data collected by the EPA.

Background

Investigation Area

The Exposure Investigation area includes the following Township-Ranges: 15S 06W, 15S 07W, 16S 06W, 16S 07W, 16S 08W, 17S 07W, 17S 08W, and 17S0 9W (Figure 1). The investigation area covers approximately 286 square miles (182,990 acres) in western Lane County and encompasses most of the communities along the Highway 36 Corridor.

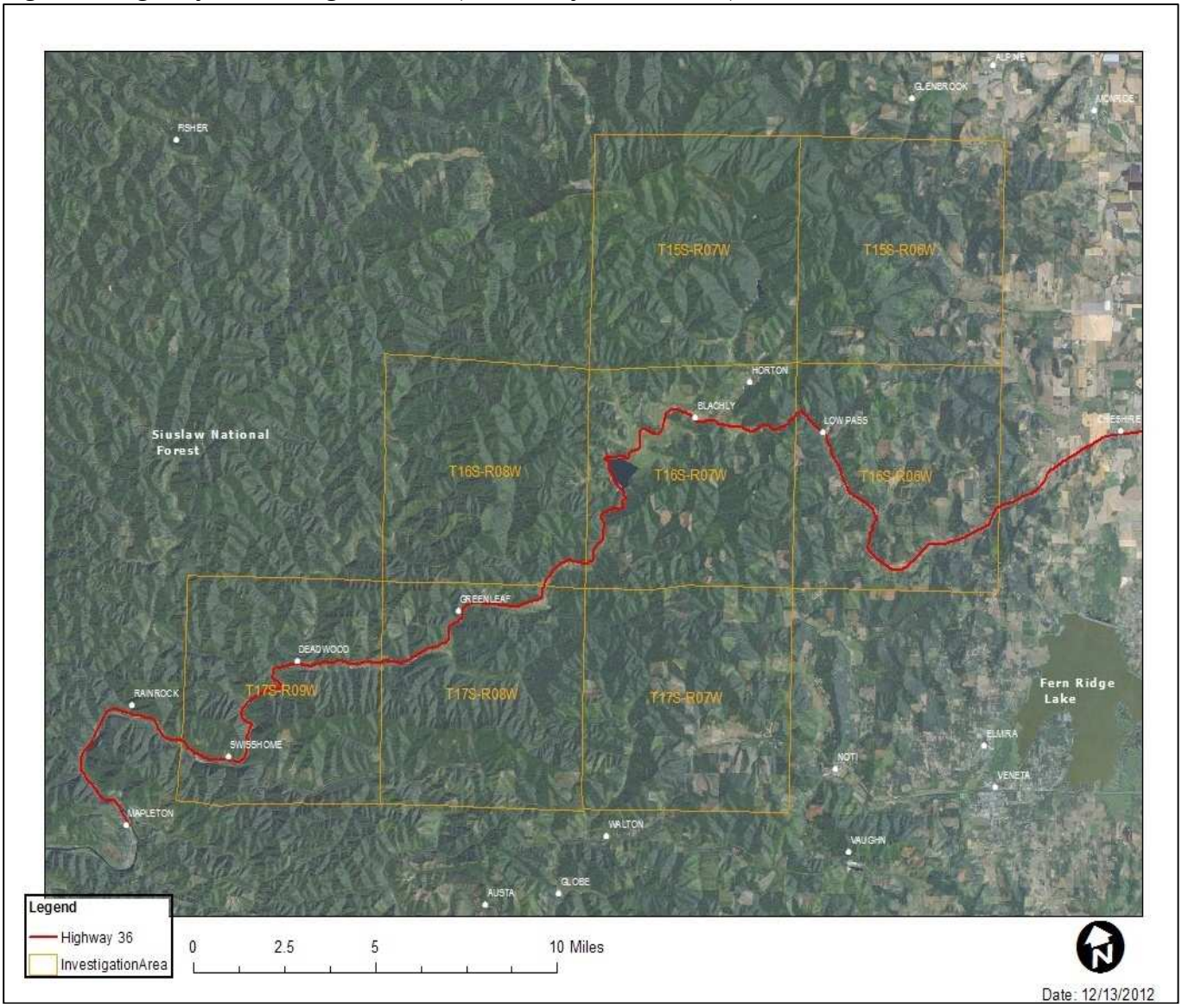
Recruitment Area

OHA established focused participant recruitment areas based on the proximity of residences to timber units that had been harvested in 2010 or 2011. All participants lived within the investigation area and within 1.5 miles of a 2010 or 2011 clear-cut.

Site Description

The investigation area is situated along a portion of Oregon state route 36 (Highway 36 in this report), which is a 52 – mile highway between the towns of Junction City and Mapleton in western Lane County. The Oregon Department of Transportation manages the highway and right of way. The investigation area includes the rural communities of Swisshome, Deadwood, Greenleaf, Triangle Lake, Blachly, Horton and Low Pass. Approximately 2,161 people live in the investigation area. Approximately 1% (2505 acres) of land in the investigation area is classified as rural residential. Approximately 5% (7273 acres) is classified as agricultural land. According to the Oregon Department of Agriculture (ODA), agricultural production in the area includes pasture, hay, Christmas trees, small fruits, vegetables, and tree fruits. Forestry represents the majority of the land use in the investigation area and comprises approximately 95% (173,152 acres) of the classified use. Approximately half of the forestland in the investigation area is publicly owned, 25% is designated as privately owned industrial (ownerships greater than 5000 acres) land, and the remaining 25% is designated as private non-industrial (ownerships less than 5000 acres) [1]. Although forestry comprises 95% of the land use within the investigation area, land use percentages outside the investigation area vary dramatically, particularly to the east near Junction City, Eugene, and Harrisburg.

Figure 1: Highway 36 investigation area (shown in yellow outline).



Investigation History

Within the Highway 36 corridor, there are residential properties located near forest, agricultural or other residential lands where landowners may use pesticide products to control unwanted vegetation. Since 2005, some Highway 36-area residents have expressed concerns to Oregon state agencies about the human health and environmental effects from pesticide applications on nearby forest and agricultural lands. These residents have been advised by a consulting agronomist that the local geography and climate increase the likelihood of drift from these pesticide applications to nearby residences and farms [2]. They have expressed a specific concern about aerial pesticide applications on harvested timberlands.

In 2005, a group calling itself The Pitchfork Rebellion (PR) began requesting that ODA address their concerns about alleged pesticide exposures from local application practices. In addition to being the State's regulatory authority for pesticides, ODA administers the Pesticide Analytical Response Center (PARC). PARC is a multi-agency group with responsibilities to "centralize receiving of information relating to actual or alleged health and environmental incidents involving pesticides" and "mobilize expertise necessary for timely and accurate investigation of pesticide incidents and analyses of associated samples" [3].

In early 2010, PR petitioned the U.S. Environmental Protection Agency (EPA) to "conduct an unbiased study to determine what would be an appropriate aerial spray buffer zone for the specific conditions found along the Highway 36 Corridor in Lane County, Oregon" [4]. During a meeting with EPA Region 10 staff in April 2010, PR members reported instances of illnesses that they attributed to exposure to pesticides applied to forestlands near their homes [5]. In September 2010, EPA Region 10 requested the Agency for Toxic Substances and Disease Registry's (ATSDR) assistance in evaluating and addressing the health concerns raised by these residents and other organizations concerned about aerial pesticide applications on forestlands. In the winter of 2010, ATSDR Region 10 reviewed available information on illness reports and concerns from the area, conducted a site visit, and evaluated options to respond to local health concerns.

In spring 2011, 43 Highway 36 corridor residents had their urine tested for pesticide metabolites by a researcher from Emory University (Atlanta, Georgia).[1] Based on the residents' assumption that aerial pesticide applications were the source of their health complaints, some community members collected urine samples both before and after aerial pesticide applications near their homes.

In April 2011, the researcher and a PR representative reported some of the community-collected urinalysis results at an Oregon Board of Forestry meeting. According to the presenters, the data indicated that:

- All of the submitted urine samples had detectable levels of 2,4-dichlorophenoxy acetic acid (2,4-D) and the atrazine metabolite diaminochlorotriazine (DACT).
- The researcher's presentation slides include a graph that compares purported "pre-spray" and "post-spray" 2,4-D and atrazine levels in participants' urine to the "U.S. population" which indicates higher levels in the local samples compared with the comparison.
- Some individual results showed that the 2,4-D and DACT levels in "post-spray" samples were higher than the levels found in "pre-spray" samples. The presenters ascribed the increase in concentrations to aerial applications on private forestlands. [2]

Shortly after these data were presented publicly, the Oregon Department of Forestry (ODF) notified PARC of information regarding actual or alleged health incidents involving pesticides in the Highway 36 corridor. PARC agencies (OHA, the Department of Environmental Quality [DEQ], ODA, ODF, and

[1] See Appendix D for details on how spring 2011 urine samples were collected and tested. See the community-collected urine data section for OHA's interpretation of these data.

[2] The slides do not indicate the source of the "US comparison group", the total number of samples submitted, the numbers of "pre-spray" and "post-spray" samples, or the dates on which the samples were collected.

PARC consultants), CDC/ATSDR Region 10 and EPA Region 10 joined to form the Highway 36 Corridor EI team. The Governor's Office designated OHA as the lead state agency for the Exposure Investigation.

At the beginning of the investigation, the EI team did not have access to the biological sampling data presented at the April 2011 Board of Forestry meeting. Although some community members suspected aerial applications to forestlands, the investigation team broadened the investigation to evaluate local pesticide application practices and several potential exposure routes. This decision was supported by the presence of elevated 2,4-D and atrazine levels in all community-collected urine samples and not just those collected after a purported aerial pesticide application on forestland. The data presented in April 2011 suggested that residents could have chronic (or continuous) exposures to pesticides, possibly through contaminated drinking water or another source of exposure. The observed increase in 2,4-D and atrazine metabolites between first and second samples indicated there could also be acute (or short-term) exposures to pesticides after a nearby application. The investigation team chose a methodological approach to evaluate chronic and acute exposures from any local exposure source or pathway.

The EI Team also began an extensive effort to open and maintain an active dialog with all of the residents in the investigation area. In keeping with ATSDR's approach to work with affected communities during an investigation, the EI team used a broad range of methods and venues to communicate with community residents, elected officials, industrial landowners, non-governmental organizations, trade organizations, technical experts, and other stakeholders. This communication effort was designed to provide community members with a variety of opportunities to receive information and share their thoughts and concerns about the investigation. It also provided the EI team important access to a broad range of community perspectives, as well as information on factors that could impact the design and implementation of investigation activities.

Discussion

Exposure Pathway Analysis

At the beginning of the EI, OHA conducted an exposure pathway analysis to identify the major pathways by which people could be exposed to pesticides in the Highway 36 corridor. Exposure, which is defined as contact between a person and a chemical, can only occur if all of the following elements are present:

- a chemical source or released into the environment,
- a way or medium in which the chemicals move in the environment (e.g., water, soil, air, food),
- an exposure point or location where people come into contact with the chemicals,
- an exposure route by which people have physical contact with the chemicals (breathing it in, swallowing it, etc.), and
- an exposed population that comes into contact with the chemicals [6].

Scientists categorize exposure pathways as complete, potential, or eliminated based on their analysis of these five elements. In a complete exposure pathway, all five of these elements are present, indicating a strong likelihood that people could be exposed to a chemical. In a potential exposure pathway, one or more of the elements may be absent, but additional information is needed before eliminating or

confirming the pathway. In an eliminated exposure pathway, exposure to a chemical is unlikely because at least one of these elements is absent. Scientists also attempt to determine if exposures occurred in the past, present, and/or future.

At the beginning of the EI, OHA identified five potential pathways by which Highway 36 corridor residents could be exposed to pesticides in the environment (Table 1). OHA considered these "potential" pathways because at the outset of the investigation there were no environmental data to identify or rule out possible sources or pathways. OHA did not evaluate exposure to pesticide residues on food from retail grocery stores. While this is a valid and probable exposure pathway for many Highway 36 corridor residents, it does not represent a unique local pathway that distinguishes this group from the general U.S. population. OHA also did not evaluate exposures to pesticides that occurred outside the investigation area. It is likely that many residents leave the study area periodically, which could cause them to be exposed to pesticides from uses other than those common to the investigation area.

Table 1: Potential Exposure Pathways at the beginning of the Highway 36 Exposure Investigation.

Pathway	Source/Release*	Transport in environment (Media)	Point of Exposure	Route of Exposure	Exposed Population	Time
Air-borne particles	Aerial applications of pesticides and pressured ground sprays	Movement (drift) of chemicals off application sites (Air)	Outdoor air, indoor air	Breathing in chemicals in air	People who live or work near application areas	Past, present, future
Volatilized chemical vapors	Applications of pesticides	Volatilization of chemicals from soil to air (Air)	Outdoor air, indoor air	Breathing in chemicals in air	People who live or work near application areas	Past, present, future
Surface Soil	Applications of pesticides	Deposition of chemicals on surface soil (Soil)	Soil in gardens, yards	Swallowing, absorbing through skin	Gardeners, farmers, outdoor workers who have contact with surface soil	Past, present, future
Home-grown foods	Applications of pesticides	Deposition on, or uptake of, chemicals in garden vegetables, milk, eggs, etc. (Food)	Garden vegetable, milk, eggs, etc.	Eating	People who eat home-produced foods	Past, present, future
Drinking water	Applications of pesticides	Movement of chemicals through soil to groundwater or over land to surface water (Groundwater, surface water)	Tap	Drinking	Residents and other people who drink water from private ground/surface water sources	Past, present, future

*Aerial applications are primarily used on industrial forestlands in the Highway 36 corridor. Ground applications include backpack spraying, “hack and squirt” applications, or roadside spraying by industrial or commercial landowners, government agencies, or private individuals.

Investigation Design

The EI team developed an investigation plan to evaluate the five potential exposure pathways and answer the Exposure Investigation questions. The EI team proposed to collect data during at least two sampling events: one in fall 2011 and one in spring 2012. The EI team implemented the fall 2011 sampling plan [7]; this report discusses the corresponding methods and results. The EI team was unable to implement the spring 2012 sampling plan for reasons discussed in the Spring 2012 Sampling section below.

The EI team designed the fall 2011 sampling protocol to collect information about pesticide sources and exposure pathways, except air, under baseline or low pesticide use conditions. The spring 2012 sampling plan was intended to evaluate the air exposure pathway during spring aerial or ground spray pesticide applications. As part of the spring 2012 phase, the EI team planned to collect urine samples before and after a nearby aerial or ground spray pesticide application and collect air monitoring data during one or more pesticide applications.

A note about EIs: EIs are not the same as epidemiological health studies and lack some key features commonly associated with epidemiological studies. For example, EIs are intentionally biased to seek out and test those individuals (or locations) expected to be most highly exposed (or contaminated). EIs are not randomized studies. EIs also do not identify or test control groups for comparison. This focuses all sampling resources on individuals at highest risk for exposure to and/or harm from environmental chemicals. EI results are not generalizable to populations outside of the ones tested in the investigation.

Fall 2011 Sampling

In August and September 2011, OHA, ATSDR, EPA and DEQ collected urine and environmental samples to evaluate if residents were being exposed to pesticides through drinking water, soil, and home-grown food. OHA recruited 66 participants from 38 households using the following methods [7]:

- During a public meeting on July 14, 2011, OHA provided attendees with a flyer with information on how to volunteer for the Fall 2011 sampling event. OHA sought assistance from local community members to circulate this flyer through several informal community networks and post it at prominent public locations throughout the community.
- OHA contacted people who signed in at the July meeting by phone and email. OHA also encouraged community members to give our contact information to other interested residents.
- OHA established a toll-free hotline dedicated to the recruitment of volunteers.
- OHA established a listserv to announce updates on the Exposure Investigation and to recruit more volunteers.

The criteria for participation in the Exposure Investigation were that volunteers lived inside the boundaries of the investigation area, lived within 1.5 miles of a timber unit that had been clear-cut in 2010 or 2011 and did not work as a pesticide applicator.[3]

ATSDR and OHA staff collected 66 urine samples from 38 households on August 30 and 31, 2011. The samples were immediately frozen on dry ice and then shipped overnight to the CDC's National Center for Environmental Health (NCEH) laboratory in Atlanta, Georgia. Samples were tested for 2,4-D and atrazine[4] metabolites. These two pesticides were the focus of the EI's urine analysis for three reasons:

1) These pesticides were used in local agricultural and forestry applications;
2) The CDC has laboratory methods to test for these chemicals and national reference levels against which to compare the results for 2,4-D; and
3) These chemicals were tested in the spring 2011 community-collected urine samples.

EPA and DEQ staff collected drinking water, soil, homegrown and wild food samples from the same 38 households on September 19 – 22, 2011. DEQ's laboratory in Hillsboro, Oregon analyzed the drinking water samples for a broad range of pesticides (see Appendix B for the complete list). All other environmental samples, including food and soil, were analyzed at the ODA laboratory in Portland, Oregon for pesticides used in both agricultural and forestry applications. DEQ and ODA laboratories used EPA-approved methodologies and quality assurance protocols [8–15].

Fall 2011 Urine and Environmental Sampling Results

Urine Results

The urine samples collected in fall 2011 were analyzed for 2,4-D and atrazine metabolites, and the results were compared to data from the CDC's *Fourth National Report on Human Exposure to Environmental Chemicals* [16]. These national comparison data were collected as part of NHANES, a nationwide survey that includes monitoring for environmental chemicals in human blood and urine. NHANES is the best source of biomonitoring reference values for the general U.S. population because it is representative of the civilian, non-institutionalized U.S. population in terms of age, sex, and race/ethnicity. However, NHANES data may not reflect variations due to geographic location, season, or residence in urban versus rural areas [17].

These results were originally reported by ATSDR in the first formal report for the Exposure Investigation, *"Exposure Investigation: Biological Monitoring for Exposure to Herbicides, Highway 36 Corridor , Lane County, Oregon"*[17] released in March 2012. ATSDR's earlier report compared the EI urine results to NHANES values from 2001-2002; these were the most current NHANES data available at the time that report was released. In this current report, we compared the fall 2011 urine results against NHANES data collected in 2003-2004. Our use of 2003-2004 NHANES reference data explains the difference between this report's findings and the findings in a separate ATSDR report on the fall 2011 urine samples. The 2003-2004 NHANES values used in this report are slightly higher than the

[3] According to ODF, these units were most likely to be treated with pesticides during the fall 2011 and spring 2012 spray seasons. In the original investigation plan, OHA planned to collect urine and environmental samples from the same participants and households in fall 2011 and spring 2012.
[4] See Appendix E for general information on 2,4-D and atrazine.

2001-2002 values. Our use of different comparison values explains why this report's findings are different from those in the March 2012 ATSDR report.

None of the 66 EI participants had detectable concentrations of atrazine or its metabolites in their urine, indicating there were no recent exposures at the time of testing. Of the 64 EI participants over the age of six[5], 59 (92%) had detectable levels of 2,4-D in their urine. The 95th percentile of the EI participants was not statistically different than the 95th percentiles of the NHANES populations tested in 2003-2004 (Table 2).

Three EI participants had creatinine-adjusted[6] urinary 2,4-D levels above the 2003-2004 NHANES 95th percentile; this number was not statistically higher than expected. Twenty-two EI (34.4%) participants had creatinine-adjusted urinary 2,4-D levels above the NHANES 75th percentile. This number was higher than expected and approaches statistical significance, which is typically defined by a p-value of 0.05 or less. Here the p-value was 0.06 and OHA considers this an uncertain result. OHA cannot conclusively determine whether EI participants were statistically different than the general U.S. population with respect to urinary 2,4-D levels at the time of the fall 2011 sampling (Table 3).

Table 2: Summary of urine results for 2,4-D from fall 2011 sampling.

Units	Mean	Median	Geometric mean	Range	95th percentile of EI (CI)	95th percentile of 2003-2004 NHANES (CI)
µg/L	1.14	0.33	0.37	<LOD -29.98	1.39 (0.98-29.98)	1.63 (1.31-2.37)
µg/g creatinine	1.15	0.37	0.4	<LOD -37.33	1.46 (0.92-37.33)	1.58 (1.24-2.34)

EI – Exposure Investigation; CI = 95% confidence interval; LOD = Limit of Detection (0.1 µg/L for EI); NHANES = National Health and Nutrition Examination Survey; µg/L = micrograms per liter; µg/g; micrograms per gram

[5] There are no NHANES values for comparison for children under six years old.

[6] Contaminant concentrations in urine are influenced by the hydration status and kidney function of the person who provided the sample. In many studies, these factors are controlled by relating contaminant levels to the amount of creatinine measured in urine. Creatinine is a urinary by-product of protein metabolism that is filtered by the kidney at a known and predictable rate. Urinary creatinine levels can vary greatly from person to person and depend on the individual's age, sex, body mass, and other factors [18].

Table 3: Fall 2011 creatinine-adjusted urine results for 2,4-D compared against NHANES 95th and 75th percentiles.

NHANES percentile level	EI urine results above NHANES percentile		One Sample binomial test	
	Number	Percent	95% Exact CI	Two-sided Exact p-value*
95th	3	4.7%	0 – 9	0.60
75th	22	34.4%	22.7 – 46.0	0.06

CI = 95% confidence interval; NHANES = National Health and Nutrition Examination Survey; EI = Exposure Investigation
*Typically, a p value equal to or less than 0.05 is considered statistically significant.

To evaluate the health significance of the urinary 2,4-D levels in EI participants, we compared the urine results to the biomonitoring equivalent (BE) for 2,4-D. A BE represents the estimated concentration of 2,4-D that would be present in the urine of a person who was chronically exposed to 2,4-D at a dose equal to EPA's reference dose (RfD) for 2,4-D. An RfD is an estimate of the daily oral exposure that people (including sensitive populations) could be exposed to over a lifetime without experiencing harmful health effects. The BE for chronic exposures (lasting more than 7 years) to 2,4-D is 200 µg/L; for acute exposures (lasting one day), the BE is 400 µg/L for women of reproductive age and 1,000 µg/L for the rest of the population [19-20].

The maximum concentration of 2,4-D detected in an EI participant (30 µg/L) was about seven times lower than the chronic BE, and between 13 and 33 times lower than the acute BE for women of reproductive age and the general population respectively. The average 2,4-D concentration measured in EI participants' urine (1.14 µg/L) was 175 times lower than the chronic BE, and more than 350 times lower than the acute BEs. These data indicate that at the time of testing, EI participants were not exposed to 2,4-D at levels known to cause adverse health effects from acute or chronic exposures. The weight of available scientific evidence indicates that the 2,4-D levels measured in EI participants' urine do not pose public health risks.

Environmental Sampling Results

EPA, with assistance from DEQ, collected environmental samples, which included drinking water, soil, and community grown food samples from participating households. Thirty-six drinking water samples were collected from EI participants' homes. Nineteen of these samples were from domestic wells and 17 samples were from springs. A surface water sample was also collected from nearby Little Lake, which is not used as a drinking water source. EPA and DEQ collected 29 soil, fourteen vegetation, four berry, four egg, two milk, and two honey samples from participating households. DEQ analyzed each water sample for over 100 chemicals (analytes), and ODA's lab analyzed all other samples for 11 analytes used in agricultural and forestland applications in the area. Appendix B includes the list of analytes tested for in environmental samples.

Pesticides were detected in three (one analyte in each sample) of the 36 drinking water samples (Table 4). The three analytes detected were N,N-diethyl-meta-toluamide (DEET), hexazinone, and fluridone. DEET was also detected in the sample collected from Little Lake. Each of these detections was below health-based screening values for these three chemicals. DEET is the active ingredient in many personal-use insect repellent products [21]. Hexazinone is an herbicide used to control a broad spectrum of weeds including undesirable woody plants in alfalfa, rangeland and pasture, woodland, pineapples, sugarcane, and blueberries. It is also used on ornamental plants, forest trees, and other non-crop areas [22]. Fluridone is an herbicide used to control aquatic weeds in ponds and lakes. Hexazinone is the only analyte detected that was listed in investigation area forest application notifications between 2009 and 2011.

The ODA lab detected at least one of the eleven pesticides in three of the 29 soil samples analyzed. Glyphosate and 2,4-D were both detected in one soil sample, and only 2,4-D or glyphosate was detected in the two other soil samples. The glyphosate and 2,4-D levels in these samples were below ATSDR's health-based screening values, which are 5,000 ppm for glyphosate and 500 ppm for 2,4-D (Table 4). None of the households with pesticides detected in their soil had any detectable pesticides in their drinking water. No pesticides were detected in any of the vegetation, berry, egg, milk, or honey samples collected in fall 2011.

Table 4: Fall 2011 environmental sampling results – detections in water and soil.

Location	Sample Type	Analytes Detected	Analyte Concentration (ppm)	Health-based Screening Value (ppm)	Source of screening value
Household 1	Domestic well water	DEET	0.0000047	0.2	Derived*
Household 2	Domestic spring water	Hexazinone	0.000183	0.2	HBSL
Household 3	Domestic well water	Fluridone	0.000031	0.4	HHBP
Little Lake	Surface water	DEET	0.0000058	1	Derived*
Household 4	Soil	Glyphosate	0.081	5,000	RMEG
	Soil	2,4-D	0.046	500	RMEG
Household 5	Soil	2,4-D	0.014	500	RMEG
Household 6	Soil	Glyphosate	3.3	5,000	RMEG

ppm = parts per million; DEET = *N*,*N*-Diethyl-3-methylbenzamide; HBSL = U.S. Geological Survey Health Based Screening Level; HHBP = U.S. Environmental Protection Agency Human Health Benchmark for Pesticides; RMEG = Reference dose Media Evaluation Guide; 2,4-D = 2,4-dichlorophenoxy acetic acid
* Derived using Agency for Toxic Substances and Disease Registry methodology and Reference Dose developed by Minnesota Department of Health (0.33 mg/kg-day) [23]

Survey data

After urine samples were collected on August 30 and 31, 2011, OHA asked EI participants to complete a short survey on their pesticide use at home and place of work (see Appendix C for survey questions). Most EI participants were sent the survey via email and a few without internet access were contacted by phone. Forty-four (67%) of the 66 EI participants responded to the survey. Of the 44 respondents, 26 (59%) reported they did not use pesticides on their own land. Of the 18 who reported using pesticides on their land, a few respondents specified that they used Roundup® (active ingredient glyphosate), Weedmaster® (active ingredients 2,4-D and dicamba) or Crossbow® (active ingredients 2,4-D and triclopyr). Four (9%) survey respondents reported using pesticides at their place of work, and two of these four respondents had not used pesticides at work for the past several months. In the week prior to having their urine collected by ATSDR, none of the 44 survey respondents reported using pesticides at home or at work.

Comparison to Application Record data

OHA reviewed the available 2011 pesticide application data provided by ODF and ODA to determine if any commercial, public or private pesticide applications occurred during the fall 2011 urine or environmental sample collections.[7] Two ground-based applications occurred during the urine sample collection and were as close as 0.3 miles to a participating household. The first application occurred on August 30 and used glyphosate, sulfometuron methyl, metsulfuron methyl, and imazapyr. The second application was a hack and squirt application on August 31 that used imazapyr. Neither of these applications used 2,4-D or atrazine (the chemicals that were tested for in urine). The only reported commercial applications using 2,4-D or atrazine occurred in April and May, approximately three months prior to the urine testing (see Appendix A).

There were thirteen reported pesticide applications on the days EPA and DEQ collected environmental samples (September 19-22). Eight applications occurred on 9/20, six of which were aerial applications on forestland. The eight applications on 9/20 used the pesticides glyphosate, sulfometuron methyl, metsulfuron methyl, and imazapyr. One of these six aerial applications was as close as 1.1 miles from a participating household; the water, soil and vegetable samples collected from this household on 9/22 did not have pesticide detections. There were three applications of imazapyr on 9/21, one application of imazapyr on 9/22, and one application of aminopyralid on 9/22. The applications on 9/21 and 9/22 were ground-based and located more than three miles from participating households.

Integration of Fall 2011 Data

Seven individual participants (in six households) who provided urine samples had pesticides detected in either their soil or drinking water (see Table 5). Two of these environmental samples had detections of 2,4-D, which was the only pesticide found in urine. The number of detections in environmental samples

[7] OHA obtained records of pesticide applications in the investigation area from 2009 – 2011, but only evaluated records from 2011 for this report. See Appendix A for additional information on 2011 application record data.

is too small to determine if there is a correlation between the 2,4-D levels measured in soil and the 2,4-D levels measured in urine.

The EI team cannot determine the sources of the pesticides detected in the fall 2011 drinking water or soil samples. In the survey administered by OHA shortly after the urine sample collection, all but one of the seven households with environmental sample detections reported using some kind of herbicide on their own property on a somewhat regular basis. Where specific products were named, Roundup® (active ingredient glyphosate) and Crossbow® (active ingredients 2,4-D and triclopyr) were the two most frequently used. However, none of the participants in these households reported using any pesticide products in the week prior to the urine sample collection. Further, application records indicate that none of the thirteen known pesticide applications that occurred when EPA was collecting environmental samples, contained the pesticides that were detected in drinking water (DEET, hexazinone, and fluridone). During the time the soil samples were collected, there were eight local pesticide applications that used glyphosate, which was detected in two households' soil samples. These applications were over three miles from these households, but some evidence suggests that under certain conditions some pesticides can travel long distances [24], [25], [26], [27], [28], [29], [30], [31].

Table 5: Combined Urine and Environmental Data from Fall 2011 sampling.

Household	Participant	Urine 2,4-D (µg/g-creatinine)	Drinking Water (ppm)	Soil (ppm)
Household 1	Participant A	0.29	DEET: 0.0000047	Non-Detect
Household 2	Participant B	0.61	Hexazinone: 0.000183	Non-Detect
Household 3	Participant C	0.24	Fluridone: 0.000031	Non-Detect
Household 4	Participant D	37.3	Non-Detect	Glyphosate: 0.081 2,4-D: 0.046
	Participant E	0.94		
Household 5	Participant F	0.38	Non-Detect	2,4-D: 0.014
Household 6	Participant G	1.12	Non-Detect	Glyphosate: 3.3

µg/g = micrograms per gram; ppm = parts per million; 2,4-D = 2,4-dichlorophenoxy acetic acid; DEET = *N*,*N*-Diethyl-3-methylbenzamide

Uncertainties/Limitations

All scientific processes involve some uncertainties. This section discusses some of the uncertainties and limitations related to the fall 2011 sampling and results.

- All samples collected in fall 2011 (urine, water, soil, and food) represent snapshots in time. This is especially true for urine results since 2,4-D and atrazine are cleared rapidly from the body [32], [27], [33]. As such, any conclusions about exposure and health risks based on urine results only apply to the times these samples were collected.
- Therefore, the results of fall 2011 sampling do not tell us whether EI participants had past chronic, acute, or repeated acute exposures to 2,4-D or atrazine. Chemical exposures are typically more harmful the longer they last. An ongoing (chronic) exposure may be more

concerning than a short-term (acute) exposure even if the short-term exposure is more intense (i.e., greater amount of a chemical enters the body).
- We do not know if participants were exposed to other pesticides at the time of sample collection since we were only able to test for 2,4-D and atrazine metabolites in urine.
- Currently, there is little scientific information about the health implications of exposure to multiple chemicals at low doses.

Summary of Fall 2011 sampling

- At the end of August 2011, 59 (92%) of the 64 EI participants over six years of age had detectable levels of 2,4-D in urine.
- Because statistical significance tests on urinary 2,4-D levels were equivocal, OHA cannot conclude whether EI participants were statistically different than the general U.S. population with respect to urinary 2,4-D levels at the time of sampling.
- Three drinking water samples, one surface water sample, and three soil samples had detectable levels of pesticides (see Table 4).
- The levels of pesticides measured in urine, drinking water, surface water, and soil samples in fall 2011 are not expected to cause harmful health effects.
- There are insufficient data to determine if there is a statistically significant correlation between environmental sampling results and urine sampling results.
- All but one of the participants with pesticides detected in their environmental samples reported occasional or regular home use of herbicides, including those containing glyphosate and 2,4-D.
- None of the participants (including those with pesticides detected in their environmental samples) reported pesticide use in the week prior to urine sample collection.
- None of the known commercial pesticide applications that occurred during the fall 2011 urine sample collection used 2,4-D or atrazine.
- Eight of the 13 known commercial, public, or private pesticide applications that occurred during the fall 2011 environmental sample collection used glyphosate, which was detected in two households' soil samples. However, the applications occurred over three miles away from these households.
- Some evidence suggests that under certain circumstances, pesticides may travel long distances; therefore it is unclear whether 2,4-D and glyphosate detections in participants' soil samples can be linked to known commercial, public, or private pesticide applications.

Spring 2012 Sampling/ Investigation Suspension

In the original investigation plan, urine and air samples were to be collected in spring 2012 to evaluate the only medium (ambient air) not tested in fall 2011. The spring 2012 data would have been used to determine if aerial pesticide applications resulted in measureable levels of pesticides in air and in the urine of residents in the investigation area. OHA and ATSDR planned to collect urine from local residents prior to and immediately after aerial applications of 2,4-D and/or atrazine. EPA and DEQ planned to collect air samples during application events and test these samples for a wider range of pesticides.

The EI team suspended spring sampling on March 8, 2012 because the areas that were slated for applications of 2,4-D and/or atrazine were in remote locations which have very few residents. In spite of

significant effort, OHA was unable to recruit enough participants for pre/post-application urine sampling. Further, EPA and DEQ were not ready to conduct air monitoring at the time. After suspending the investigation, the EI team reassessed progress on answering the investigation questions, and considered options to fill the remaining data gaps. OHA decided not to pursue additional biosampling because of the technical and logistical challenges involved in a pre/post-application sampling design. These challenges include: the limited number of pesticides able to be measured in urine; lack of appropriate comparison data for most pesticides in urine; the relatively short half-lives of 2,4-D and atrazine in urine; and difficulty in obtaining information about the exact timing of planned pesticide applications. EPA is developing a sampling method to passively monitor air for pesticides of interest. However, it is unlikely that air monitoring will occur until late 2013 or 2014.

Community-collected data

ATSDR allows for the inclusion of community-collected data in Exposure Investigations and provides guidelines for evaluating the quality of these data [6]. According to ATSDR guidelines, data should be weighted based on impartial data quality criteria and not on the credentials or background of the entity that provided or collected the data [6].

In early spring 2012, while OHA was trying to recruit participants for the pre- and post-spray urine sampling, some community members indicated their willingness to share the community-collected urine sample data collected in spring 2011. They also offered to share environmental data (water and air) they had collected at their own expense in the investigation area. The community members requested the EI team evaluate their data for inclusion in the Exposure Investigation. The EI team agreed to evaluate community-collected urine and environmental data for chain of custody, quality control, and their potential implications for exposure and human health.

Community members and the private consultants and laboratories they employed supplied OHA, DEQ, and EPA with all the documentation needed to evaluate the quality of the community-collected data. OHA, DEQ, and EPA reviewed this documentation and agree that the data are of sufficient quality to be analyzed and presented in this PHA (with the exceptions noted in the sections below). Details of our data quality evaluation process are presented in the sections below.

Community-collected Urine Data

Community members in the Highway 36 corridor collected urine samples in spring 2011 as part of their own assessment, independent of government agency oversight. Community organizers recruited 43 individuals to participate and organized the collection of 62 urine samples from these participants between February 8 and June 1, 2011. A research professor at Emory University in Atlanta, GA tested the urine samples received by her laboratory for evidence of recent pesticide exposures.

In May and June 2012, OHA obtained written informed consent from 29 participants who live in the investigation area to use their spring 2011 urine results for this PHA. OHA obtained these 29 participants' results directly from the Emory University researcher.

Residents' decision to collect samples

OHA contacted the 29 consenting individuals in the investigation area to learn more about the sequence of events that occurred around the time of the spring 2011 urine collection. We asked them to describe what prompted them to collect urine samples at various times between February and June 2011. About half the participants collected samples in February 2011 with the intention of having their urine tested before aerial pesticide applications began for the spring season. Participants used ODF's Notification of Operation system to determine when the spring application season would begin. As one participant stated, "We didn't just assume that there had been no spray. We had no notifications, and it was very much the end of the "no-spray" season. There is a good network of people out here with notifications; nothing had been scheduled for months." Other participants provided their first samples in March and April 2011.

Beginning April 9, 2011, community members started collecting second urine samples in order to capture what they believed were "post-spray" conditions. The individuals' reasons for collecting a second sample vary, but several people reported collecting a second sample after:

- hearing, seeing, and/or filming an aerial spraying;
- receiving notification by email that a spray was occurring nearby; or
- feeling unwell or reported experiencing symptoms they attributed to nearby spraying.

One participant stated, "We were trying to figure out when to go for the 2nd test. But tracking sprays is impossible to do because there is too broad a scope of time between when you get notified and when they spray, so we just started getting sick one day at the same time, and went in to get tested after realizing we couldn't track it."

In May and June 2011, more people began providing initial urine samples because they either witnessed an aerial spray or experienced symptoms they attributed to nearby spraying.

Community urine sample collection, shipment, and laboratory analysis[8]

The 29 consenting participants within the investigation area provided 46 samples for the community urine collection. OHA verified that all 46 samples (100%) had a complete chain of custody from the time the residents had their urine collected at a PeaceHealth facility in Eugene, OR to the time PeaceHealth shipped the samples to Emory University (Table 6). OHA confirmed that Emory's Central Shipping and Receiving (CS&R) facility received 33 of the 46 samples (72%), and that the researcher's laboratory received 26 samples (57%). OHA was unable to verify a receipt date for thirteen samples at either Emory CS&R or the lab. OHA also found that seven samples received by the lab were apparently not tested. In all, the researcher analyzed 39 of the 46 samples for 2,4-D and atrazine metabolites and provided these results to OHA. Urine samples were kept frozen throughout transport and in storage until the time of analysis. The researcher used CDC method 6107.01 [34] to analyze urine samples for atrazine metabolites and CDC method 6103.01 [35]to test urine samples for 2,4-D. No field blanks were included with the community-collected samples.

[8] See Appendix D for detailed information on residents' sample collection, shipment, and laboratory analysis.

Table 6: Chain of custody for 46 community-collected urine samples.

Number of Samples with Confirmed Collection Documentation at Peace Health	Number of Samples with Confirmed Transport Date by PeaceHealth Courier	Number of Samples with Confirmed Shipment Date from PeaceHealth to Emory	Number of Samples with Confirmed Receipt Date at Emory	Number of Samples with Confirmed Receipt Date at Lab	Number of Samples with 2,4-D/ Atrazine results from Lab
46	46	46	33	26	39

2,4-D = 2,4-dichlorophenoxy acetic acid

OHA analysis of community-collected urine results

The researcher tested the 39 community-collected urine samples for 2,4-D and three metabolites of atrazine: diaminochlorotriazine (DACT), desethyl atrazine (DEA), and di-dealkylated atrazine mercapturate (DAAM). For ease of analysis and interpretation, we present atrazine results as atrazine equivalents. OHA was not able to adjust the urinary 2,4-D and atrazine results for creatinine because the 39 samples were not tested for creatinine. Results are presented as straight urine concentrations in micrograms per liter (µg/L). Table 7 shows basic descriptive statistics for the 39 community-collected samples.[9]

All 39 samples had detectable levels of 2,4-D and atrazine metabolites. OHA compared the spring 2011 community-collected urine samples to the fall 2011 samples collected by ATSDR (Table 8) using a statistical test called the Mann-Whitney U Test. For 2,4-D, the geometric mean in spring 2011 samples was significantly higher than the geometric mean in fall 2011 samples. Atrazine metabolites were found in all of the spring 2011 samples, while none were found in fall 2011 samples.

Table 7: Summary urine results (µg/L) from spring 2011 community-collected samples (N = 39).

Contaminant	Mean* (Range)	25th Percentile	50th Percentile	75th Percentile	95th Percentile
2,4-D	4.9 (0.7-31.7)	2.2	5.0	11.7	25.6
Atrazine equivalents†	5.0 (0.6-62.1)	2.4	4.8	11.4	29.8

*Mean is geometric mean; †Atrazine equivalents reflect the sum of measurements of the metabolites diaminochlorotriazine (DACT), desethyl atrazine (DEA), di-dealkylated-atrazine mercapturate (DAAM)
2,4-D = 2,4-dichlorophenoxy acetic acid

[9]OHA used geometric means instead of arithmetic means in order to compare the EI data to NHANES data (which are reported as geometric means). Arithmetic means are calculated by adding up all the results and dividing the result by the number of results (n). Geometric mean is calculated by multiplying all the results and then taking nth root of the product.

Table 8: Comparison of spring 2011 community-collected samples to fall 2011 ATSDR samples.

Contaminant	Spring 2011 Mean* (µg/L) (N=39)	Fall 2011 Mean* (µg/L) (N=64)	Mann-Whitney U Test (P Value)
2,4-D	4.9	0.37	<0.0001
Atrazine equivalents	5.0	None detected	-
*Geometric mean; µg/L = micrograms per liter; 2,4-D = 2,4-dichlorophenoxy acetic acid			

OHA determined that 20 of the 39 community-collected samples had the necessary documentation to establish a complete chain of custody from the time the samples were collected at PeaceHealth to the time they were delivered to Emory University. The missing documentation for the other 19 samples consisted of the slips confirming receipt at either Emory University's CS&R or the Emory laboratory. However, there was complete documentation confirming that the samples were shipped from PeaceHealth's shipping facility, and the Emory lab had results for these samples. This indicates that these 19 samples were actually delivered to the laboratory at Emory.

OHA conducted an additional statistical analysis to verify that the 19 samples without complete documentation were not statistically different than the rest of the samples. The average levels of 2,4-D and atrazine metabolites in the 19 samples without complete chain of custody were not statistically different from the average levels in the 20 samples with complete chain of custody (Table 9). Therefore, OHA accepted all 39 samples as valid test results, and all 39 were included in the analyses and conclusions presented.

Table 9: Comparison of urinary 2,4-D and atrazine levels by chain of custody, spring 2011.

Chemical	Incomplete custody sample mean* (N = 19)	Complete custody sample mean* (N = 20)	Wilcoxon two-sample P-value
2,4-D (µg/L)	6.2	3.9	0.1477
Atrazine Equivalents (µg/L)	6.6	3.8	0.1363
*Geometric mean; µg/L = micrograms per liter; N = number; 2,4-D = 2,4-dichlorophenoxy acetic acid			

Comparison to Application Record Data

After obtaining the community-collected urine data and the pesticide application records, OHA was able to identify the urine samples that were collected before and after an application of 2,4-D and/or atrazine. Of the 39 community-collected samples, 30 were collected prior to any reported commercial applications of 2,4-D or atrazine. Nine of the 39 samples were collected the day of or the day after an application of 2,4-D or atrazine.[10] For this report, OHA reclassified spring 2011 samples as "baseline" (N = 30) and "post-application" (N=9) based on pesticide application records data (regardless of the classifications assigned by community members who provided the samples).

OHA compared the average concentrations of 2,4-D and atrazine in the nine post-application samples to the average concentrations in the 30 baseline samples (Table 10). While the levels of 2,4-D were statistically similar in the two groups, the levels of atrazine were significantly higher in the post-application samples compared to the baseline samples.

The higher levels of atrazine found in the post-application samples suggest that these samples were collected at a time when there were relatively higher levels of atrazine exposure among participating community members. There were four known applications of atrazine, all aerial applications and all co-applied with 2,4-D, which occurred less than 24 hours before the collection of nine post-application samples. These four applications were located between 2 and 3.8 miles from the homes of participants who collected these samples with an average of 2.65 miles. No site- or time-specific information is available about the persistence and movement of atrazine in the environment after it was applied in this case. Therefore, OHA cannot confirm that the relatively elevated atrazine levels in post-application urine samples were from a specific pesticide application, the contribution of multiple applications in the area, or some other source. However, there is evidence suggesting that aerially applied pesticides in general [25], [26], [28], [29], [30], [31], and atrazine in particular [27], can move at least 2-4 miles away from the application site; therefore it is possible that local aerial atrazine applications contributed to the elevated levels of urinary atrazine metabolites detected in participants.

Table 10: Comparison of baseline and post-spray levels of 2,4-D and atrazine in urine, spring 2011.

Chemical	Baseline sample mean* (N = 30)	Post-application sample mean* (N = 9)	Exact Wilcoxon two-sample P-value
2,4-D (µg/L)	4.4	7.2	0.2312
Atrazine Equivalent (µg/L)	4.0	10.0	0.0450**

*Geometric mean; µg/L = micrograms per liter; N = number; 2,4-D = 2,4-dichlorophenoxy acetic acid
**Indicates a statistically significant finding ($p < 0.05$)

[10] In 2011, there were 16 commercial pesticide applications that included the use of 2,4-D or atrazine. Thirteen of these applications occurred in April 2011 and three occurred in May 2011.

2,4-D

NHANES tracks 2,4-D nationwide but it does not track the atrazine metabolites measured in the community-collected urine samples. Therefore, we were only able to compare the spring 2011 urine results to NHANES data for 2,4-D results. The baseline (N=30) and post-application (N=9) samples, as well as the spring 2011 samples in total (N=39), had 2,4-D concentrations greater than the 2003-2004 NHANES 75th percentile (0.58 µg/L). Eighty percent (80%) of baseline, 100% of post-application, and 84.6% of all spring 2011 samples also had 2,4-D concentrations higher than the NHANES 95th percentile (1.63 µg/L). All of these differences were statistically significant (Table 11). This means that at the time the samples were collected, the 2,4-D levels in participants' urine were statistically higher than the levels found in the general U.S. population.

Table 11: Comparison of 2,4-D levels in community-collected urine samples (N = 39) to 2003-2004 NHANES* data.

	Values above NHANES 75th percentile (0.58 µg/L)		One Sample Binomial Test	Values above NHANES 95th percentile (1.63 µg/L)		One Sample Binomial Test
Samples	Number	Percent	Two-sided Exact p-value	Number	Percent	Two-sided Exact p-value
Baseline samples (N = 30)	30	100	<0.0001	24	80.0	0.0066
Post-application samples (N = 9)	9	100	<0.0001	9	100	<0.0001
Total (N = 39)	39	100	<0.0001	33	84.6	0.025
µg/L = micrograms per liter; NHANES = National Health and Nutrition Examination Survey; N = number						

We also compared the community-collected spring 2011 urine results to published studies measuring urinary 2,4-D levels in pesticide applicators. The community-collected results were most similar to two studies of 2,4-D exposures among farm applicators [36], [37] that found average pre-application 2,4-D levels of 7.8 and 3.8 µg/L, respectively.

To assess the potential health risks from the levels of exposure seen in community-collected urine samples, we compared the spring 2011 urine results to the biomonitoring equivalent[11] for 2,4-D. The BE was six times higher than the highest urinary 2,4-D concentration measured in spring 2011 samples (31.7 µg/L). OHA does not expect that the levels of 2,4-D exposures seen among participants in the spring 2011 urine assessment were high enough to pose risks to public health. Current scientific evidence indicates that none of the 2,4-D levels measured in Highway 36 corridor residents in spring and fall 2011 indicate exposures that are expected to cause adverse health effects.

Atrazine

In the case of atrazine, there are no national reference values against which to compare the spring 2011 urine results. Therefore, OHA searched peer-reviewed literature for smaller studies where the same

[11] See Fall 2011 Urine results for additional information on the 2,4-D biomonitoring equivalent.

atrazine metabolites were measured in human urine. Table 12 summarizes these studies. The levels of atrazine metabolites measured in spring 2011 urine samples were in the higher range of those found in pregnant women in France [38], lower than those found in turf applicators, and in the range of those measured in non-occupationally exposed individuals [39]. In fall 2011, no atrazine or atrazine metabolites were detected in any of the participants, indicating that atrazine exposures were higher in spring than in fall.

Table 12: Atrazine metabolite equivalents measured in peer reviewed literature.

Study	Population	Median atrazine equivalents (µg/L)	Metabolites measured	Range (µg/L)
French women's study [38]	Pregnant women in Brittany region of France (N = 579)	1.2±	DEA, DACT, DIA, atrazine mercapturate	ND – 17.1
Barr study [39]	Individuals with occupational* exposures (N = 8)	Not reported	DEA, DIA, DACT, DAAM, ATZ, ATZ-OH, DEA-OH	100-510
	Individuals with non-occupational exposures (N = 5)	Not reported		10-235

µg/L = micrograms per liter, DEA = Desethyl atrazine, DIA = desisopropyl atrazine, DACT = Diaminochlorotriazine, DAAM = Didealkylated atrazine mercapturate, ATZ = atrazine, ATZ-OH = hydroxy atrazine, DEA-OH = hydroxy desethyl atrazine, N = number, ND = non-detect

± Median among detected values; *Commercial lawn care applicators

Unlike 2,4-D, there are no published BEs for atrazine metabolites, so it is not possible to compare these results against toxicity-based threshold values. Therefore, it is not possible at this time to determine if the levels of atrazine metabolites found in the spring 2011 urine samples could be associated with adverse health effects.

Uncertainties/Limitations

- The spring 2011 community urine samples were collected as part of an independent assessment. Aside from the application records provided by regulated pesticide applicators in the area, we do not have information on other potential sources of exposure that could explain the higher than expected levels of 2,4-D and atrazine metabolites found in these participants' urine samples.
- Contaminant levels in urine are influenced by the hydration status and kidney function of the person who provided the sample. In many studies, these factors are controlled by measuring the amount of creatinine (a urinary by-product of protein metabolism that is filtered by the kidney at a known and predictable rate) and relating contaminant levels to the amount of creatinine. Urinary creatinine levels can vary greatly from person to person, depending on the individual's age, sex, body mass, and other factors [18]. Because the spring 2011 urine samples were not tested for creatinine, we were not able to control for the variables of hydration status or kidney function in our analyses.

Summary of community-collected urine data

- All 39 samples from 29 participants in the community urine collection had detectable levels of 2,4-D and atrazine metabolites.

- The levels of 2,4-D measured in the urine of 29 Highway 36 corridor residents in spring 2011 were statistically higher than those found in the general U.S. population and statistically higher than the levels measured in Highway 36 corridor residents in fall 2011. The levels of atrazine metabolites measured in spring 2011 were higher than the levels found in fall 2011. However, OHA has insufficient information to determine why the spring 2011 samples had higher levels of 2,4-D and atrazine compared to fall 2011 samples, but it is possible that these results were influenced by environmental conditions, which fluctuate seasonally.
- The urinary levels of 2,4-D measured in spring 2011 were several times lower than the BE for 2,4-D (200 µg/L), and do not indicate a public health risk.
- We cannot determine if the levels of atrazine metabolites measured in spring 2011 pose health risks because there is no toxicity-based threshold for atrazine concentrations in urine.
- The levels of atrazine metabolites in community-collected urine samples were significantly higher in samples collected within a day of a known application of atrazine compared to samples that were not collected within a day of a known application. Additional information is needed to understand how these chemicals move in the environment in order to interpret the likelihood that local applications that occurred in the area may have contributed to these increased concentrations. There is conflicting evidence regarding whether the distance of two miles from the point of application to the participants' homes is sufficiently protective; in addition, we do not know if there were other sources of atrazine exposure in the environment.

Community-Collected Environmental Data

Water (POCIS) Data

Some members of the community, called the Siuslaw Watershed Guardians (SWG), conducted surface water sampling within the investigation area, in the spring and summer months of 2011, independently and at their own expense. This section describes their work and results.

Methods

The SWG used Polar Organic Chemical Integrative Samplers (POCIS), which are designed to absorb organic chemicals that have dissolved in water. POCIS samplers are typically positioned in a stream and left for up to 28 days. Because of the long deployment time and continuous sampling, POCIS allows for measurement of very low concentrations of chemicals, in fact much lower than could be detected using traditional water sampling methods. However, results from POCIS samplers cannot be used to evaluate human exposure. This is because it is impossible to obtain the two pieces of information needed to calculate the concentration of a contaminant in water: the volume of water sampled by the POCIS (i.e. liters per day) and the associated uptake rate of the chemical (i.e., micrograms or milligrams of a contaminant). Therefore, POCIS results are mainly qualitative in nature and are reported as an amount of chemical per individual POCIS sampler (e.g., nanograms per POCIS or ng/POCIS) [40]. In other words, we can describe the presence and amount of a chemical found in the POCIS sampler, but not the exact concentration in the water. POCIS data are often used to compare relative amounts of contaminants at one time or location with another time or similar location. For example, POCIS data can be used to compare contaminant levels in two tributaries or to monitor seasonal variations in contaminant levels in a particular stream.

The SWG deployed POCIS samplers at five locations shown in Table 12. Most samplers were deployed from April to May of 2011, but one was deployed from June to July of 2011. Duplicate samples were collected at two sample locations: Fish Creek (near the mouth) and Nelson Creek (downstream from Almaisie Creek). The SWG POCIS samplers were analyzed by Anatek labs in Moscow, Idaho for seven analytes: 2,4-D, atrazine, desethyl atrazine, desisopropyl atrazine, hexazinone, trichloropyridinol, and triclopyr. Desethyl atrazine and desisopropyl atrazine are breakdown products of atrazine.

With the permission of the community, Anatek Labs sent data and data quality assurance/control reports to DEQ for independent review. DEQ reviewed the raw lab data and Anatek' s quality assurance/control procedures. DEQ also compared the SWG sampling results to POCIS data collected by DEQ in other parts of the state. DEQ found that the SWG used valid sampling methods and that the analysis performed by Anatek Labs was appropriate and valid for the purposes of the study. DEQ provided OHA with a summary of their findings.

Results

The SWG POCIS samples contained atrazine, hexazinone, and desethyl atrazine (Table 12). Two of these contaminants, atrazine and hexazinone, are typically found by DEQ in waters throughout the state. Desethyl atrazine is not measured in DEQ's state-wide Toxics Monitoring Program; therefore, we do not know if the presence of this chemical in SWG's samplers is unusual. DEQ frequently detects 2,4-D and triclopyr as part of its state-wide POCIS monitoring, but neither of these chemicals were detected in the SWG samplers. Because these POCIS sampling results cannot be expressed as concentrations in water, OHA was not able to further evaluate these data by comparing them to health-based CVs for contaminants in water.

Uncertainties

There was no information about stream flow rate provided, and this creates some uncertainty in comparing results from one stream or location with another.

Table 13: Community POCIS data for surface water.

			Analytes (ng/POCIS)						
Sample Location	Deployment Dates	Lab Analysis Date	2,4-D	Atrazine	Desethyl Atrazine	Desisopropyl Atrazine	Hexazinone	Trichloropyridinol	Triclopyr
Fish Creek Near Mouth	4/17/2011-5/15/2011	9/8/2011	ND	52.3	15.9	ND	50.7	ND	ND
Fish Creek Near Mouth (Duplicate)	4/17/2011 - 5/15/2011	5/15/2012	NR	93	26.7	NR	81	NR	NR
Lake Creek Upstream of Fish Creek	4/17/2011 - 5/15/2011	9/8/2011	ND	15.8	0.9	ND	9.3	ND	ND
Congdon Creek a quarter mile from mouth	4/23/2011 - 5/21/2011	9/8/2011	ND	1.9	ND	ND	3.6	ND	ND
Unnamed drainage to Congdon Creek	4/23/2011-5/21/2011	9/8/2011	ND	ND	ND	ND	ND	ND	ND
Nelson Creek downstream of Almaisie Creek	6/3/2011 - 7/3/2011	9/8/2011	ND	ND	ND	ND	ND	ND	ND
Nelson Creek downstream of Almaisie Creek (duplicate)	6/3/2011-7/3/2011	5/15/2012	NR	ND	ND	NR	16.8	NR	NR
ng = nanograms; POCIS = Polar Organic Chemical Integrative Samplers; ND = Not detected; NR= Not reported; 2,4-D = 2,4-dichlorophenoxy acetic acid									

Air Data

Highway 36 community members also conducted air sampling within the investigation area and submitted the results to OHA for review and inclusion in this PHA.

Methods

Community members provided data on 16 air samples in the investigation area. Eleven samples were collected in October 2011, one sample was collected in March 2012, and four samples were collected in May 2012. Community members collected samples around Fish Creek, Triangle Lake, and private residences in the valleys below private timberlands. The 11 October samples and one March sample were intended as baseline data, meaning that no known pesticide applications were occurring when the samples were collected. The May 2012 samples were collected during and immediately following a pesticide application on nearby forestland.

Samples were collected using Tisch Environmental, Inc. Te-PUF Polyurethane foam high volume active air samplers according to the manufacturer's instructions.[12] Field blanks accompanied and were analyzed along with each of the samples. Each sample was collected over approximately 12 hours resulting in total collected air volumes ranging from 77 – 147 m^3. The samples were sent directly to Anatek Labs in Moscow, Idaho for analysis. Anatek labs analyzed each sample for 27 chemicals: clopyralid; 2,4,5-trichlorophenoxyacetic acid (2,4,5-T); 2-(2,4,5-Trichlorophenoxy)propionic acid (2,4,5-TP or Silvex); 2,4-dichlorophenoxy acetic acid (2,4-D); 4-(2,4-dichlorophenoxy)butyric acid (2,4-DB); dacthal; dalapon; dicamba; dichloroprop; dinoseb; 2-methyl-4-chlorophenoxyacetic acid (MCPA); picloram; atrazine; chlorsulfuron; desethyl atrazine; halosulfuron; hexazinone; imazapyr; imazosulfuron; iodosulfuron; metsulfuron methyl; nicosulfuron; prosulfuron; rimsulfuron; sulfometuron methyl; triasulfuron; and tiflusulfuron methyl.

Results

Most of the air samples were non-detect for all 27 chemicals tested. Six of the eleven samples collected in October tested positive for 2,4-D. The field blanks associated with four of these six samples also tested positive and contained similar amounts of 2,4-D. This indicates that these four samples were likely contaminated and cannot be used as valid results. One of these field blank also tested positive for picloram, but picloram was not detected in the main sample. Because of these contamination issues, OHA and DEQ do not consider the October air sample results to be valid.

One of the four samples collected in May, which was collected during an observed pesticide application to nearby forestland, had a positive detection of clopyralid at 0.37 ng/m^3. This appears to be a valid result, as the field blank was clean. OHA does not currently have access to the pesticide application records that correlate to the observed application. However, clopyralid was one of the pesticides listed on the notification record associated with that harvest unit.

There are no established health-based screening level for clopyralid in air. However, there is a standard method for converting an oral reference dose (RfD) into a reference concentration (RfC) [41]. An RfC is

[12] This type of active sampling is different from the passive air sampling methods that EPA is working to develop. Active sampling requires a power source and tight coordination with pesticide applicators to know exactly when to start the 12-hour sample collection window. Passive sampling would not require a power source or this type of coordination.

an estimate of a continuous inhalation exposure concentration that is likely to be without risk of harmful effects during a lifetime of exposure. An RfC builds in safety margins that are intended to be protective of the most sensitive populations.

Appling this method to clopyralid's RfD (150 µg/kg-day) [42] yields an RfC of 525,000 ng/m^3. The level of clopyralid measured in the community-collected air sample (0.37 ng/m^3) is over a million times lower than the calculated RfC. This indicates that the level of clopyralid measured at this time and location is unlikely to pose a public health risk.

Table 14: Community-collected air data – valid detections.

Collection Date	Detections /Valid Samples	Analytes Detected	Maximum Analyte Concentration Detected (ng/m^3)	Health-based Screening Value (ng/m^3)	Source of screening value
May 2012	1/4	Clopyralid	0.37	525,000	Derived RfC*

ng/m^3 = nanograms per cubic meter; 2,4-D = 2,4-dichlorophenoxy acetic acid; RfC = Reference Concentration
*Derived from the U.S. Environmental Protection Agency's oral reference dose for clopyralid

Uncertainties

- Each of these samples was collected over an approximate 12-hour time period, and the results represent a snapshot in time. Therefore, it is unknown whether the results are typical for the locations or times sampled.
- The derived RfC for clopyralid is based on chronic or long-term exposure. It is not ideal to compare a 12-hour sample to a chronic RfC. However, no short-term or acute inhalation toxicity values for clopyralid are currently available. In general, short-term and acute toxicity values are higher than chronic toxicity values. Therefore, comparing a short-term sampling result to a chronic RfC is a conservative approach that is protective of health.
- The method for extrapolating an RfC from an oral RfD is not as precise or as valid as an RfC derived from actual inhalation toxicology studies. Some chemicals have different toxicities and endpoints depending on the route of exposure (i.e., inhalation vs. ingestion). The calculated RfC does not account for inhalation-specific toxic effects. Chemicals may come into contact with different organs when inhaled as opposed to ingested. This can lead to differential toxicity based on the sensitivity of the organ that comes into contact with the chemical. Therefore, this calculated RfC might be more or less protective than a traditionally derived RfC. However, clopyralid would have to be over a million times more toxic via the inhalation route than the ingestion route for the measured concentration to pose a public health risk. While many chemicals are more toxic via the inhalation pathway than the ingestion pathway, it is unusual for the difference in toxicity to be as great as a million fold.

Evaluation of Health Outcome Data

The Superfund law requires ATSDR and its cooperative agreement partners to consider if health outcome (i.e., mortality and morbidity) data (HOD) should be evaluated in a PHA [6]. The main requirements for evaluating HOD are: the presence of a completed human exposure pathway; a known time period of exposure; a quantified population that was (or is being) exposed; sufficient contaminant levels and time to result in health effects; and the availability of systematically collected HOD for the health outcomes associated with chemicals in the pathway [6].

The Highway 36 Corridor investigation does not meet the requirements for including an evaluation of HOD in this PHA. The main reason we did not evaluate HOD is that we do not how many people have been (or are being) exposed to pesticides in the Highway 36 investigation area. Further:

- The environmental data collected in fall 2011 indicate that people were not being exposed to pesticides in drinking water, soil, or home-grown foods at levels that could harm human health.
- The levels of 2,4-D measured in community members' urine in spring and fall 2011 were below levels of health concern.
- For community residents who had atrazine detected in their urine in spring 2011, we do not know when they were exposed to atrazine, if they were exposed at levels that could result in health effects, and if enough time has passed for these health effects to develop. We also do not know which effects to look for because there is limited scientific evidence on the health effects associated with atrazine exposure. Atrazine is a known endocrine disrupter that has been associated with hormonal and reproductive effects in animals and humans. However, there is currently not enough evidence to identify the specific effects associated with low-level exposures to atrazine. There is also not enough evidence to determine if atrazine increases the risk for cancer in humans (See Appendix E).

Children's Health Considerations

OHA and ATSDR recognize that infants and children may be more vulnerable to exposures than adults in communities faced with contamination of their air, water, soil, or food. This vulnerability is a result of the following factors:

- Children are more likely to play outdoors and bring food into contaminated areas.
- Children are shorter, resulting in a greater likelihood to breathe dust, soil, and heavy vapors close to the ground.
- Children are smaller, resulting in higher doses of chemical exposure per body weight.
- The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages.
- Children are more likely to swallow or drink water during bathing or when playing in and around water.
- Children are more prone to mouthing objects and eating non-food items like toys and soil.

Because children depend on adults for risk identification and management decisions, ATSDR is committed to evaluating their special interests in the Highway 36 Corridor. In this public health

assessment, children were identified as the most vulnerable to health problems caused by pesticides. OHA has designed conclusions and recommendations that, if followed, will protect children from these potentially dangerous chemical exposures.

Community Concerns

This section of the report describes Highway 36 community concerns related to forestland and agricultural pesticide applications, chemical exposures, and the EI. Understanding community health concerns related to a site or environmental contamination is an important component of the public health assessment process and ATSDR's overall mission. It is important to gather this information early and continuously through the investigation process [6]. ATSDR embraces the philosophy that community involvement requires earnest, respectful, and continued attention. Furthermore, ATSDR believes that one of the keys to the success of the public health assessment process lies in the ability to establish clear expectations, communicate effectively, and place the community at the center of its response [6]. A community's perspective provides a vital link to science by ensuring that our work is relevant.

The term "community" as used in this section of the report includes individuals who reside in the investigation area. However, because of the dynamic nature of social interactions individuals may belong to multiple communities at any one time. A person may be a member of a community by choice or by virtue of their innate personal characteristics, such as age, gender, race, or ethnicity [43]. Therefore, when initiating community engagement efforts, we make every effort to be aware of these complex associations [44], and be inclusive of all individuals who identify as being a member of a given community. This inclusiveness is important for understanding prevailing attitudes, beliefs, actions, and concerns that help to inform and improve our work.

For this section of the report, OHA evaluated qualitative data from several sources. In environmental public health, qualitative information helps public health practitioners understand the daily lives of people in the community in order to:

- learn about a community's history;
- focus on community priorities;
- understand how to best respond to community concerns;
- determine how people may be exposed to potential environmental contamination;
- identify the most effective ways to reduce potential exposures;
- communicate in relevant, inclusive, and equitable ways; and
- ensure the diversity of a community's perspective is represented [45].

Table 15 describes the sources of qualitative data we evaluated in this section. Because of the dynamic nature of social interactions and the lengthy history of both industrial chemical use and anti-pesticide activism in this area of the coastal mountains, we have included relevant information that may extend beyond the eight township-ranges that encompass the investigation area.

The community concerns section is not a sociological study, nor does it substitute for the report's conclusions. The purposes of this section are to:

- convey what we have learned is important to the community,

- understand the best ways to provide balanced and objective information, and
- assist with understanding the problems, alternatives, opportunities, and/or solutions.

OHA values, documents, and responds to community input as part of its public health assessment process. Listing or documenting a concern does not mean that we are verifying it as a fact, nor does it indicate our intent to address it with a specific recommendation. We also recognize that the information presented here is not an exhaustive list of concerns. Community members and the public will have an opportunity to review and comment on this section during the public comment period in order to ensure accurate representation.

Table 15: Qualitative data used in this PHA.

Qualitative data sources	Types of data included	Usefulness
Participation	Meetings - internal & external, providing assistance, engaging in outreach, encouraging feedback, developing involvement approaches	Establishes relationships, builds rapport & promotes transparency with community; enhances ability to represent community's perspective in the investigation; uncovers assumptions
Observation	Visits and interactions with community, field notes, reflections, community meetings, filmed events, social media	Discovers the multiple communities within the investigation area & the complex set of community dynamics
Interviews, correspondences & conversations	Phone calls, visits to individual homes, conversations at community meetings, emails, correspondences and letters	Uncovers and describes community members' perspectives on events
Review of Documents	News stories, blogs, journal articles, agency documents, reports, community gathered qualitative data, editorials, speeches, pamphlets, newsletters, books, announcements	Documents experiences, values and beliefs of the community; useful in understanding and describing community dynamics; places EI into geographic and historical context
Videos, films & photographs	Community-submitted video, documentaries and photographs; YouTube videos documenting community meetings and gatherings; social media	Discovery; validation of community's experiences; provides information from non-replicable, unique events
Historical analysis	Oral testimonies, life histories, historical records, past events, contemporary records, legal records, statutes, public reports, advocacy group work, demonstrations, reports of eyewitnesses	Discovery; establishes a context for and enhances credibility of community concerns; re-examines questions & assumptions

Qualitative data sources	Types of data included	Usefulness
Questionnaires & surveys	Recruitment and pesticide use questionnaires, urine sample collection surveys	Provides direct answers to specific questions about community knowledge, actions, food sources, activities, time spent outdoors, occupation & hobbies

Analysis of qualitative data

OHA staff reviewed substantial amounts of information in the form of comments, questions, emails, phone calls, historical and legal documents, media articles, videotaped events, observations during public meetings, and other qualitative information sources. OHA grouped this information into four major categories, or themes, based on content analysis. These four themes are:

1. Past and current exposures to pesticides from local pesticide applications
2. Health concerns reported by community members that they attribute to local pesticide applications
3. Psychological, emotional, and social stress
4. Inadequate protection of public health

The following sections describe each of these themes in more detail.

1. Past and current exposures to pesticides from local pesticide applications

Community groups living in and around Oregon's coastal mountain range have raised concerns about the chemicals used in forestland management for several decades. While this EI is focused on chemicals used in both forest and agricultural practices, the predominant community concerns raised throughout the years by members of the community relate to the aerial spraying of pesticides by helicopters. Historical and legal documents dating back to the 1960s have documented aerial applications of chemicals, including dioxin-contaminated 2,4,5-T [46], on forestlands, pastures, and rights-of-way in the coastal mountains. In 1979, EPA issued an emergency order suspending the use of 2,4,5-T and Silvex after documenting high miscarriage rates among women living near Alsea in Oregon's coastal mountain range [47]. Some people who currently live in the investigation area were involved in these early efforts to stop aerial pesticide applications and continue to document their experiences. Some residents report being unaware of local pesticide application practices before moving into the area.

The investigation team heard many community members' concerns about their personal health, the health of their children, and the health of their animals and the environment. Some of these residents moved to the area intending to live and farm organically. They express frustration and anger about their inability to take action to protect their families and farms from alleged chemical drift. They also are angry that any amount of chemicals used in forestry practices were found in their urine. Some

community members report moving to the area to retire, but have either left or are considering the option of moving away to avoid the seasonal sprays, which they find intolerable. Some parents express alarm and anger that the pesticide imazapyr was detected in the local school's drinking well water after the land above the school was clear-cut and treated with pesticides. Families in the investigation area have reported postponing having children and others worry their children will suffer from future health effects.

There are residents who have spent a great deal of time and money in an effort to understand the area's unique geographic conditions and cool moist climate. These residents have surmised that pesticides applied to the steep slopes of the mountains are drifting down into the valleys where they live. They believe pesticide drift is threatening crops grown by farms and vineyards in the area. They assert that the area's climate, which is conducive to fog formation, causes pesticides to "re-volatilize" (or vaporize repeatedly from the soil to air). They contend that the re-volatilized chemicals travel down from the application sites to the valleys where most of the residents live.

While we have heard and documented these concerns, it is important to note that other community members report having no health concerns related to local pesticide application practices. These residents claim they have not experienced health effects from pesticide applications in spite of having lived and worked in the area for generations. Some residents report that they have never missed a day of work due to illness. Many of these community members are timber owners, farmers, and ranchers who use traditional methods of weed control, including the use of pesticides. One resident explained that if an aerial application were planned for an adjoining property, they would sometimes ask the applicator to fly over their property and spray a segment of their land.

This group of residents wants to have pesticides available as tools to control noxious, invasive, and unwanted vegetation. They see this controversy as a private-property rights issue. Many of these community members have stated they view anti-pesticide efforts as an invasion of their personal rights to manage their own land. Some of these residents have reported feeling harassed and intimidated by neighbors who are opposed to the use of chemicals. They are worried about possible legal action if they use chemicals on their own farms and timberlands, and have modified their land use decisions in response to these fears. These community members have said they hope the EI will lay the issue to rest, and are worried about ongoing conflicts with their neighbors and within their community.

The third and potentially largest segment of the community does not identify with either of the two positions taken by their fellow community members. Nonetheless, they are affected by the conflict generated by these opposing views. They have said they are interested in the findings of the EI and express support for efforts to learn if exposures may be occurring from local application practices. They also express concern about the ongoing conflict within their community.

2. Health concerns reported by community members that they attribute to local pesticide applications

Some area residents have reported and documented their own health issues and those of their friends, families, and neighbors. They assert that their illnesses and conditions correspond with the seasonal pesticide applications. In the absence of systematically collected health outcome data (i.e., from disease registries) these residents have reconstructed events on their own and have concluded that there are an unusual number of health problems in this area. The health issues reported by these residents include

miscarriage, birth defects, congenital disorders in children, and rare cancers in teenagers and young adults.

Pesticide-related health conditions are difficult to diagnose because many of the known symptoms cannot be distinguished from other common illnesses. Most doctors are not trained to identify these conditions. It is very difficult to link environmental exposures of any kind to a specific health outcome in an individual, especially when there is a great deal of uncertainty about the nature of the exposure. In the Highway 36 community, there are uncertainties about whether and how people are being exposed to pesticides from local application practices, and the extent of any exposures. There also are uncertainties about the multiple chemicals used in pesticide applications and their singular and combined health effects, especially on developing babies, children, and the reproductive system.

Below is a list of human health effects attributed by community members to seasonal pesticide applications:

- miscarriages
- birth defects
- stillborn babies
- infertility
- endocrine disorders
- abnormal menstruation
- rare cancers in teenagers and young adults
- other more common types of cancer
- rashes, sores and other skin ailments
- cysts
- cardiovascular effects: tightness in the chest, difficulty breathing, heart arrhythmia, heart attacks, stroke
- weakness, muscle cramps and spasms, joint pain
- moodiness, depression, anxiety, fear, stress and aggression
- PTSD (Post-Traumatic Stress Disorder) and ongoing traumatic stress disorders
- Parkinson's Disease
- burning/itchy/sore/dry eyes, nose and throat
- inability to concentrate, loss of memory, headaches
- Attention Deficit Disorder
- asthma, coughs
- stomach and intestinal ailments, nausea
- porphyria
- chemical sensitivity
- auto immune disorders
- hair loss
- kidney Failure

There are other people living in the investigation area who have not had any health problems associated with forest pesticide applications. They express confusion and skepticism about why others in the community report being sick and unwell. While several of these people express concern about the reports of illness, they also express concern that these reports may be blown out of proportion.

3. Psychological, emotional & social stress

Psychological stress and its associated health effects are well-documented in communities living with real or perceived chemical contamination [48]. People who are unwillingly exposed to chemicals often experience anger, fear, irritability, uncertainty, and worry over the possible health effects of their exposures. People in these situations report feeling helpless and less secure within their homes and communities. Over time, this stress can lead to major depression, chronic anxiety, or post-traumatic

stress disorder (PTSD), and physical changes such as increased blood pressure, increased heart rate, and changes in stress hormones [48].

It is not uncommon for conflict to arise within communities where reports of environmental exposures are under investigation. The divisions described above that are occurring within the Highway 36 community mirror conflicts identified in other such communities. These conflicts indicate a breakdown in social cohesion, which is an important protective factor and source of support for individual and community health.

Residents in the Highway 36 area have documented or reported many of the symptoms associated with psychological stress. Residents have stated in public meetings and to agency staff that they are experiencing hostility, fear, and a loss of community cohesion. Residents describe a pervasive climate of suspicion about the intentions of fellow community members, government agencies and industry. During the course of the EI, several themes related to stress have emerged, including:

- Fear and anxiety about:
    - their health and the health of their children
    - possible contamination of their property and the health of their animals and wildlife
    - their personal safety, including intimidating gestures, outbursts, and threats of violence
- Frustration and anger
- Feelings of mistrust
- Alienation from neighbors or former acquaintances and the erosion of social support

The following sections describe these themes in more detail.

Fear and anxiety:
Much of the fear and anxiety expressed by some community residents is related to the still-evolving scientific understanding of the effects from low-dose chronic exposures to pesticides and the uncertainties about the long-term health consequences. Some express deeply held beliefs that any amount of contamination is unacceptable. These community members are concerned that chemicals used in the investigation area are endocrine disruptors, for which there is a great deal of scientific uncertainty.

In the face of these uncertainties, some community members draw upon their own knowledge, beliefs, and values to develop a personal interpretation of their overall risk, and seek out others whose interpretations are similar to their own [49]. Several advocacy groups have emerged within the Highway 36 community that represent opposing viewpoints on the use of chemicals, in particular the aerial spraying of chemicals. This has become a polarizing issue. The differing beliefs and interpretations about risk and exposure reflect, and may contribute to, social conflict within the community.

There are also concerns that some of these groups receive assistance and resources from organizations outside of the investigation area. This perceived interference by outside interests has amplified community divisions. All of these dynamics contribute to the overall levels of stress within the community, and make it more difficult for people to cope with real or perceived chemical contamination [50].

The investigation team has heard repeated claims that it is a person's "right to know" where and when applications will occur near their homes, and what chemicals have been or will actually be used. Community members have reported more stress and anxiety during spray seasons because they cannot get this information prior to actual pesticide applications. They seek this information so they can leave the area when applications occur and avoid potential exposure. At the same time, they express frustration that they must take these actions to protect themselves.

Several community members pay a fee of $25 a year to receive ODF's application notifications as a way to anticipate where and when applications will occur.[13] Community members have voiced their frustration with this notification system, and have reported the following issues to the investigation team:

- The fee is a hardship.
- Notifications are not available electronically.
- The period within which applications may occur is not specific (applications can occur between 15 days to 12 months after the notification is submitted).
- The chemicals listed include what could potentially be used, not what will actually be used.
- Handwritten notifications are sometimes illegible.
- Notifications are difficult to understand.
- The forms are not standardized, and they do not collect the same information from every applicator.
- Many of the notification forms are not fully filled out.
- Several notifications are sent at one time in a packet through the mail for a five-section or square mile area.
- Notifications include a topographical map without context for the larger geographic area.
- Subscribers are not given notice when their subscription is up for renewal.
- Once a subscription has lapsed, there is no way to obtain notifications for the lapsed period of time.
- There is no way to notify subscribers of modifications or changes to a particular notification once it has been sent to the subscriber.
- If a landowner requests a waiver for any notification requirements, subscribers are not informed about why the waiver was requested or if one was granted.

Personal Safety:

There is a history of mistrust and community conflict in the coastal mountain range. This conflict stems from divergent views on forest practices, property and human rights, land use and the environment, and differences in personal beliefs and lifestyles. This history is relevant because some community members who oppose the use of pesticides have expressed fear of retribution based on historical events. Some of this ongoing fear for personal safety originates from events that occurred in the 1970's that they witnessed or heard about from others. Historical and legal documents have described harassment of anti-pesticide activists by government agencies and industry. These include allegations of "suspicious house fires, cars that were rigged to explode" [51], and in one case involving a noted activist, being

[13] Under ORS 527.670(8), ODF provides copies of notifications and written plans for designated areas to interested persons who pay the required fee. In addition, under ORS 527.670(6), ODF provides such information on a non-fee basis to persons with downstream surface water rights, if such persons request that service in writing.

"harassed by aircraft flying dangerously low and, in the case of the helicopters, hovering and circling for extended periods of time" [52].

Other residents report feeling intimidated by the approaches used by activists who are opposed to pesticide use. Some people have expressed fear that they will be sued or harassed for using chemicals on their property. Helicopter pilots and activists alike have reported or documented threats to their personal safety. The EI team has observed aggressive and intimidating gestures and language from both sides during public meetings or on recorded tapes and videos.

Frustration and Anger:
Residents express anger at many things, including: Oregon's Right to Farm and Forest Law; the Forest Practices Act (FPA); the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA); timber companies; pesticide makers; the chemical industry; trade lobbying organizations; environmental organizations; ODA; ODF; PARC; and the EI.

Community members have expressed frustration over having to navigate a complex system of governmental oversight in order to understand how to effect change. Some believe the law favors the economic interests of large industrial landowners more than it protects people's health. Other residents are frustrated and angry about letters they received from lawyers who were hired to prevent them from using chemicals on their own property. There are disputes and litigation between neighbors over allegations of chemical drift, economic and business losses, and property devaluation.

Mistrust and alienation:
Many community members have expressed some degree of mistrust and skepticism about industry's influence on the regulation of pesticides and on the EI. Some specific concerns related to the regulation of pesticides include:

- the chemical and timber industries' degree of influence over public policy relating to the regulation, application, and use of pesticides;
- the government's process for determining whether risks to human health are adequately understood and used to inform pesticide use laws; and
- the validity of research used to support claims of chemical safety and inform requirements for pesticide labeling and use.

Community members have also expressed skepticism about the EI, including concerns about the following:

- The EI lacks independence and scientific rigor. Community members are concerned that the EI will be unduly influenced by community activists who are intent on eliminating access to pesticides or by trade lobbying groups who are intent on ensuring continued access to the use of pesticides.
- The EI is an unwarranted expenditure of public funds.
- The resources needed to complete the investigation will be reduced or eliminated, or that industrial landowners have, and will continue, to thwart the investigation by using chemicals that cannot be tested for in urine.
- The EI is not inclusive enough of community input, doesn't allow community as an equal stakeholder, and is not doing enough to stop the spraying until the extent of human exposure is known.

4. Inadequate protection of public health

As pointed out, there is a wide range of viewpoints regarding aerial spraying and the use of pesticides within the Highway 36 community. Some people are confident that EPA's pesticide labeling and risk assessment process is protective of health. Others are skeptical and want the government to do more to protect their health. Some community members have proposed establishing aerial spray buffer zones around homes and schools, while others want a complete moratorium on all uses of pesticides.

Most community members express some degree of appreciation for the agencies' investment in their community and support for the investigation efforts. Some of these community members are comfortable with the initial, baseline EI conducted by ATSDR, are not concerned about exposures and question why the investigation continues. Others are frustrated with what they see as a delay in acting to prevent exposures they believe are occurring during each spray season.

Residents seeking a change in application practices express one or more of the following concerns or positions:

- Government agencies are not doing enough to protect private citizens' health.
- Existing environmental regulations are based on a risk assessment process that does not adequately protect human health and the environment.
- As science advances, pesticides will be found to be more harmful than previously thought.
- Government is not taking community concerns seriously, and they feel like "guinea pigs".
- The "Precautionary Principle"[14] should be invoked by placing a moratorium on some application practices (specifically aerial spraying) until these practices are proven safe.

In an effort to address their own health concerns, a few residents have taken steps to hire a forensic agronomist, test their own drinking water, collect and have their urine samples analyzed, and pay for air monitoring equipment and analysis. These residents want to know how pesticides move and act in the unique climate of the investigation area. In an effort to capture this information, they have educated themselves on the science of air and water monitoring and agronomics.

Summary

OHA believes that stress and community conflict in the investigation area negatively affects both individual and community health and well-being. This dynamic may impede future efforts to understand and respond to community concerns about pesticide exposures. The issue of pesticide use in general, and aerial applications in particular, has created conflict between neighbors and friends. One resident said that people who used to be friendly have stopped talking to her. Others have expressed their apologies to the investigation team for what they call embarrassing behavior - behavior they feel reflects poorly on their community. Many people have made it clear they do not know who to trust or what to believe. This type of polarization within rural communities is arguably more destructive and stressful than in more populated areas because people in rural areas or smaller communities may be more dependent on each other's relational resources and community capacity [53].

[14] The Science and Environmental Health Network describes the Precautionary Principle as follows: "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically."

OHA has identified several causes of stress and conflict within the Highway 36 community, including the following:

- fear and anxiety about personal health, safety, and children's health;
- differing views on pesticide use and human and private property rights;
- ongoing concerns about the lack of adequate notifications and records of pesticide applications;
- anger and distrust of government agencies; and
- divisions within the community and existing social networks.

These stressors negatively affect individual community members and the Highway 36 community as a whole. OHA believes that formal mediation services may help to reduce community stress and improve community cohesion in the longer term. Mediation may also be necessary for the successful completion of the EI.

Progress Toward Answering Investigation Questions

Table 16 describes the EI team's progress toward answering the original EI questions. The table also highlights outstanding gaps in available information and identifies the types of activities that would help fill these information gaps. OHA drew from information gaps identified in this table to guide recommendations and the public health action plan.

Table 16. Summary of the EI Questions and Progress Toward Answer

EI Question	Progress Toward Answer	Conclusions	What else is needed to answer the question?
Are residents in the Highway 36 Corridor being exposed to pesticides or herbicides from local application practices?	• Fall 2011 sampling was designed to capture baseline conditions when known pesticide applications were minimal. As expected, overall results of fall 2011 sampling confirm that exposures to 2,4-D and atrazine were low among Highway 36 investigation area residents during the fall season. • Community-collected data from Spring 2011 indicate that exposures to 2,4-D and atrazine were occurring in Spring 2011.	1. This investigation did find evidence that residents of the investigation area were exposed to pesticides or herbicides in spring and fall 2011. While not possible to confirm that these observed exposures occurred as a result of local application practices or were from other sources, the evidence suggests that local applications that occurred near to and at the time the samples were collected may have contributed to the concentrations of pesticides detected in participants' urine.	Additional biologic testing, conducted to coincide with the timing and location of aerial application of pesticides that can be detected in urine would provide important evidence regarding the relationship between known applications of pesticide and detectable levels in local residents.
	If residents are being exposed:		
To what pesticides or herbicides are they being exposed?	• Spring and Fall 2011 urine data indicate that Highway 36 investigation area residents were exposed to 2,4-D, and Spring 2011 urine data indicate that residents were exposed to atrazine in the spring. • Fall environmental sampling indicates that exposure to pesticides other than 2,4-D was minimal.	2. Residents in the Highway 36 investigation area had urinary biomarkers for exposure to 2,4-D in spring and fall 2011, and atrazine in spring 2011. We were unable to determine if tested residents in the investigation area had urinary biomarkers for exposure to pesticides other than 2,4-D and atrazine in spring or fall	Additional laboratory methods that allow for measurement of other pesticides in urine would enhance OHA's ability to answer this question.

EI Question	Progress Toward Answer	Conclusions	What else is needed to answer the question?
	• The inability to measure pesticides other than 2,4-D and atrazine in urine is a significant technical limitation.	2011. 3. Some Highway 36 investigation area residents may have been exposed to very low levels of DEET, fluoridone, or hexazinone in their drinking water. 4. Some Highway 36 investigation area residents may have been exposed to very low levels 2,4-D or glyphosate in their soil. 5. Some Highway 36 investigation area residents may have been exposed to very low levels of clopyralid in the air.	
To what levels are they being exposed?	• Fall 2011 urine data indicate that Highway 36 investigation area residents were exposed to low levels (perhaps slightly higher than the general U.S. population) of 2,4-D at that time. • Spring 2011 urine data indicate that Highway 36 investigation area residents were exposed to levels of 2,4-D statistically higher than in the general U.S. population at that time and higher levels of both 2,4-D and atrazine in Spring than in the Fall.	6. In the spring of 2011, Highway 36 investigation area residents had higher levels of 2,4-D exposure than the general U.S. population. 7. In the fall of 2011, Highway 36 investigation area residents had urinary 2,4-D levels that were not statistically different than the general U.S. population. 8. In the spring of 2011, urine samples from Highway 36 investigation area residents	

EI Question	Progress Toward Answer	Conclusions	What else is needed to answer the question?
		also had detectable levels of atrazine, but it is unknown how these levels compare to the general U.S. population.	
What are potential source(s) of the pesticides or herbicides to which they are exposed?	• Baseline Spring 2011 urine results and pesticide application records data indicate that there are likely other sources of 2,4-D and atrazine exposure in Highway 36 investigation area residents that have not yet been identified with existing resources. • Post-application Spring 2011 urine samples and pesticide application records data indicate that there is an association between local pesticide applications and statistically significant increases in urinary atrazine metabolite levels.	9. There is insufficient information to confirm that local pesticide applications are the source of pesticides found in the urine of participating Highway 36 investigation area residents. However, there is evidence to suggest that local aerial applications may be a contributing source of human exposure.	Additional information about non-regulated uses of 2,4-D and atrazine would help to answer this question more fully. OHA will need continued access to pesticide application records data to accompany any future monitoring efforts.
What are potential routes (pathways) of residents' exposures?	• Fall 2011 environmental sampling ruled out drinking water, soil, and homegrown foods as routes of exposure at that time. • Community-collected environmental sampling from Spring 2011 were insufficient to rule out any exposure routes for that period. • Lack of air monitoring data during the fall and spring pesticide application seasons represents a	10. We were unable to determine if air was a potential pathway of exposure to pesticides in the Highway 36 investigation area. 11. Drinking water can be eliminated as an exposure pathway for the 2,4-D and atrazine detected in Highway 36 investigation area residents' urine. 12. Soil sampled in the fall of	Widespread passive air monitoring before and during a pesticide application season, coupled with analysis for the appropriate pesticides, would provide valuable information about whether or not ambient air is an important exposure

EI Question	Progress Toward Answer	Conclusions	What else is needed to answer the question?
	significant data gap. Without this air monitoring data, exposure via ambient air either from direct drift or volatilization cannot be ruled out.	2011 can be eliminated as an exposure pathway for the 2,4-D and atrazine detected in Highway 36 investigation area residents' urine. 13. Homegrown food sampled in the fall of 2011 can be eliminated as an exposure pathway.	pathway for Highway 36 investigation area residents.
What health risks are associated with these exposures?	• Urinary 2,4-D levels in Fall and Spring of 2011 were below toxicity-based BEs, indicating that measured 2,4-D levels are not associated with health risks. • OHA cannot conclude whether or not atrazine metabolite levels measured in Highway 36 investigation area residents'' urine in Spring 2011 could harm people's health because there is no toxicity-based threshold value for atrazine in urine against which these measured levels can be compared.	14. The levels of 2,4-D measured in Highway 36 investigation area residents' urine in spring and fall 2011 were below levels expected to harm people's health. 15. We cannot determine whether the levels of atrazine metabolites measured in Highway 36 investigation area residents' urine in spring 2011 could harm people's health. 16. Drinking or contacting domestic water with pesticides at the concentrations detected in some Highway 36 investigation area properties is not expected to harm people's health.	BEs for additional pesticides, especially atrazine metabolites, would greatly enhance OHA's ability to make health determinations based on urinary pesticide concentrations. RfCs for pesticides in ambient air will be very helpful in evaluating air monitoring data collected in the future for health significance.

EI Question	Progress Toward Answer	Conclusions	What else is needed to answer the question?
		17. Contact with soil with pesticides at the concentrations detected in the fall of 2011 in some Highway 36 investigation area soil is not expected to harm people's health. 18. Handling or consuming garden vegetables, berries, eggs, milk or honey from the Highway 36 investigation area from fall 2011 will not harm people's health.	

Conclusions

As a result of this Exposure Investigation, OHA reached *twenty* important conclusions addressing the questions about the presence, type and source of exposure to pesticides in the Hwy 36 investigation area:

OHA reached *one* conclusion related to the question: **Are residents in the Highway 36 Corridor being exposed to pesticides from local application practices?**

> **Conclusion 1:** This investigation did find evidence that residents of the investigation area were exposed to pesticides or herbicides in spring and fall 2011. However, it was not possible to confirm if these observed exposures occurred as a result of local applications practices or were from other sources.

OHA reached *four* conclusions related to the question: **To what pesticides are they being exposed?**

> **Conclusion 2:** Residents in the Highway 36 investigation area had urinary biomarkers for exposure to 2,4-D in spring and fall 2011, and atrazine in spring 2011. We were unable to determine if participants in the investigation area had urinary biomarkers for exposure to pesticides other than 2,4-D and atrazine in spring or fall 2011.
>
> **Conclusion 3:** Some Highway 36 investigation area residents may have been exposed to very low levels of DEET, fluoridone, or hexazinone in their drinking water.
>
> **Conclusion 4:** Some Highway 36 investigation area residents may have been exposed to very low levels 2,4-D or glyphosate in their soil.
>
> **Conclusion 5:** Some Highway 36 investigation area residents may have been exposed to very low levels of clopyralid in the air.

OHA reached *three* conclusions related to the question: **To what levels are they being exposed?**

> **Conclusion 6:** In the spring of 2011, Highway 36 investigation area residents had higher levels of 2,4-D exposure than the general U.S. population.
>
> **Conclusion 7:** In the fall of 2011, Highway 36 investigation area residents had urinary 2,4-D levels that were not statistically different than the general U.S. population.
>
> **Conclusion 8:** In the spring of 2011, urine samples from Highway 36 investigation area residents also had detectable levels of atrazine, but it is unknown how these levels compare to the general U.S. population.

OHA reached *one* conclusion related to the question: **What are potential source(s) of the pesticides to which they are exposed?**

Conclusion 9: There is insufficient information to confirm that local pesticide applications are the source of pesticides found in the urine of participating Highway 36 investigation area residents. However, available evidence suggests it is possible that reported applications may have contributed to the levels detected in participants' urine.

OHA reached *four* conclusions related to the question: **What are potential routes (pathways) of residents' exposures?**

Conclusion 10: We were unable to determine whether air is a pathway of exposure to pesticides in the Highway 36 investigation area.

Conclusion 11: Drinking water can be eliminated as an exposure pathway for the 2,4-D and atrazine detected in Highway 36 investigation area residents' urine.

Conclusion 12: Soil sampled in the fall of 2011 can be eliminated as an exposure pathway for the 2,4-D and atrazine detected in Highway 36 investigation area residents' urine.

Conclusion 13: Homegrown food sampled in the fall of 2011 can be eliminated as an exposure pathway.

OHA reached *five* conclusions related to the question: **What health risks are associated with these exposures?**

Conclusion 14: The levels of 2,4-D measured in Highway 36 investigation area residents' urine in spring and fall 2011 were below levels expected to harm people's health.

Conclusion 15: We cannot determine whether the levels of atrazine metabolites measured in Highway 36 investigation area residents' urine in spring 2011 could harm people's health.

Conclusion 16: Drinking or contacting domestic water with concentrations of pesticides detected in some Highway 36 investigation area properties is not expected to harm people's health.

Conclusion 17: Contact with soil containing pesticides at the concentrations detected in the fall of 2011 in some Highway 36 investigation area soil is not expected to harm people's health.

Conclusion 18: Handling or consuming garden vegetables, berries, eggs, milk or honey from the Highway 36 investigation area from fall 2011 will not harm people's health.

OHA reached *two* additional conclusions related to the impacts to the EI and to the health of community members from community conflict.

Conclusion 19: Divisions and hostility among community members, fueled by cultural and values differences over land use, pesticide use and property rights, are creating significant stressors on many individual community members and on the community as a whole.

Conclusion 20: Leadership activity within the community has been oriented toward debating issues of land use, pesticide use, and property rights. No formal or informal leader has yet emerged who has a mediating influence on these differences. Formal mediation services for the Hwy 36 community may be necessary for both the successful completion of the EI and for the important progress needed to reduce community stress and improve community cohesion in the longer term.

Recommendations

Pertaining to the Exposure Investigation underway, OHA recommends that:

1. US EPA work with the Exposure Investigation team on developing a sampling and analysis plan designed to evaluate exposures to pesticides in air and to address gaps in the data needed to answer Exposure Investigation questions. At the time of publication of this report, passive air monitoring over several application seasons appears to be the best option to collect community-wide air data.
2. ODA and ODF continue to provide pesticide application data as needed to interpret air sampling (or other) data collected as part of this investigation.
3. State and federal agencies involved in the ongoing Exposure Investigation develop an implementation plan that includes identification of necessary resources to carry out activities appropriate for each agency's role in this effort.

Pertaining to broader and/or longer-term issues identified by the Exposure Investigation, OHA recommends that:

1. ODA and ODF work with pesticide applicators to develop consistent pesticide application record-keeping processes to ensure that application record data are accurately maintained and usable.
2. State agencies explore the feasibility of implementing a system that would allow sensitive populations to be notified of imminent pesticide applications in such time and with such specificity that they could take action to avoid exposure to those applications. Such policies could include adoption of systems developed by other jurisdictions, or modification of existing regulatory systems designed to monitor pesticides applications.
3. State and federal agencies involved in the ongoing Exposure Investigation develop an implementation plan to address these recommendations, including the identification of resources to carry out activities appropriate for each agency's role in serving the communities of Oregon. That plan should include a recommendation on how the agencies should coordinate, collaborate and share resources.
4. Community members, including local government representatives and other community leaders, consider seeking the assistance of a professional mediation group to address immediate and long-

term conflicts among community members and identify actions to move these conflicts toward resolution.

Public Health Action Plan

Public health actions completed:

- The EI team collected urine and environmental samples in fall 2011, and communicated individual results back to EI participants in winter 2011/2012.
- The EI team hosted two public meetings (July 2011 and April 2012) and one open house (November 2011) in Blachly, OR.
- ATSDR released a report on the fall 2011 urine sample results in March 2012.
- OHA led outreach activities including the development of a Highway 36 EI web page and listserv, press releases, flyers, a factsheet, and other communication materials.

Public health actions planned:

OHA will:

- Review and respond to all public comments received, and release a final version of this interim report upon completion.
- Work with state and federal partners, community members, and other stakeholders to implement the recommendations in this report.
- Continue to maintain and provide updates through the Highway 36 web page and listserv.
- Compare application records from 2011 to application records from 2009 and 2010 to determine if there were noticeable (substantial) changes in pesticide application practices after the EI was initiated in 2011.
- Review air sampling data once it is collected by the EPA.
- Develop and release a final Public Health Assessment report which will include all previous sampling data, pesticide application data from 2009-2011 and air sampling data collected by the EPA.

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Report Preparation

This Public Health Assessment for the Highway 36 Corridor site was prepared by the Oregon Health Authority under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). This report was not reviewed or cleared by ATSDR.

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Appendix A: Application Records

OHA requested 2009-2011 application records from ODA and ODF in October 2011 and received most of the application records in June 2012. This section describes OHA's analysis of 2011 application records.

2011 Application Records: Descriptive Statistics

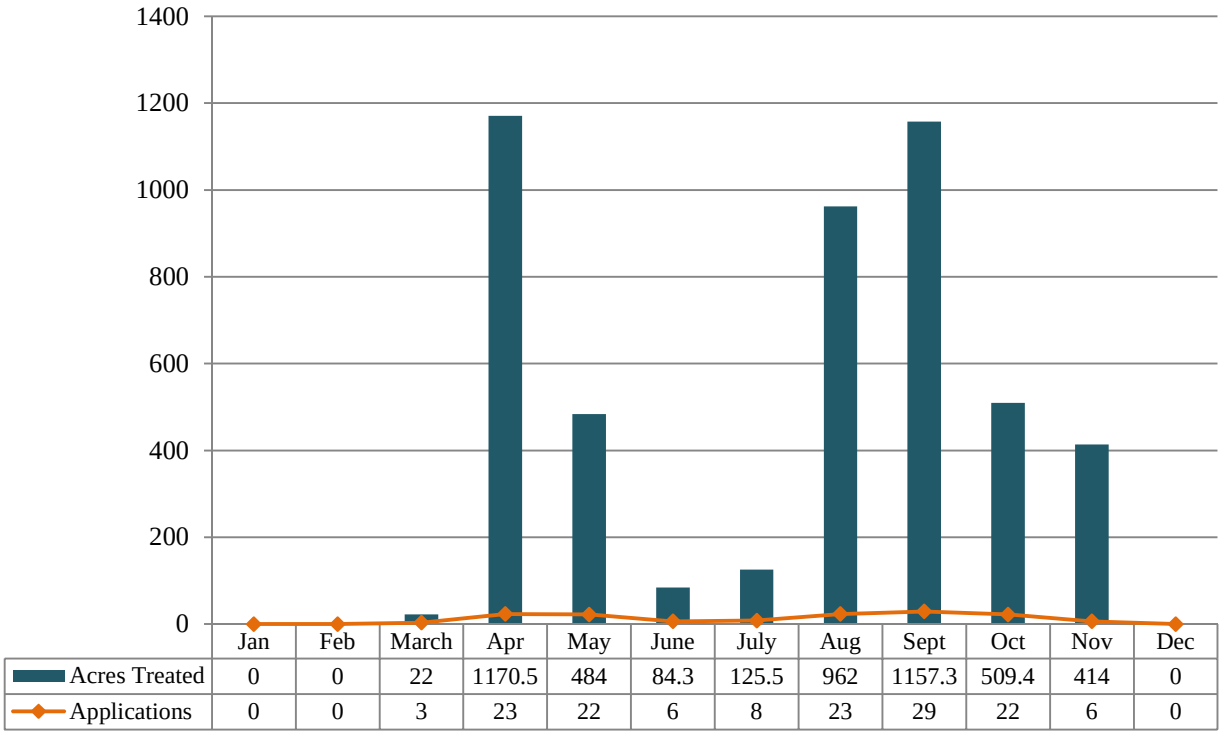
There were 142 reported pesticide applications in the Highway 36 investigation area during 2011. Forty-one (29%) of these 142 reported applications were only reported to ODA, and 101(71%) applications were reported to ODF. Based on OHA's interpretation of the data, 10 (7%) of the 142 applications were for agricultural purposes (e.g., applications on Christmas tree farms and pasture land), 114 (80.3%) were for forestry operations, and 18 (12.7%) were roadside applications. Table 17 shows a breakdown of the 2011 application data by these three major "sectors".

Table 17: 2011 application data by sector.

	Agricultural	Forestry	Roadside	Total
Applications	10 (7.0%)	114 (80.3%)	18 (12.7%)	142 (100%)
Acres Treated	90 (1.8%)	4,756 (96.5%)	83 (1.7%)	4,929 (100%)
Amount pesticides applied (gallons)	128.6 (6.0%)	1972.4 (91.5%)	53.5 (2.5%)	2154.5 (100%)
Amount pesticides applied (pounds)	60.0 (4.3%)	1345.9 (95.7%)	0.0 (0.0%)	1405.9 (100%)
% = percent				

There were no applications in January and February, and three applications on 22 acres of land at the end of March (Figure 2). There were 23 applications on 1,171 acres in April, and 22 applications on 484 acres in May. There were few applications in June and July, and 23 applications on 962 acres in August. The largest number of applications occurred in September (29 applications on 1,157 acres). There were 22 applications in October on 509 acres and six applications in November on 414 acres. There were no applications in December 2011.

Figure 2: Applications and acres treated in 2011 by month.*



	Jan	Feb	March	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Acres Treated	0	0	22	1170.5	484	84.3	125.5	962	1157.3	509.4	414	0
Applications	0	0	3	23	22	6	8	23	29	22	6	0

* Note: Two applications in March and one application in July were missing data on acres treated.

Aerial applications accounted for 26% of 2011 applications, and roughly 45% of acres in the investigation area were treated with this method (Table 18). Approximately 20% of applications were hack and squirt treatments (24% of acres), and approximately 23% of applications were ground-based treatments (18% of acres).

Table 18: Application methods for 2011 pesticide applications in investigation area.*

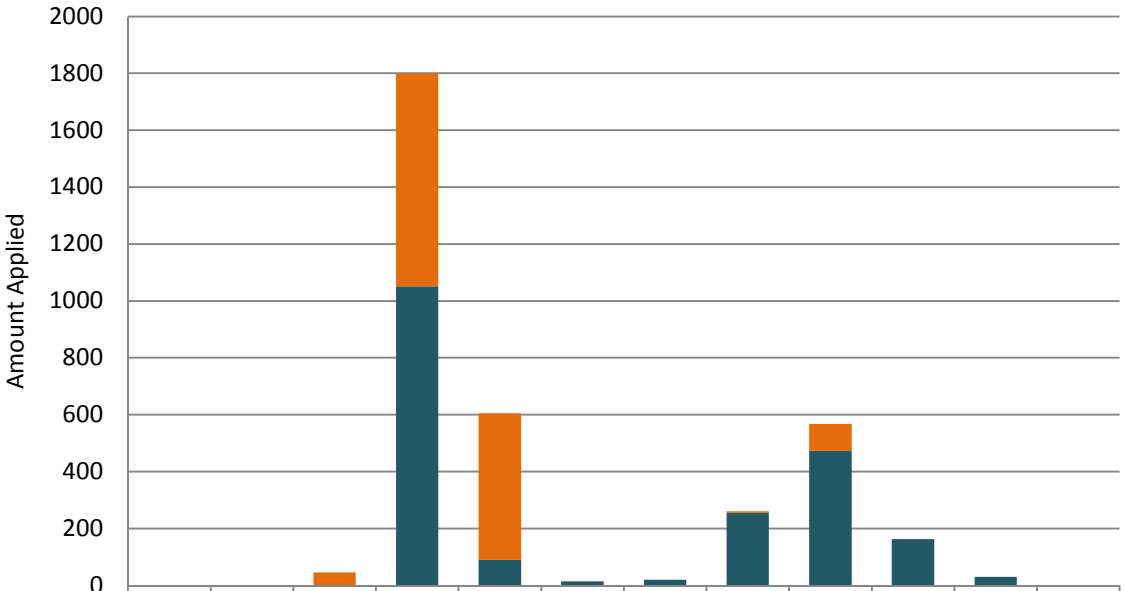
Application Method	Number of Applications	Acres Treated
Aerial	37 (26.1%)	2198.5 (44.6%)
Ground	32 (22.5%)	891.2 (18.1%)
Roadside	18 (12.7%)	82.8 (1.7%)
Hack and Squirt	28 (19.7%)	1182.0 (24%)
Unknown	27 (19.0%)	574.5 (11.7%)
Total	142 (100.0%)	4929.0 (100%)

*Note: We inferred application method for six aerial applications, three ground applications and two roadside applications. % = Percent

During 2011, an estimated 2,097 gallons of liquid pesticides and 1,406 pounds of dry pesticides[15] were applied in the investigation area (Figure 3). There were ten pesticides (not including adjuvants) applied in the same area in 2011: 2,4-D, aminopyralid, atrazine, clopyralid, glyphosate, hexazinone, imazapyr, metsulfuron methyl, sulfometuron methyl, and triclopyr. The pesticides used in largest quantities were (in descending order): hexazinone (1,304 lbs/50 gallons), glyphosate (710 gallons), atrazine (702 gallons), 2,4-D (345 gallons) and imazapyr (252 gallons). 2,4-D, atrazine, clopyralid and hexazinone were used exclusively during during the early part of the year (April and May), while imazapyr, metsulfuron methyl, and sulfometuron methyl were used predominantly in late summer and fall applications (Table 19).

In the investigation area, the township ranges with the most pesticide applications and largest number of acres treated were 16S 06W and 16S 07W (Figure 4). The township ranges with fewest applications (and fewer acres treated) were 16S 08W and 17S 07W.

Figure 3: Amounts of pesticide products applied in 2011 by month.*



	Jan	Feb	March	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Pounds	0.0	0.0	44.0	747.8	514.5	0.0	0.0	5.8	93.9	0.0	0.0	0.0
Gallons	0.0	0.0	1.1	1051.5	89.6	14.1	19.6	255.0	473.4	162.8	30.0	0.0

* Note: The amount applied does not include adjuvants or carriers (e.g., water, surfactants, and dyes). Two applications (one in March, one in August) were missing data indicating the amount applied.

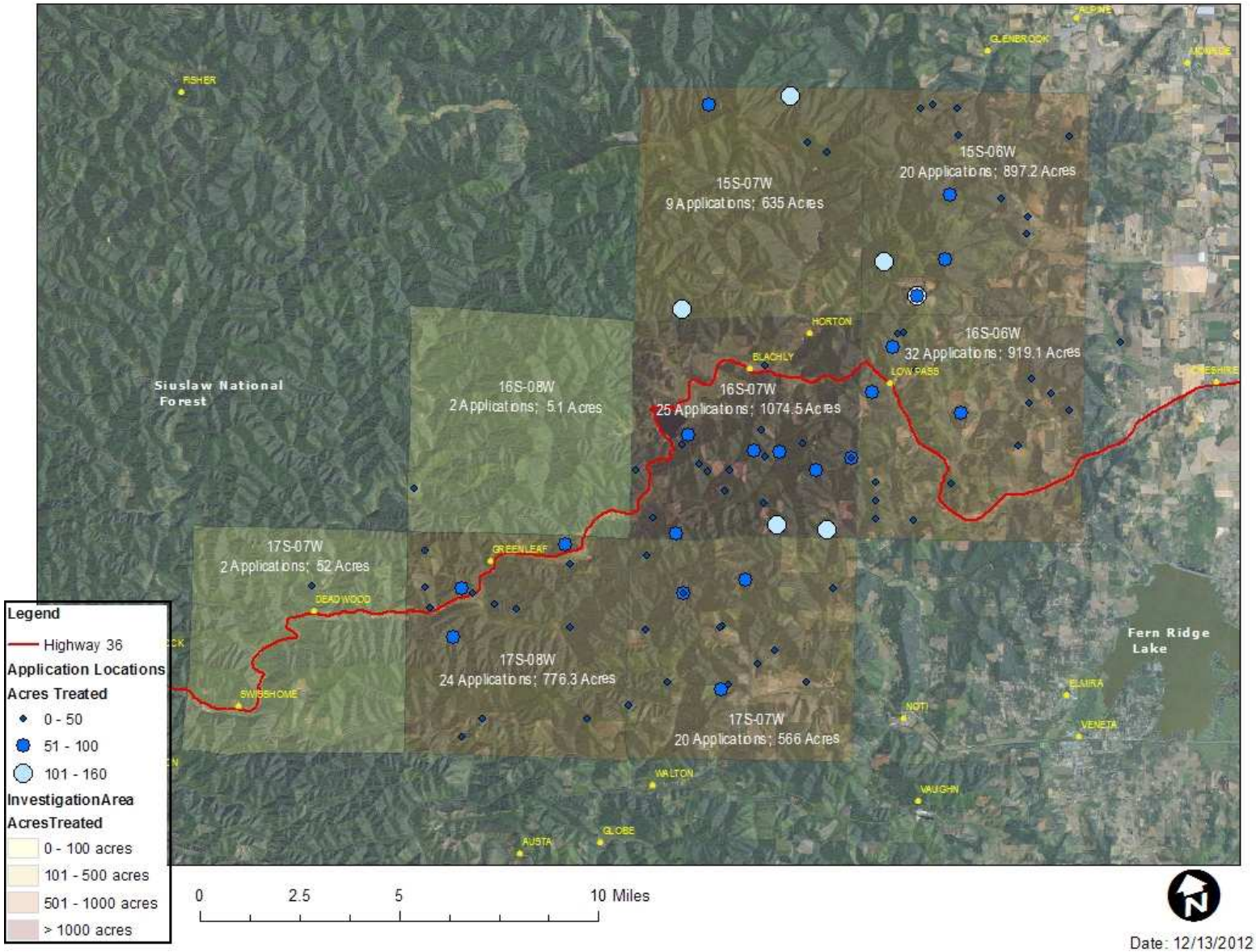
[15] These are estimates of pesticides in liquid and dry form before they were mixed with water, surfactants and other additives.

Table 19: Amount of pesticides applied in 2011 by month (darker shading indicates larger amounts).

Active Ingredient	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
2,4-D (gal)		325.4	20.0							345.4
Aminopyralid (gal)		1.5			0.6	2.7	0.5			5.3
Aminopyralid, Triclopyr (gal)			5.1	1.2	1.5					7.8
Atrazine (gal)		672.6	29.0							701.6
Clopyralid (gal)		10.8	2.1							12.9
Glyphosate (gal)	1.0	2.5	22.0	12.8	16.5	202.4	330.9	121.4		709.5
Hexazinone (gal)		38.6	11.2							49.8
Hexazinone (lbs)	44.0	745.8	514.2							1304.0
Imazapyr (gal)			0.3		1.1	42.6	140.4	37.2	30.0	251.5
Metsulfuron methyl (gal)						0.1	0.9	0.2		1.3
Metsulfuron methyl (lbs)						5.8	22.6			28.3
Sulfometuron Methyl (gal)	0.1					3.8	0.6	4.0		8.6
Sulfometuron Methyl (lbs)		2.0	0.3							2.3
Sulfometuron methyl, Metsulfuron methyl (gal)						3.3				3.3
Sulfometuron methyl, Metsulfuron methyl(lbs)							71.3			71.3
Triclopyr (gal)			0.5	1.3	21.8	24.6	8.6	0.8		57.5
Total (gal)	1.1	1051.5	90.1	15.3	41.4	279.5	482.0	163.5	30.0	2154.5
Total (lbs)	44.0	747.8	514.5	0.0	0.0	5.8	93.9	0.0	0.0	1405.9

*Notes: Excludes carriers and adjuvants. One application of glyphosate and sulfometuron methyl in March, and one application of glyphosate and triclopyr in August were missing data on the amount applied. Gal = gallons; lbs = pounds.

Figure 4: Pesticide application locations in Highway 36 investigation area, 2011.



Data Processing and Analysis

The ODA and ODF application data were processed in Excel and SAS to obtain a single dataset of 2011 pesticide applications in the Highway 36 investigation area. The final merged dataset had data on 142 applications (Table 20). SAS was used to obtain basic descriptive statistics (e.g., number of applications per month, acres treated) for the pesticide application data.

Table 20: Number of records and applications in 2011 dataset.

	ODA Records	ODF Records
Files	-	82
Total Observations (Rows)	165	275
Number applications	100	101
ODA applications not in ODF dataset	41	
Total applications	142	
ODF – Oregon Department of Forestry; ODA = Oregon Department of Agriculture		

ODF Records Data Entry

OHA staff abstracted all available ODF records for 2011. Data were abstracted into an Excel spreadsheet. Table 21 shows the fields abstracted from the records. One OHA staff member abstracted records from January – July 2011, and another OHA staff member abstracted records from August – December 2011.

Table 21: Data fields abstracted from ODF records.

Data Field	Notes
Notification and Unit Number	-Indicates the corresponding ODF notification number
Application Date	-Date of application. Some records had more than one date on the record. If the record indicated the amount of chemicals applied on each date, we entered each date as a unique application. If the record provided the total amount of chemicals applied over several dates, we treated the record as a single application, and entered multiple dates/times in the appropriate cells.
Project Name	Name of treated unit
Landowner, Operator, Contractor	The Landowner and Contractor fields were abstracted from records; the operator field was populated based on information on ODF's SharePoint site.
Township, Range and Section	Township-Range-Section location of treated unit. If the area spanned multiple sections, we entered all sections separated by commas (e.g., 10, 12, 14).
Longitude, Latitude	Many records did not have latitude/longitude indicated. For these records, we estimated coordinates using the following process: 1) If the record (or corresponding notification) included a map of the unit, we visually identified the unit using ArcGIS, and used the rough center point of the unit for longitude/latitude coordinates. 2) If no map was available, we used the coordinates of the center point of

Data Field	Notes
	T/R-Section in which the unit was located. Note: Used GCS_NA_1983 coordinate system
Other location	Not standard across records; may drop this field. Some records indicated elevation (entered as E:XXXX). A few applications occurred in Benton County, but within our investigation area.
Acres	Most records indicated the number of acres treated, though a few records of roadside treatments indicated miles instead of acres.
Chemical Supplier	Entered company indicated on record; left blank if not indicated.
Product Name and Registration Number	Chemical name and EPA registration number. In some cases, the product name and registration number did not match up. In these cases, we crosschecked the information with ODA application records, or used our professional judgment to enter the correct product name and corresponding registration number. In addition to registered products, we entered data on adjuvants (e.g., surfactants, dyes).
Active Ingredient	Identified from EPA product labels
Product Application Rate	In most cases, we entered the product application rate as indicated on the record. If the rate was not provided on the ODF record, but provided in a corresponding ODA record, we entered the ODA application rate. In some cases, we back-calculated the rate by dividing the total amount applied by acres.
Product Total	Total product applied during the application. If the total was not provided on the record, we calculated the total amount by multiplying the application rate by number of acres.
Carrier	Product carrier used during application
Carrier Rate	Product carrier rate. In some cases, we back-calculated the rate by dividing the total amount applied by acres, or estimated the rate based on the percentages provided on the record.
Carrier Total	If the total was not provided on the record, we calculated the total amount by multiplying the application rate by number of acres, or estimated the total based on the percentages provided on the record.
Start Time and End Time	The start and end time indicated on the application record.
Total Rate and Total Applied	The total amount of product(s) and carrier applied during an application. If not indicated on the record, we calculated this field based on product and carrier rates/totals.
Application Type	This information was not indicated on some records. In some cases, we inferred application type based on other information on the record (e.g., equipment used, meteorological data).
Meteorological Information	We entered the time of measurement, temperature, humidity, wind speed, and wind direction for up to 4 meteorological readings. A few records (with multiple application dates) had more than 4 readings; for these, we entered the first four readings.
Planting Date	Date/Year unit was planted; rarely indicated on record, may drop this field.
Target Species	Species targeted during application.
Equipment Used	Equipment used for application; sometimes method was indicated (e.g., hack and squirt)

Data Field	Notes
ODF – Oregon Department of Forestry; T = Township; R = Range; EPA = Environmental Protection Agency; ODA = Oregon Department of Agriculture	

Data Quality Check
To ensure the data were abstracted correctly, all data entries were checked against the actual application record. In addition, ODF conducted a 10% check of abstracted records.

ODA Records Acquisition and Data Quality Control
The following pages are an ODA document describing the records acquisition and data quality control process that ODA used in support of this EI.

Oregon
John A. Kitzhaber, MD, Governor

Department of Agriculture
635 Capitol St NE
Salem, OR 97301-2532

Oregon Department of Agriculture, Pesticides Program
HWY 36, Health Exposure Investigation (EI), Western Lane County
Pesticide Application Record Data Review Project, Verification and Validation
November 21, 2012

Background

Residents living in western Lane County, near Triangle Lake and Highway 36, have expressed concern for several years over possible exposures to pesticides from application activities on forestland, right-of-way, and agricultural sites. Several residents have reported potential health effects associated with pesticide use in the surrounding area. Based on concerns of adverse health expressed by some residents, the multi-agency Oregon Pesticide Analytical Response Center (PARC), in cooperation with Oregon Health Authority (OHA), Department of Agriculture (ODA), Department of Environmental Quality (DEQ), the Agency for Toxic Substances and Disease Registry (ATSDR) and the U.S. Environmental Protection Agency USEPA), initiated an Exposure Investigation (EI) to assess whether, and to what extent, these residents are being exposed to pesticides. The Oregon Health Authority (OHA) had been identified as the state lead agency to initiate the Exposure Investigation. OHA requested ODA, Pesticides Program, to collect and provide specific pesticide application data for 2009, 2010, and 2011, in support of the Exposure Investigation. The investigation was initiated in the fall of 2011 and is anticipated to continue into the fall of 2012.

Objectives:

#1 – Obtain Commercial Pesticide Operator and Public Pesticide Applicator pesticide application record data for 2009, 2010, and 2011, within subject area. Request Private Pesticide Applicators to submit pesticide application data within the subject area for 2009, 2010, and 2011, in support of the Exposure Investigation.

#2 - Verify and validate pesticide use application data submitted to the Oregon Department of Agriculture, Pesticides Program, by Commercial Pesticide Operators and Public Pesticide Applicators in support of the Highway 36 Exposure Investigation (EI). Collect and compile Commercial Pesticide Operators, Public Pesticide Applicator and Private Pesticide Applicator application data submitted to ODA within the subject area for 2009, 2010, and 2011, in support of the Exposure Investigation.

Oregon Pesticide Applicator License Definitions/Recordkeeping Requirements

A Commercial Pesticide Operator is defined as: "a person who owns or operates a business engaged in the application of pesticides upon the land or property of another." Oregon Revised Statute (ORS) Chapter 634.146 requires Commercial Pesticide Operators to prepare, maintain and make available for inspection during business hours pesticide application information. Records shall be maintained for a period of at least three years from the date of application. Specific record elements to be maintained are identified in ORS 634.146.

A Public Pesticide Applicator is defined as: "a person who is an employee of the State of Oregon or its agencies, counties, cities, municipal corporations, other governmental bodies or sub divisions thereof, irrigation districts, drainage districts and public utilities and telecommunications utilities who performs or carries out the work, duties or responsibilities of a pesticide applicator utilizing power equipment or a restricted use pesticides. Pursuant to Oregon Administrative Rule 603-057-0130, Public Pesticide Applicators shall prepare and maintain the records required of pesticide operators as identified by ORS 634.146 for applications utilizing power equipment or a restricted use pesticide. Specific record elements to be maintained are identified in ORS 634.146.

A Private Pesticide Applicator is defined as; "a person who uses or supervises the use of any pesticide, classified by the department as a restricted-use or highly toxic pesticide, for the purpose of producing agricultural commodities or forest crop on land owned or leased by the person". Oregon Revised Statutes, Chapter 634 (ORS 634) – Pesticide Control, and corresponding Oregon Administrative Rules, OAR 603 Division 57, do not require private pesticide applicators to prepare or maintain pesticide application records.

As required by the 1990 Farm Bill, and administered by the U.S. Department of Agriculture (USDA), Agricultural Marketing Service (AMS), Recordkeeping Branch, private pesticide applicators are required to maintain records of all restricted use pesticides applied to agricultural commodities or forest crop on land owned or leased by the person. USDA authorized representatives may perform compliance and inspection of the USDA recordkeeping requirements. Record information shall be maintained for a period of two years following the application.

Note: As specified by Oregon Laws 1999, Chapter 1059, Sections 2 to 11,15,20,21 and 22, each pesticide user must report to the Department of Agriculture the use of any pesticide product, as defined by ORS 634.006(8). This requirement is referred to as the Pesticide Use Reporting System (PURS). The term "pesticide user" is defined as any person who uses or applies a pesticide in the course of business or any other non-profit enterprise, or for a governmental entity, or location that is intended for public use or access. Private Applicators would be included in the definition of "pesticide user". Due to state budget constraints, the Pesticide Use Reporting System (PURS) is not available to provide pesticide use data to support the Exposure Investigation. In 2009 the Oregon Legislature amended the PURS statutes. Among those amendments was that no pesticide user is required to report pesticide use information into PURS when PURS is not funded or available. In addition, Oregon Administration Rules (OAR) states that no enforcement action shall be taken for failure to report pesticide use "... for any calendar year in which the Department does not provide a fully effective means for pesticide users to report pesticide use. The Pesticide Use Reporting System has not been available for reporting pesticide use information from 2009 to present due to funding constraints.

Project/Task Description

The exposure investigation subject area was defined as T15S R06W, T15S R07W, T16S R06W, T16S R07W, T16S R08W, T17S R07W, T17S R08W, T17S R09W (Attachment #1). The

pesticide active ingredients of interest were identified as atrazine, aminopyralid, 2,4-D, clopyralid, glyphosate, hexazinone, imazapyr, metsulfuron-methyl, picloram, sulfometuron-methyl, triclopyr. The specific data elements requested by ODA and agreed upon by OHA include: date of application, location of application and acres applied, trade name/ EPA Registration Number, amount applied/Acre, crop or property treated. ODA will utilize the Pesticides Program licensing database to identify licensed pesticide businesses and applicators that may have performed pesticide application activities within the subject area during 2009, 2010, and 2011. To meet the data needs of the EI, ODA identified licensed businesses or individuals with specific pesticide license types to request pesticide application data. The license types were identified as Commercial Pesticide Operators, Public Pesticide Applicators and Private Pesticide Applicators. Within these license types, ODA identified specific pesticide use categories as well as county designations to further focus the data request to site-specific pesticide application activities within the study area. Site-specific categories utilized or for Commercial Pesticide Operator licenses include Forest (Statewide), Agriculture Herbicide (Lane, Linn, Benton, Douglas, Lincoln, Marion) as well as any license designation for Aerial-Helicopter. Site-specific categories utilized or for Public Pesticide Applicators included Right-of-Way (Lane County), Agriculture Herbicide (Lane County), and Forest (Lane County). Site-specific categories are not utilized or for Private Pesticide Applicator licensing.

Data Acquisition, Verification/Validation

Utilizing the Pesticides Program Licensing Database, ODA identified (421) licensed pesticide businesses or applicators that met the license criteria identified above: one hundred fifty six (156) Commercial Pesticide Operators, eighty-eight (88) Public Pesticide Applicators, and one hundred seventy seven (177) Private Pesticide Applicators.

On or about March 2, 2012, ODA mailed letters (Attachment #2-4) to (421) licensed pesticide businesses or applicators requesting submission of pesticide use data in support of the EI. The letters identified the specific pesticide application timeframe (2009,2010,and 2011), EI subject area map, pesticide active ingredients under review and ODA data request form (Attachment #5). ODA requested businesses and licensees to respond by submitting the pesticide application information by March 23, 2012. Pesticides Division staff will follow up with Commercial Pesticide Operators and Public Pesticide Applicators who fail to respond.

ODA Information Services (IS) utilized computer software programming to provide a ten percent (10%) random selection from the (421) licensed Commercial Pesticide operators and Public Applicators that met the license criteria. ODA Compliance/Enforcement staff will conduct routine follow-up Applicator Record Inspections (ARI) on 10 percent (10%) of the Commercial Pesticide Operators (16) and 10 % of the Public Pesticide Applicators (9) based on the IS random selection. If during ARI compliance inspections, reported pesticide application data discrepancies (Incorrect data reported, failure to provide requested data, failure to maintain required data) are documented in excess of 10 percent (10%) of the businesses or individuals inspected, ODA will increase the ARI follow up inspections by 5 percent until a confidence level of 90 percent has been confirmed. Follow up compliance inspections will be conducted utilizing established ARI procedures.

ODA Pesticides Division will not be conducting verification/validation of pesticide use data submitted to ODA by Private Pesticide Applicators. Oregon Private Pesticide Applicators are not required under Oregon Revised Statutes, Chapter 634 (ORS 634) to prepare, maintain or make available for inspection pesticide use records. Response from Private Pesticide Applicators to ODA's letter of request for pesticide use data is strictly voluntary. Pesticide use data provided to ODA in response to the request does become public record and will be provided to OHA in support of the EI.

Pesticide Application Data Management

Pesticide application record data was received by ODA and logged into an Excel spreadsheet for tracking of reporting party and comparison to the list of letters mailed by ODA. The record data from the reports was then entered into the spreadsheet containing the following data points: Company Name, Submitted by, Did not apply, Date, Location of application, Acres, Product Name, Amount applied, and Specific Crop. Each active ingredient was recorded on a separate line within the spreadsheet. The final spreadsheet was printed and provided to OHA along with the actual reports and a disk containing the spreadsheet file.

Findings:

Response To ODA Data Request Letters:

Commercial Pesticide Operators – ODA sent one hundred fifty six (156) letters to Commercial Pesticide Operators. As of May 1, 2012, ODA received one hundred fifty three (153) responses (98%). Of the three businesses that did not respond, two (2) were confirmed by ODA as being out of business and one (1) business provided verbal response that no pesticide applications had been performed within the subject area. Of the one hundred fifty three (153) written responses received, seventeen (17) reported pesticide applications within the EI subject area. One hundred thirty six (136) reported no pesticide applications within the EI subject area.

Public Pesticide Applicators – ODA sent eighty- eight (88) letters to Public Pesticide Operators. As of May 1, 2012, ODA received eighty-six (86) responses (98%). Of the eighty-six (86) written responses received, three (3) public applicators reported pesticide applications within the EI subject area. Eighty-three (83) public applicators reported no pesticide applications within the EI subject area.

Private Pesticide Applicators - ODA sent one hundred seventy seven (177) letters to Private Pesticide Applicators. As of May 1, 2012, ODA received sixty- six (66) responses (37%). Of the responses received, one (1) Private Pesticide Applicator reported pesticide applications within the EI subject area, (65) Private Pesticide Applicators reported no pesticide applications within the EI subject area.

Follow-up Applicator Record Inspections (ARI)- Data Validation and Verification:

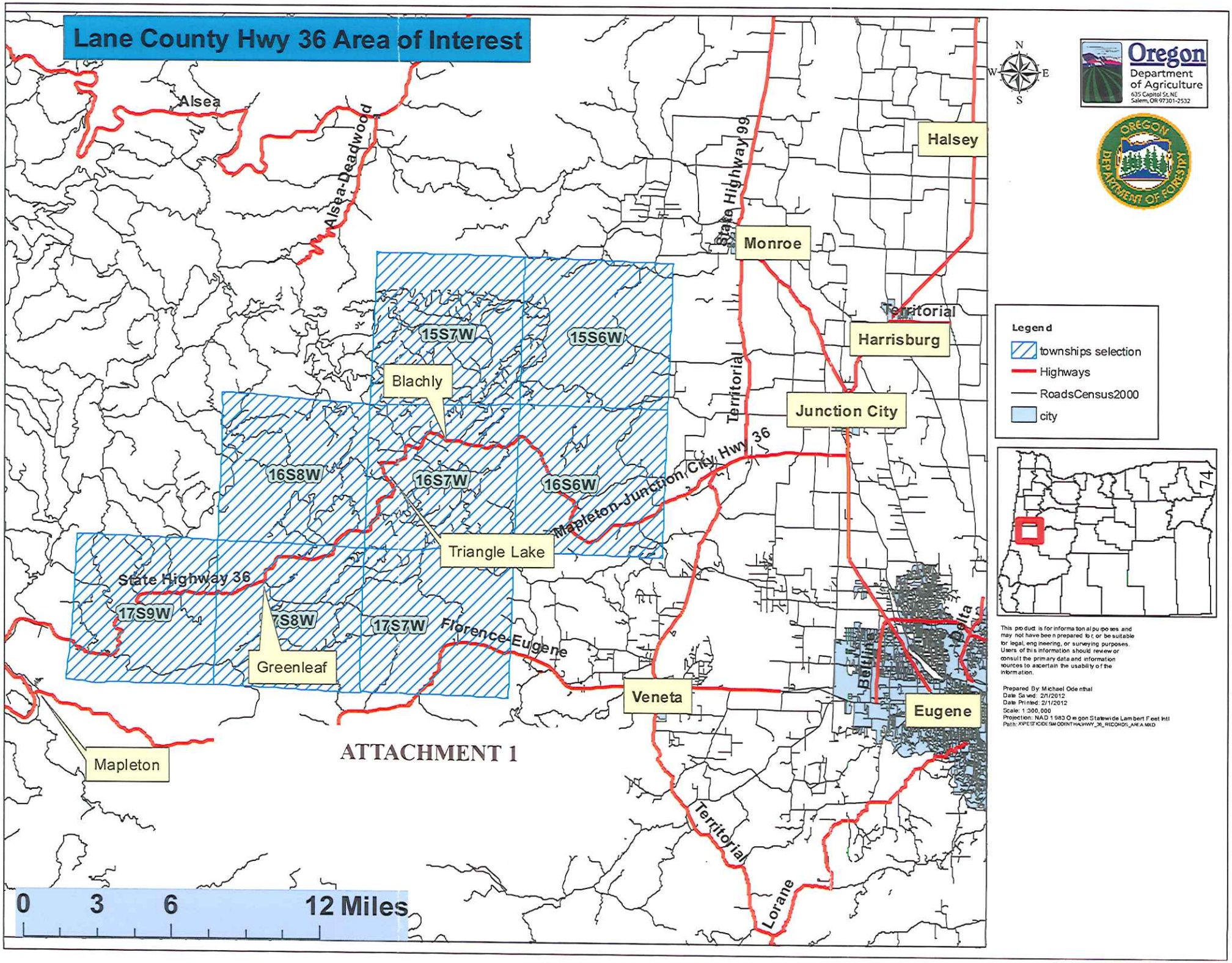
Commercial Pesticide Operators –As of November 1, 2012, ODA has completed fifteen (15) of the sixteen (16) Commercial Pesticide Operator follow-up record inspections to validate and verify response to data request and data provided to ODA. Follow up compliance inspections were conducted utilizing established ARI procedures. Thirteen (13) of the fifteen Commercial Operators reported no pesticide applications conducted in the subject area. ODA's inspection did not identify records or data subject to the EI. Two (2) of the fifteen Commercial Operators reported pesticide applications conducted within the subject area. One of the Commercial Operators records and data had been verified and confirmed. However, one of the Commercial Operators had failed to provide record data for two applications conducted within the subject area. This information was obtained by ODA and will be provided to OHA in support of the EI.

Due to scheduling conflicts with the one remaining Commercial Operator, ODA will continue to pursue scheduling of the follow-up record inspection.

Public Pesticide Applicators – As of November 1, 2012, ODA had completed all nine (9) of the Public Pesticide Applicator follow-up record inspections to validate and verify response to data request and data provided to ODA. Follow up compliance inspections were conducted utilizing established ARI procedures. Eight (8) of the Public Applicators reported no pesticide applications conducted in the subject area. ODA's inspection did not identify records or data subject to the EI. One (1) of the Public Applicators reported pesticide applications conducted within the subject area. ODA's inspection and review of record information verified and confirmed records and data submitted subject to the data request.

Private Pesticide Applicators – ODA Pesticides Division did not conduct verification/validation of pesticide use data submitted to ODA by Private Pesticide Applicators. Oregon Private Pesticide Applicators are not required under Oregon Revised Statutes, Chapter 634 (ORS 634) to prepare, maintain or make available for inspection pesticide use records. Response from Private Pesticide Applicators to ODA's letter of request for pesticide use data is voluntary. Pesticide use data provided to ODA by Private Applicators in response to the request has been provided to OHA in support of the EI.

With the exception of the one remaining Commercial Pesticide Operator follow-up inspection, ODA has completed it's verification and validation of the pesticide application record data submitted to ODA in support of the EI. Based on the follow-up inspection of record data submitted and reviewed, ODA does not anticipate additional follow-up inspections at this time.



ATTACHMENT 1

Oregon
John A. Kitzhaber, MD, Governor

Department of Agriculture
635 Capitol St NE
Salem, OR 97301-2532

PESTICIDES DIVISION

March 2, 2012

ATTACHMENT 2

«Name»
«Address»
«City», «State» «Zip_Code»

RE: Pesticide Application Record Information, Western Lane County, Oregon

Residents living in western Lane County, near Triangle Lake and Highway 36, have expressed concern for several years over possible exposures to pesticides from application activities on forestland, right-of-way, and agricultural sites. Several residents have reported potential health effects associated with pesticide use in the surrounding area. Based on information provided by some residents, the multi-agency Oregon Pesticide Analytical Response Center (PARC), in cooperation with Oregon Health Authority, Department of Environmental Quality, the Agency for Toxic Substances and Disease Registry (ATSDR) and the U.S. Environmental Protection Agency, initiated an Exposure Investigation to assess whether, and to what extent, these residents are being exposed. The investigation was initiated in the fall of 2011 and is anticipated to continue into the spring of 2012.

To support the ongoing efforts of the exposure investigation, the Oregon Department of Agriculture (ODA) requests Commercial Pesticide Operators provide specific pesticide application record information. The information may be used by any of the agencies participating in the exposure investigation. Accompanying this letter is detailed information identifying the subject area and active ingredients under review, along with the required record elements to be submitted. The required information must meet each of the following three criteria (see reverse):

- Applications were made in calendar years 2009, 2010, and 2011
- Applications were made in the investigation subject area.
- Applications were made with pesticide products containing the active ingredients under review

This information shall be submitted on the attached ODA form provided. If you need additional forms, please reproduce as necessary.

ODA requires this information pursuant to the authority established in Oregon Revised Statutes (ORS) Chapter 634. The specific record information required of Commercial Operators is listed in ORS 634.146. Failure to provide the information would be considered a violation of law and may be subject to an enforcement response.

If you did not apply pesticides meeting the above criteria, check the box on the form and return it to ODA. Negative responses are required.

Return the record information on the form provided no later than **March 23, 2012.** Record information may be provided by mail, fax to (503) 986-4735, or sent via e-mail pestreg@oda.state.or.us to the attention of Mike Odenthal. If you have any questions regarding this request, please contact me. Thank you for your cooperation.

Sincerely,

Michael L Odenthal

Michael Odenthal
Investigator
Oregon Department of Agriculture Pesticides Division
635 Capitol ST NE
Salem, OR 97301
PH: (503) 986-4655, FAX: (503) 986-4735
E-MAIL: modenthal@oda.state.or.us

Provide the following information for each pesticide application on the form provided:

- **The location of the land or property where application was made:** The address of the site, or a geographic description of the application site (such as circle number, map number, or township/section/range), and the size of the area treated (acres, square feet, linear feet, etc.)
- **The month/day/year of the application**
- **The trade name and the strength of such pesticides applied:** The EPA registration number of each pesticide product applied or the manufacturer, product name, and formulation type of each product applied
- **The amount or concentration (pounds or gallons per acre of active ingredient or concentration per approximately 100 gallons):**
  - The amount of each pesticide product applied per unit of measure (ounces, pounds, pints, quarts, etc.)
  - The type and amount of carrier applied per unit of measure (acre, square feet, etc.) or, where a specific unit of measure is not applicable, the total amount applied to the site
  - The amount and type of other material applied (such as spreader/sticker, wetting agent or drift retardant)
- **The specific site (property, crop or crops to which the pesticide was applied)**

Investigation Subject Area (within Lane County, defined by the following townships)

T15S R06W, T15S R07W, T16S R06W, T16S R07W, T16S R08W, T17S R07W, T17S R08W, T17S R09W

(See included map)

Active Ingredients Under Review

atrazine, aminopyralid, 2,4-D, clopyralid, glyphosate, hexazinone, imazapyr, metsulfuron-methyl, picloram, sulfometuron-methyl, triclopyr

Oregon
John A. Kitzhaber, MD, Governor

Department of Agriculture
635 Capitol St NE
Salem, OR 97301-2532

PESTICIDES DIVISION

March 2, 2012

ATTACHMENT 3

«Name»
«Address»
«City», «State» «Zip_Code»

RE: Pesticide Application Record Information, Western Lane County, Oregon

Residents living in western Lane County, near Triangle Lake and Highway 36, have expressed concern for several years over possible exposures to pesticides from application activities on forestland, right-of-way, and agricultural sites. Several residents have reported potential health effects associated with pesticide use in the surrounding area. Based on information provided by some residents, the multi-agency Oregon Pesticide Analytical Response Center (PARC), in cooperation with Oregon Health Authority, Department of Environmental Quality, the Agency for Toxic Substances and Disease Registry (ATSDR) and the U.S. Environmental Protection Agency, initiated an Exposure Investigation (EI) to assess whether, and to what extent, these residents are being exposed. The investigation was initiated in the fall of 2011 and is anticipated to continue into the spring of 2012.

To support the ongoing efforts of the Exposure Investigation the Oregon Department of Agriculture (ODA) requests your cooperation and assistance as a Private Pesticides Applicator, by voluntarily providing specific pesticide use information. Information provided will be used in the assessment of possible health exposures as part of the investigation. The Department acknowledges that you are not statutorily required to maintain records or make them available, however, your cooperation is appreciated. Accompanying this letter is detailed information identifying the subject area and active ingredients under review, along with the requested record elements to be submitted. The requested information must meet each of the following three criteria (see reverse):

- Applications were made in calendar years 2009, 2010, and 2011
- Applications were made in the investigation subject area
- Applications were made with active ingredients under review

A form for the information and a map of the subject area are included with this letter for your use. If you need additional forms, please reproduce as necessary.

If you did not apply pesticides meeting the above criteria, check the box on the form and return it to ODA. Negative responses are helpful and appreciated.

Send the record information (**on the form provided**) to the attention of Mike Odenthal by fax, by e-mail, or by mail (information below), no later than **March 23, 2012**. If you have any questions regarding this request, please contact me. Thank you for your cooperation.

Sincerely,

Michael L Odenthal

Michael Odenthal
Investigator, Pesticides Division
Oregon Department of Agriculture
635 Capitol ST NE
Salem, OR 97301
PH: (503) 986-4655, FAX: (503) 986-4735
E-MAIL: modenthal@oda.state.or.us

Provide only the following information for each pesticide application on the form provided:

- **The location of the land or property where application was made:** The address of the site, or a geographic description of the application site (such as circle number, map number, or township/section/range), and the size of the area treated (acres, square feet, linear feet, etc.)
- **The month/day/year of the application**
- **The trade name and the strength of such pesticides applied:** The EPA registration number of each pesticide product applied or the manufacturer, product name, and formulation type of each product applied
- **The amount or concentration (pounds or gallons per acre of active ingredient or concentration per approximately 100 gallons):**
  - The amount of each pesticide product applied per unit of measure (ounces, pounds, pints, quarts, etc.)
  - The type and amount of carrier applied per unit of measure (acre, square feet, etc.) or, where a specific unit of measure is not applicable, the total amount applied to the site
  - The amount and type of other material applied (such as spreader/sticker, wetting agent or drift retardant)
- **The specific site (property, crop or crops to which the pesticide was applied)**

Investigation Subject Area (within Lane County, defined by the following townships)

T15S R06W, T15S R07W, T16S R06W, T16S R07W, T16S R08W, T17S R07W, T17S R08W, T17S R09W

(See included map)

Investigation Active Ingredients

atrazine, aminopyralid, 2,4-D, clopyralid, glyphosate, hexazinone, imazapyr, metsulfuron-methyl, picloram, sulfometuron-methyl, triclopyr

Oregon
John A. Kitzhaber, MD, Governor

Department of Agriculture
635 Capitol St NE
Salem, OR 97301-2532

PESTICIDES DIVISION

March 2, 2012

ATTACHMENT 4

«Name»
«Address_»
«City», «State» «Zip_Code»

RE: Pesticide Application Record Information, Western Lane County, Oregon

Residents living in western Lane County, near Triangle Lake and Highway 36, have expressed concern for several years over possible exposures to pesticides from application activities on forestland, right-of-way, and agricultural sites. Several residents have reported potential health effects associated with pesticide use in the surrounding area. Based on information provided by some residents, the multi-agency Oregon Pesticide Analytical Response Center (PARC), in cooperation with Oregon Health Authority, Department of Environmental Quality, the Agency for Toxic Substances and Disease Registry (ATSDR) and the U.S. Environmental Protection Agency, initiated an Exposure Investigation to assess whether, and to what extent, these residents are being exposed. The investigation was initiated in the fall of 2011 and is anticipated to continue into the spring of 2012.

To support the ongoing efforts of the exposure investigation, the Oregon Department of Agriculture (ODA) requests Public Pesticide Applicators provide specific pesticide application record information. The information may be used by any of the agencies participating in the exposure investigation. Accompanying this letter is detailed information identifying the subject area and active ingredients under review, along with the required record elements to be submitted. The required information must meet each of the following three criteria (see reverse):

- Applications were made in calendar years 2009, 2010, and 2011
- Applications were made in the investigation subject area.
- Applications were made with pesticide products containing the active ingredients under review

This information shall be submitted on the attached ODA form provided. If you need additional forms, please reproduce as necessary.

ODA requires this information pursuant to the authority established in Oregon Revised Statutes (ORS) Chapter 634. The specific record information required of Commercial Operators is listed in ORS 634.146. Failure to provide the information would be considered a violation of law and may be subject to an enforcement response.

If you did not apply pesticides meeting the above criteria, check the box on the form and return it to ODA. Negative responses are required.

Return the record information on the form provided no later than **March 23, 2012.** Record information may be provided by mail, fax to (503) 986-4735, or sent via e-mail pestreg@oda.state.or.us to the attention of Mike Odenthal. If you have any questions regarding this request, please contact me. Thank you for your cooperation.

Sincerely,

Michael L Odenthal

Michael Odenthal
Investigator, Pesticides Division
Oregon Department of Agriculture
635 Capitol ST NE
Salem, OR 97301
PH: (503) 986-4655, FAX: (503) 986-4735
E-MAIL: modenthal@oda.state.or.us

Provide the following information for each pesticide application on the form provided:

- **The location of the land or property where application was made:** The address of the site, or a geographic description of the application site (such as circle number, map number, or township/section/range), and the size of the area treated (acres, square feet, linear feet, etc.)
- **The month/day/year of the application**
- **The trade name and the strength of such pesticides applied:** The EPA registration number of each pesticide product applied or the manufacturer, product name, and formulation type of each product applied
- **The amount or concentration (pounds or gallons per acre of active ingredient or concentration per approximately 100 gallons):**
  - The amount of each pesticide product applied per unit of measure (ounces, pounds, pints, quarts, etc.)
  - The type and amount of carrier applied per unit of measure (acre, square feet, etc.) or, where a specific unit of measure is not applicable, the total amount applied to the site
  - The amount and type of other material applied (such as spreader/sticker, wetting agent or drift retardant)
- **The specific site (property, crop or crops to which the pesticide was applied)**

Investigation Subject Area (within Lane County, defined by the following townships)

T15S R06W, T15S R07W, T16S R06W, T16S R07W, T16S R08W, T17S R07W, T17S R08W, T17S R09W

(See included map)

Active Ingredients Under Review

atrazine, aminopyralid, 2,4-D, clopyralid, glyphosate, hexazinone, imazapyr, metsulfuron-methyl, picloram, sulfometuron-methyl, triclopyr

Oregon Department of Agriculture

PARC Health Exposure Investigation - Western Lane County Oregon.

Requested Pesticide Application Data for HWY 36 Area of Interest from years 2009, 2010, 2011.

☐ Did not apply pesticide products within subject area

Date	Location of application & acres applied	Trade Name/ EPA Reg number of product applied	Amount applied/acre; type and amount of carrier	Specific crop or property, ie: forest site prep, pasture, roadside

ATTACHMENT 5

Mail to: Oregon Dept. of Agriculture
635 Capitol ST NE
Salem, OR 97301

Company Name: _____ Submitted by: _____

Appendix B: Comparison Values Used to Evaluate Biological and Environmental Samples

Many State and Federal agencies develop comparison concentrations for chemicals in various media (urine, water, food, soil, etc.). The purpose of this Appendix is to explain how OHA selected and derived the comparison values (CVs) used in this report.

Urine

Urine is a unique medium for evaluating pesticide exposures because no clear associations have been drawn between specific urine concentrations and health outcomes in humans. OHA compared the urine results from this EI to those measured in the general population through the National Health and Nutrition Examination Survey (NHANES) and reported in the Fourth National Report on Human Exposure to Environmental Chemicals [16]. For 2,4-D, OHA compared the EI results to the NHANES 75th and 95th percentiles. OHA also compared the 2,4-D results to the biomonitoring equivalent (BE) for 2,4-D. A BE represents the estimated concentration of 2,4-D that would be present in the urine of a person who was chronically exposed to 2,4-D at a dose equal to EPA's reference dose (RfD) for 2,4-D. The BE for chronic exposures (lasting more than 7 years) to 2,4-D is 200 μg/L; for acute exposures (lasting one day), the BE is 400 μg/L for women of reproductive age and 1,000 μg/L for the rest of the population [19 - 20]. There are no national reference values for atrazine in urine. Therefore, OHA searched peer-reviewed literature for smaller studies where the same atrazine metabolites were measured in human urine (see Table 12).

Water and Soil

OHA used ATSDR's hierarchy for choosing CVs for water and soil (Figure 5). If a hierarchy 1, 2 or 3 CV was not available, EHAP chose the lowest of EPA's Regional Screening Levels (RSL), U.S. Geological Survey's Health-based Screening Levels (HBSL), or EPA's Human Health Benchmark for Pesticides (HHBP). Tables 22 and 23 show the CVs used for water and soil respectively.

Figure 5: ATSDR's hierarchy for selecting CVs in water, soil and air **[6]**.

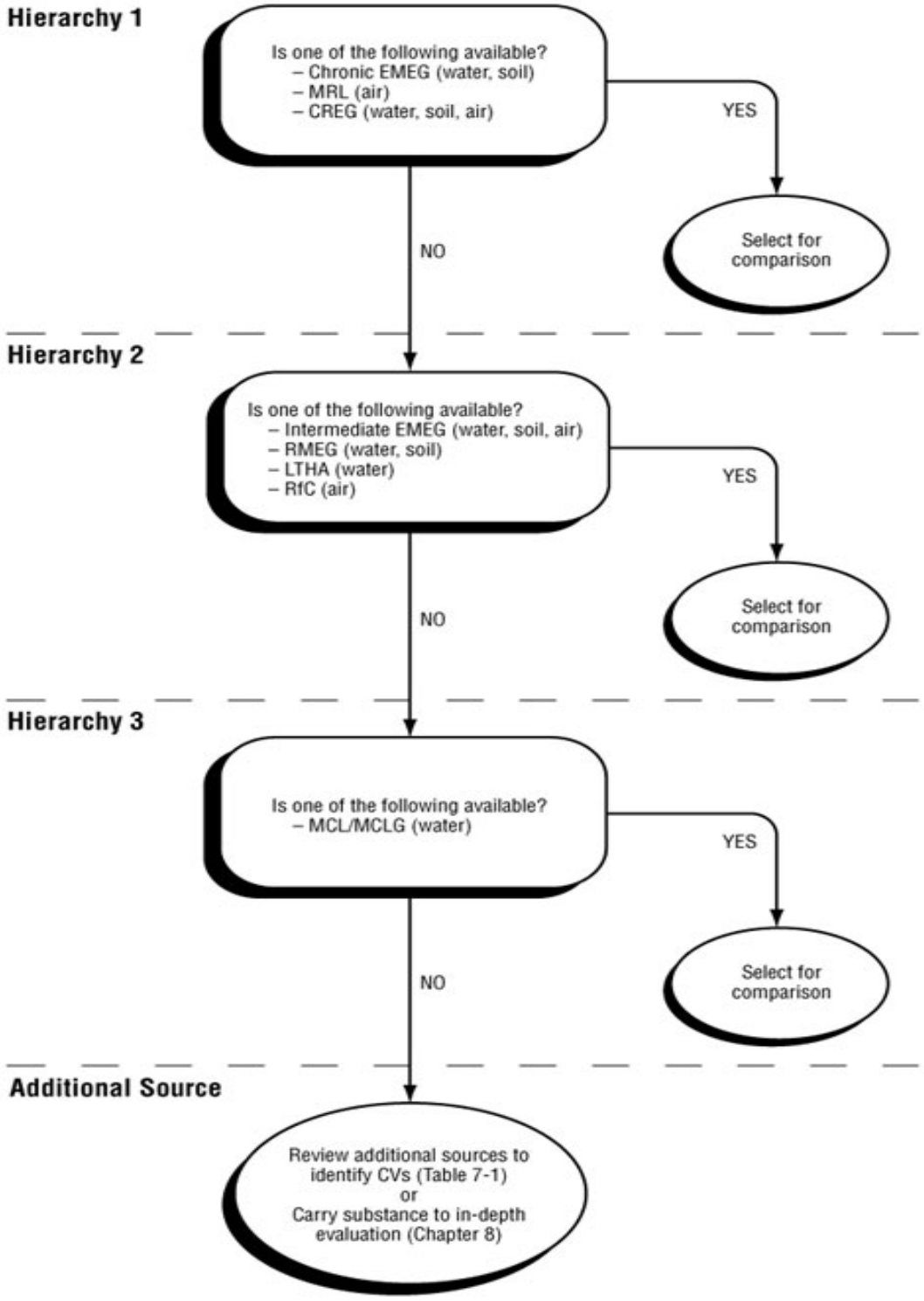


Table 22: Analytes, detections, and comparison values for water samples.

Analyte	Detections (N = 37)**	Maximum Detected (ppm)	Comparison Value (ppm)	CV Source
2 (2,4,5-Trichlorophenoxy) propionic acid (2,4,5-TP/Silvex)	0	<0.00011	0.05	LTHA
2,4,5-Trichlorophenoxyacetic Acid 2,4,5 (2,4,5-T)	0	<0.00033	0.07	LTHA
2,4-Dichlorophenoxyacetic Acid (2,4-D)	0	<0.00011	0.1	RMEG
3,5-Dichlorobenzoic acid	0	<0.00033	NA	-
4-(2,4-dichlorophenoxy) butyric acid (2,4-DB)	0	<0.00066	0.08	RMEG
4-chloro-2-methylphenoxyacetic Acid (MCPA)	0	<0.022	0.005	RMEG
Acetamiprid	0	<0.0000041	0.5	HHBP
Acetochlor	0	<0.00001	0.2	RMEG
Acifluorfen	0	<0.00022	0.09	HBSL
Alachlor	0	<0.000031	0.1	RMEG
Aldrin	0	<0.000026	0.0000021	CREG
alpha-Chlordane (cis-Chlordane)	0	<0.000026	0.0001	CREG
alpha-Hexachlorocyclohexane (alpha-BHC)	0	<0.000026	0.000006	CREG
Ametryn	0	<0.0000041	0.06	LTHA
Aminocarb	0	<0.0000041	NA	-
Atrazine	0	<0.000051	0.03	Intermediate EMEG
Baygon	0	<0.0000041	0.003	LTHA
beta-Hexachlorocyclohexane (beta-BHC)	0	<0.000026	0.000019	CREG
Bifenthrin	0	<0.000082	0.091	HHBP
Bromacil	0	<0.000026	0.07	LTHA
Butachlor	0	<0.000026	NA	-
Butylate	0	<0.000026	0.4	LTHA
Carbaryl	0	<0.0000051	1	RMEG
Carbofuran	0	<0.0000041	0.05	RMEG
Chlorneb	0	<0.000026	0.09	HHBP
Chlorobenzilate	0	<0.000026	0.2	RMEG
Chlorothalonil	0	<0.000026	0.15	RMEG
Chlorpropham	0	<0.000026	2	RMEG
Cyanazine	0	<0.000026	0.001	LTHA
Cycloate	0	<0.000026	0.035	HHBP
Dacthal (DCPA - Dimethyl tetrachloroterephthalate)	0	<0.000026	0.07	LTHA
DCPA (Dimethyl tetrachloroterephthalate) acid metabolites	0	<0.00066	0.07	LTHA* (Parent: DCPA)

Analyte	Detections (N = 37)**	Maximum Detected (ppm)	Comparison Value (ppm)	CV Source
delta-Hexachlorocyclohexane (delta-BHC)	0	<0.000026	0.000006	CREG* (Parent: alpha-BHC)
Desethyl Atrazine	0	<0.0000041	0.03	Intermediate EMEG* (Parent: Atrazine)
Desisopropyl Atrazine	0	<0.0000041	0.03	Intermediate EMEG* (Parent: Atrazine)
Diazinon	0	<0.000026	0.007	Chronic EMEG
Dicamba	0	<0.00033	0.3	RMEG
Dichlorodiphenyldichloroethane (4,4'-DDD)	0	<0.000026	0.00015	CREG
Dichlorodiphenyldichloroethylene (4,4'-DDE)	0	<0.000026	0.0001	CREG
Dichlorodiphenyltrichloroethane (4,4'-DDT)	0	<0.000026	0.0001	CREG
Dichloroprop	0	<0.00033	0.3	HBSL
Dichlorvos	0	<0.000026	0.00012	CREG
Dieldrin	0	<0.000026	0.0000022	CREG
Dimethoate	0	<0.000026	0.002	RMEG
Dinoseb	0	<0.00033	0.007	LTHA
Diuron	0	<0.0000041	0.02	RMEG
Chlorpyrifos	0	<0.000026	0.01	Chronic EMEG
Endosulfan I	0	<0.000026	0.02	Chronic EMEG
Endosulfan II	0	<0.000026	0.02	Chronic EMEG* (Parent: Endosulfan I)
Endosulfan sulfate	0	<0.000026	0.02	Chronic EMEG* (Parent: Endosulfan I)
Endrin	0	<0.000026	0.003	Chronic EMEG
Endrin aldehyde	0	<0.000026	0.003	Chronic EMEG* (Parent: Endrin)
Ethoprophos	0	<0.000026	0.001	HBSL
Etridiazole (Terrazole)	0	<0.000026	0.112	HHBP
Fenamiphos	0	<0.000031	0.0007	LTHA
Fenarimol	0	<0.000026	0.042	HHBP
Fenvalerate/Esfenvalerate	0	<0.000512	0.25	RMEG
Fluometuron	0	<0.0000041	0.09	LTHA
Fluridone	1	0.000031	1.05	HHBP
gama-Hexachlorocyclohexane (Lindane)	0	<0.000026	0.0001	Intermediate EMEG
gamma-Chlordane (trans-Chlordane)	0	<0.000026	0.0001	CREG
Heptachlor	0	<0.000026	0.0000078	CREG
Heptachlor epoxide	0	<0.000026	0.0000038	CREG
Hexazinone	1	0.000183	0.4	HBSL

Analyte	Detections (N = 37)**	Maximum Detected (ppm)	Comparison Value (ppm)	CV Source
Imazapyr	0	<0.000041	17.5	HHBP
Imidacloprid	0	<0.00002	0.4	HHBP
Linuron (Lorox)	0	<0.0000041	0.005	HBSL
Malathion	0	<0.000026	0.2	Chronic EMEG
Methiocarb	0	<0.0000041	0.04	HBSL
Methomyl	0	<0.0000041	0.2	LTHA
Methoxychlor	0	<0.000026	0.04	LTHA
Methyl paraoxon	0	<0.000026	0.003	Chronic EMEG* (Parent: Methyl Parathion)
Methyl parathion (Parathion methyl)	0	<0.000026	0.003	Chronic EMEG
Azinphos-Methyl (Guthion)	0	<0.000041	0.03	Chronic EMEG
Methylchlorophenoxypropionic acid (MCPP)	0	<0.066	0.28	HHBP
Metolachlor	0	<0.000026	0.7	LTHA
Metribuzin	0	<0.000026	0.07	LTHA
Mevinphos	0	<0.000026	0.002	HHBP
Mexacarbate	0	<0.0000041	NA	-
Molinate	0	<0.000026	0.02	RMEG
N,*N*-Diethyl-3-methylbenzamide (DEET)	2	0.0000058	0.2	Minnesota Department of Health [21]
Napropamide	0	<0.000026	0.8	HBSL
Neburon	0	<0.0000051	NA	-
N-Octyl bicycloheptene dicarboximide (MGK 264)	0	<0.000051	0.427	HHBP
Norflurazon	0	<0.000026	0.01	HBSL
Oxamyl	0	<0.0000041	0.25	RMEG
Pebulate	0	<0.000026	0.05	HBSL
Penoxalin (Penoxsulam)	0	<0.000026	1.029	HHBP
Pentachlorophenol	0	<0.00011	0.000088	CREG
Permethrin	0	<0.000051	0.5	RMEG
Phosmet	0	<0.000026	0.004	HBSL
Picloram	0	<0.00066	0.5	MCL
Prometon	0	<0.0000041	0.15	RMEG
Prometryn	0	<0.0000041	0.04	RMEG
Pronamide	0	<0.000026	0.75	RMEG
Propachlor	0	<0.000026	0.13	RMEG
Propazine	0	<0.000026	0.01	LTHA
Propiconazole	0	<0.00002	0.07	HBSL
Pyraclostrobin	0	<0.0000041	0.24	HHBP
Pyriproxyfen	0	<0.000256	2.5	HHBP

Analyte	Detections (N = 37)**	Maximum Detected (ppm)	Comparison Value (ppm)	CV Source
S-ethyl dipropylcarbamothioate (EPTC)	0	<0.000026	0.25	RMEG
Siduron	0	<0.0000041	1	HBSL
Simazine	0	<0.000026	0.05	RMEG
Simetryn	0	<0.0000041	NA	-
Sulfometuron-Methyl	0	<0.0000041	1.9	HHBP
Tebuthiuron	0	<0.000026	0.5	LTHA
Terbacil	0	<0.000026	0.09	LTHA
Terbufos	0	<0.000041	0.0004	LTHA
Terbutryn	0	<0.0000041	0.01	RMEG
Terbutylazine	0	<0.0000041	0.002	HBSL
Tetrachlorvinphos (Stirophos)	0	<0.000026	0.3	HHBP
trans-Nonachlor	0	<0.000026	NA	-
Triadimefon	0	<0.000026	0.238	HHBP
Triclopyr	0	<0.00033	0.35	HHBP
Tricyclazole	0	<0.000026	NA	-
Trifluralin	0	<0.000026	0.0045	CREG
Vernolate	0	<0.000026	0.01	RMEG

N = Total number of samples; ppm = parts per million; CV = comparison value; < = Less than; NA = Not Available; - = Not Available; LTHA = Life-time Health Advisory; RMEG = Reference dose Media Evaluation Guide; HHBP = U.S. Environmental Protection Agency Human Health Benchmark for Pesticides [54]; HBSL = U.S. Geological Survey Health-Based Screening Level [55]; CREG = Cancer Risk Evaluation Guideline; EMEG = Environmental Media Evaluation Guide; MCL = Maximum Contaminant Level

* Comparison value for parent compound as surrogate for environmental degradates.

**37 samples include 36 drinking water samples and one surface water samples not used for drinking water.

Table 23: Analytes, detections, and comparison values for soil samples.

Analyte	Detections (N = 29)	Maximum Detected (ppm)	Comparison Value (ppm)	CV Source
2,4-D	2	0.046	500	RMEG
Aminopyralid	0	<0.010	25,000	RMEG – provisional*
Atrazine	0	<0.010	150	Intermediate EMEG
Clopyralid	0	<0.010	25,000	RMEG – provisional*
Glyphosate	2	3.3	5,000	RMEG
Hexazinone	0	<0.010	2,000	RSL
Imazapyr	0	<0.010	125,000	RMEG – provisional*
Metsulfuron Methyl	0	<0.010	12,500	RMEG – provisional*
Picloram	0	<0.010	4,300	RSL
Sulfometuron Methyl	0	<0.010	13,750	RMEG – provisional*
Triclopyr	0	<0.010	2,500	RMEG – provisional*

N = Total number of samples; ppm = parts per million; CV = Comparison Value; < = less than; 2,4-D = 2,4-dichlorophenoxyacetic acid; RMEG = Reference dose Media Evaluation Guide; EMEG = Environmental Media Evaluation Guide; RSL = U.S. Environmental Protection Agency Regional Screening Level

*Provisional RMEG = Derived using the analyte's Reference Dose (RfD and the Agency for Toxic Substances and Disease Registry's drinking water RMEG equation for children. This was a fourth tier option because there were no other comparison values for these analytes.

Food

ATSDR does not have CVs for chemicals in food. Therefore, OHA used the hierarchy shown in Table 24 to select CVs for pesticides in food samples. Table 25 shows results for egg, milk and honey samples. Table 26 shows results for berry, leafy vegetable, and tomato samples.

Table 24: Hierarchy used to select Comparison Values for food.

Hierarchy Level	Source of Comparison Value	Rationale
1	US EPA Pesticide Tolerance for foods [56]	Chemical and medium specific
2	Tolerance or equivalent from World Health Organization [57] or Health Canada [58] *	Chemical and medium specific
3	European Union Default Maximum Residue Limit [59] (0.01 ppm)	Not chemical or medium specific

US EPA = US Environmental Protection Agency; ppm = parts per million
*If both the World Health Organization and Health Canada had a tolerance for a particular food, chose the lowest of the two tolerances.

Table 25: Analytes, detections, and comparison values for egg, milk, and honey samples.

	Eggs				Milk				Honey			
Analyte	Detections (N = 4)	Max Detected (ppm)	CV (ppm)	Source	Detections (N = 2)	Max Detected (ppm)	CV (ppm)	Source	Detections (N = 2)	Max Detected (ppm)	CV (ppm)	Source
2,4-D	0	<0.01	0.01	WHO	0	<0.01	0.05	EPA	0	<0.01	0.01	EU
Aminopyralid	0	<0.01	0.01	WHO	0	<0.01	0.03	EPA	0	NR	0.01	EU
Atrazine	0	<0.01	0.04	HC	0	<0.01	0.02	EPA	0	<0.01	0.01	EU
Clopyralid	0	<0.01	0.1	EPA	0	<0.01	0.2	EPA	0	<0.01	0.01	EU
Glyphosate	0	<0.01	0.05	EPA	0	<0.01	0.05	WHO	0	<0.01	0.01	EU
Hexazinone	0	<0.01	0.01	EU	0	<0.01	11	EPA	0	<0.01	0.01	EU
Imazapyr	0	<0.01	0.05	HC	0	<0.01	0.01	EPA	0	<0.01	0.01	EU
Metsulfuron Methyl	0	<0.01	0.01	EU	0	<0.01	0.05	EPA	0	<0.01	0.01	EU
Picloram	0	<0.01	0.05	EPA	0	<0.01	0.25	EPA	0	<0.01	0.01	EU
Sulfometuron-Methyl	0	<0.01	0.01	EU	0	<0.01	0.01	EU	0	<0.01	0.01	EU
Triclopyr	0	<0.01	0.05	EPA	0	<0.01	0.01	EPA	0	<0.01	0.01	EU

N = Total number of samples; Max = maximum; ppm = parts per million; CV = Comparison Value; < = less than; 2,4-D = 2,4-dichlorophenoxyacetic acid; NR = No Result; EPA= US Environmental Protection Agency; HC = Health Canada; EU = European Union; WHO = World Health Organization

Table 26: Analytes, detections, and comparison values for berry and vegetation samples.

	Berries				Vegetation (Leafy Greens/Tomatoes)			
Analyte	Detections (N = 4)	Max Detected (ppm)	CV (ppm)	Source	Detections (N = 14)	Max Detected (ppm)	CV (ppm)	Source
2,4-D	0	<0.01	0.2	EPA	0	<0.01	0.05	EPA
Aminopyralid	0	<0.01	0.01	EU	0	<0.01	0.01	EU
Atrazine	0	<0.01	0.01	EU	0	<0.01	0.25	EPA
Clopyralid	0	<0.01	0.5	EPA	0	<0.025	5	EPA
Glyphosate	0	<0.01	0.2	EPA	0	<0.04	0.1	EPA
Hexazinone	0	<0.01	0.6*	EPA	0	<0.01	0.01	EU
Imazapyr	0	<0.01	0.01	EU	0	<0.01	0.01	EU
Metsulfuron Methyl	0	<0.01	0.01	EU	0	<0.01	0.01	EU
Picloram	0	<0.01	0.01	EU	0	<0.05	0.01	EU
Sulfometuron-Methyl	0	<0.01	0.01	EU	0	<0.01	0.01	EU
Triclopyr	0	<0.01	0.01	EU	0	<0.01	0.01	EU

N = Total number of samples; Max = maximum; ppm = parts per million; CV = Comparison Value; < = less than; 2,4-D = 2,4-dichlorophenoxyacetic acid; EPA= US Environmental Protection Agency; HC = Health Canada; EU = European Union; WHO = World Health Organization

*For blueberries

Appendix C: Fall 2011 Survey Questions on Home/Work Pesticide Use

Hi _____
Thank you for participating in the Highway 36 pesticide Exposure Investigation. We have a few questions for you to answer, that will help us learn more about any potential exposure to pesticides or herbicides you may have had in the last several days. Please reply to this e-mail, with your responses to the questions below. Please call me at 971-XXX-XXXX if you have any questions. Thank you.

We were at your house on _____.
.....

1. Approximately how much time per day did you spend outdoors around your home, in the week (7 days) before providing your urine sample? Is that typical for you?

2. Do you work at home?

3. Do you use any pesticides or herbicides on your land or in your garden?

4. Do you have a job where you handle or are around pesticides or herbicides?
   If Yes:
   What do you use?

   What application method(s) do you use?

   How much do you use on a weekly basis?

5. Did you use pesticides or herbicides in the week (7 days) before providing your urine sample?
   If Yes:
   When did you apply them?

   What did you use?

   Where did you apply it?

6. Do you know of any herbicide applications that occurred near your home (within a mile or so) in the week before you provided a urine
   sample?
   If Yes:
   Where did that application occur?

   When did that application occur?

   Do you know what method was used to apply them (backpack, aerial spray)?

Thank you for your time!

Appendix D: Chain of Custody for Community-Collected Urine Samples

Description of urine collection and shipment process

1. Community organizers assigned each participant a unique alpha-numerical Personal Identification Number (PIN).
2. A medical doctor in Eugene, OR provided prescriptions for urine collection.
3. Participants had urine samples collected at a PeaceHealth laboratory facility per PeaceHealth's Urine Collection Process and protocols PHL.ALL.271.114, PHL.ALL.69.05, PHL.OR.394.57 and PHL.ALL.69.7
    a. Each participant had their identification verified using two sources of identification confirming their full name and birthdate.
    b. Each participant verified their unique PIN.
    c. Each sample was labeled with the unique PIN and a unique PeaceHealth Laboratory accession number (PHLAN). No personally identifiable information (e.g., name, birthdate) were included on the sample label.
4. A PeaceHealth courier transported the urine samples from the collection site to the PeaceHealth Send Out Department. Each sample was accompanied by a packing slip that included the specimen label (with PIN and PHLAN) and a copy of the original prescription.
5. The PeaceHealth Send Out Department packed and shipped the samples via United Parcel Service or Federal Express to the lab at Emory University in Atlanta, GA.
6. Packaged samples were received by Central Shipping and Receiving (CS&R) at Emory University, and were delivered to the laboratory by an Emory University courier.

Laboratory Analysis

The urine samples were analyzed for 2,4-D and atrazine using CDC's laboratory methods for these chemicals [34], [35].

Reconstruction Process

In June 2012, after obtaining consent from 31 community urine collection participants, OHA began reconstructing and verifying the chain of custody from sample collection at PeaceHealth to delivery at Emory University. Forty-six of the 50 samples from consenting participants were collected at the PeaceHealth collection site in Eugene, OR. The other four samples were collected at a community hospital in Grants Pass, OR. These four samples were from two individuals who live outside the Exposure Investigation area and were excluded from further analyses in this PHA. A chain of custody was not established for those four samples.

To reconstruct and verify the chain of custody, OHA took the following steps:

1. Obtained and generated a list of PINs and PHLANs from:
    a. Copies of packing slips from packages received by the laboratory (provided by laboratory researcher on 6/12/2012);
    b. List of all consented participants with corresponding PINs and birthdates (provided by community organizers on 6/20/2012).
2. Sent PeaceHealth Client Services a list of PINs and corresponding PHLANs and birthdates

3. Obtained internal reports from PeaceHealth Client Services, Send Out Department, and Quality and Compliance to confirm the following for all 46 samples:
    a. Date and time the samples were picked up by the PeaceHealth Laboratory courier at the collection site;
    b. Date and time the samples were received at PeaceHealth's Send Out Department; and
    c. Date, time, ship-to address and method of shipment from PeaceHealth's Send Out Department to Emory University
4. Contacted Senior Operations Manager at the Rollins School of Public Health at Emory University, who confirmed the receipt of 26 samples by the CS&R at Emory University and the delivery of those 26 samples to laboratory.
5. Confirmed receipt of seven unanalyzed samples by CS&R at Emory University through the Federal Express tracking system.

Appendix E: Herbicides and Human Health

Herbicides are pesticides that are designed to be toxic to plants or specific types of plants. However, some herbicides have the potential to cause health problems in humans. In concentrated mixtures, herbicides can cause irritation to the skin and eyes if there is direct contact with these tissues. In general, the strongest scientific evidence on the health effects from herbicide exposures is from studies that examined relatively high levels of herbicide exposure. There is less certainty about the health effects of long-term exposure to lower doses, which characterizes the types of exposures the general public is most likely to experience. Some herbicides have been proven so harmful to human health that they have been banned. Others have been shown to be less toxic to humans.

Health Effects of 2,4-D and atrazine

Both 2,4-D and atrazine have the potential to harm human health. The types and severity of harm depend on the dose or how much of these pesticides get into the body. Pesticides are typically assessed for potential human health hazards based on laboratory studies in animals exposed to the pesticides via the diet and other routes of exposure. The lowest dose at which test animals show adverse effects is used as an endpoint for estimating potential risks to humans. Measurements of adverse effects are typically taken from studies of one-time or short-term exposures ("acute studies") and longer-term exposures ("chronic studies") to the pesticide.

2,4-D

In acute studies in rodents and rabbits, 2,4-D generally has demonstrated low acute toxicity via the oral, dermal, and inhalation routes of exposure. In people inadvertently exposed to 2,4-D in the short-term, the most common symptoms were dermal irritation and ocular problems. In chronic testing that serves as the basis for EPA's current human health risk assessment of 2,4-D, adverse effects observed in laboratory rats exposed to 2,4-D included gait abnormalities in a neurotoxicity study, skeletal abnormalities in pups in a developmental study, and decreased weight gain in a chronic toxicity study [60]. Some studies of pesticide exposures in humans ("epidemiology studies") have found links between 2,4-D and a specific type of blood cancer called non-Hodgkin's lymphoma, but other studies have not found evidence of this link. Because 2,4-D is often mixed with other herbicides, it is difficult for scientists to tell whether 2,4-D or other herbicides in the mix might be linked to cancer. Currently, scientists don't know whether 2,4-D can cause cancer in humans [60], [61]. EPA is currently updating its toxicology database and risk assessments for 2,4-D through an ongoing process referred to as registration review. As part of this process, EPA is reviewing studies specifically designed to address the potential for endocrine disrupting effects from 2,4-D.

The urinary half-life of 2,4-D is 18 hours in humans [32]. This is a relatively short half-life meaning that the human body rapidly eliminates 2,4-D.

Additional resources on the health effects of 2,4-D are available at the National Pesticide Information Center (NPIC): http://npic.orst.edu/factsheets/24Dgen.html

Atrazine

Adverse effects associated with laboratory animal testing with atrazine include delayed ossification of certain bones in fetuses, decreased weight gain in adults, disruption of hypothalamic function, and kidney lesions [27]. Based on epidemiologic evidence, EPA has concluded that atrazine is "not likely to be carcinogenic to humans." Atrazine is an endocrine disruptor meaning that it interferes with the body's hormone system. Atrazine seems to interfere with those hormones that control reproduction and development of the reproductive system. At higher doses, atrazine can cause liver, kidney, and heart damage in animals. It is possible that atrazine could cause these same effects in people, although no scientific studies have examined these outcomes in humans exposed to atrazine [27], [62]. EPA's registration review of atrazine is scheduled to commence during 2013.

The urinary half-life of atrazine is 24-28 hours in humans [33]. This is a relatively short half-life meaning that the human body rapidly eliminates atrazine. Atrazine is also rapidly metabolized into other compounds [27].

Additional resources about the health effects of atrazine can be found at the Agency for Toxic Substances and Disease registry. http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=59

Appendix F: ATSDR Glossary

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR serves the public by using the best science available to take responsive public health actions and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the EPA, which is the federal agency that develops and enforces environmental laws to protect the environment and human health.

This glossary defines words used in this PHA when communicating with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call CDC/ATSDR's toll-free telephone number, 1-800-CDC-INFO (1-800-232-4636).

Absorption:	How a chemical enters a person's blood after the chemical has been swallowed, has come into contact with the skin, or has been breathed in.
Acute Exposure:	Contact with a chemical that happens once or only for a limited period of time. ATSDR defines acute exposures as those that might last up to 14 days.
ATSDR:	The **A**gency for **T**oxic **S**ubstances and **D**isease **R**egistry. ATSDR is a federal health agency in Atlanta, Georgia that deals with hazardous substance and waste site issues. ATSDR gives people information about harmful chemicals in their environment and tells people how to protect themselves from coming into contact with chemicals.
Background Level:	An average or expected amount of a chemical in a specific environment or amounts of chemicals that occur naturally in a specific environment.
Cancer:	A group of diseases that occur when cells in the body become abnormal and grow, or multiply out of control.
Carcinogen:	Any substance shown to cause tumors or cancer in experimental studies.
Chronic Exposure:	A contact with a substance or chemical that happens over a long period of time. ATSDR considers exposures of more than one year to be *chronic*.
Completed Exposure Pathway:	See **Exposure Pathway**.
Comparison Value: (CVs)	Concentrations of substances in air, water, food, and soil that are unlikely, upon exposure, to cause adverse health effects. Comparison values are used by health assessors to select which substances and environmental media (air, water, food and soil) need additional evaluation while health concerns or effects are investigated.
Concern:	A belief or worry that chemicals in the environment might cause harm to people.

Concentration:	How much or the amount of a substance present in a certain amount of soil, water, air, or food.
Contaminant:	See **Environmental Contaminant**.
Dermal Contact:	A chemical getting onto your skin. (See **Route of Exposure**).
Dose:	The amount of a substance to which a person may be exposed, usually on a daily basis. Dose is often explained as "amount of substance(s) per body weight per day".
Environmental Contaminant:	A substance (chemical) that gets into a system (person, animal, or the environment) in amounts higher than the **Background Level**, or what would be expected.
Environmental Media:	Usually refers to the air, water, and soil in which chemicals of interest are found. Sometimes refers to the plants and animals that are eaten by humans. Environmental Media is the second part of an **Exposure Pathway**.
U.S. Environmental Protection Agency (EPA):	The federal agency that develops and enforces environmental regulations to protect human health and the environment.
Exposure:	Coming into contact with a chemical substance. (For the three ways people can come in contact with substances, see **Route of Exposure**.)
Exposure Pathway:	A description of the way that a chemical moves from its source (where it began) to where and how people can come into contact with (or get exposed to) the chemical. ATSDR defines an exposure pathway as having 5 parts: 1. Source of Contamination, 2. Environmental Media and Transport Mechanism, 3. Point of Exposure, 4. Route of Exposure, and 5. Population (Receptor). When all 5 parts of an exposure pathway are present, it is called a **Completed Exposure Pathway**. When additional information is needed on one or more of the five parts, it is called a **Potential Exposure Pathway**. Each of these 5 terms is defined in this Glossary.
Frequency:	How often a person is exposed to a chemical over time; for example, every day, once a week, or twice a month.

Ingestion:	Swallowing something, as in eating or drinking. It is a way a chemical can enter your body (See **Route of Exposure**).
Inhalation:	Breathing. It is a way a chemical can enter your body (See **Route of Exposure**).
kg	Kilogram or 1000 grams. Usually used here as part of the dose unit mg/kg/day meaning mg (contaminant)/kg (body weight)/day.
µg	Microgram or 1 millionth of 1 gram. Usually used here as part of the concentration of contaminants in water (µg/Liter).
mg	Milligram or 1 thousandth of 1 gram. Usually used here as in a concentration of contaminant in soil mg contaminant/kg soil or as in the dose unit mg/kg/day meaning mg (contaminant)/kg (body weight)/day.
MRL:	**M**inimal **R**isk **L**evel. An estimate of daily human exposure – by a specified route and length of time -- to a dose of chemical that is likely to be without a measurable risk of adverse, noncancerous effects. An MRL should not be used to predict adverse health effects.
NPL	The National Priorities List for Uncontrolled Hazardous Waste Sites. EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.
PHA:	**P**ublic **H**ealth **A**ssessment. A report or document that looks at chemicals at a hazardous waste site and tells if people could be harmed from coming into contact with those chemicals. The PHA also tells if possible further public health actions are needed.
Point of Exposure:	The place where someone can come into contact with a contaminated environmental medium (air, water, food or soil). Some examples include: the area of a playground that has contaminated dirt, a contaminated spring used for drinking water, or the backyard area where someone might breathe contaminated air.
Population:	A group of people living in a certain area or the number of people in a certain area.
Potential Exposure Pathway:	See **Exposure Pathway**.
Public Health Assessment(s):	See **PHA**.

Reference Dose (RfD):	An estimate, with safety factors (see **safety factor**) built in, of the daily, life-time exposure of human populations to a possible hazard that is not likely to cause harm to the person.
Route of Exposure:	The way a chemical can get into a person's body. There are three exposure routes: – breathing (also called inhalation), – eating or drinking (also called ingestion), and – getting something on the skin (also called dermal contact).
Source (of Contamination):	The place where a chemical comes from, such as a landfill, pond, creek, incinerator, tank, or drum. Contaminant source is the first part of an **Exposure Pathway**.
Special Populations:	People who may be more sensitive to chemical exposures because of certain factors such as age, a disease they already have, occupation, sex, or certain behaviors (like cigarette smoking). Children, pregnant women, and older people are often considered special populations.
Superfund Site:	See **NPL**.
Toxic:	Harmful. Any substance or chemical can be toxic at a certain dose (amount). The dose is what determines the potential harm of a chemical and whether it would cause someone to get sick.
Toxicology:	The study of the harmful effects of chemicals on humans or animals.
Safety Factor	Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. Safety factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between effect levels. Scientists use safety factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called an uncertainty factor].