Letter Health Consultation

AMERITIES WEST

THE DALLES, OREGON

APRIL 13, 2018

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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LETTER HEALTH CONSULTATION

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Prepared By:

U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
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DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Agency for Toxic Substances
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Atlanta GA 30333

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April 13, 2018

Re: Exposures to Chemicals in Ambient Air, The Dalles, Oregon

Dear Ms. Thalhofer,

Per your request on October 31, 2016, the Agency for Toxic Substances and Disease Registry (ATSDR), in partnership with the Oregon Health Authority (OHA), assessed whether concentrations of naphthalene and other polycyclic aromatic hydrocarbons (PAH) in outdoor air pose long-term, health risks to residents near the AmeriTies West facility (AmeriTies), a facility that treats wooden railroad ties. At the time of the request, the Oregon Department of Environmental Quality (DEQ) was conducting outdoor air sampling for naphthalene and other PAHs around AmeriTies. By December 1, 2016, DEQ's sampling had ended and AmeriTies had changed its treatment formula to reduce odors and emissions.

Air sampling. DEQ collected 24-hour air samples every 3 days from June through November, 2016; measured contaminant concentrations were used to evaluate health risks. DEQ used three air monitors. One measured background contaminant levels. Another, placed at Wasco County Public Works, measured contaminant levels close to the facility. The third measured contaminant levels in neighborhoods (at three locations for two-month periods) on the bluff above AmeriTies. Limitations of air sampling included targeting toward those chemicals most likely to be of concern (other chemicals not tested for could have been present), challenges in placing monitors that best captured the highest chemical concentrations to which community members might be exposed, and detection limits for two PAHs near or above a cancer-based comparison value (CV).

Assessment approach. ATSDR screened measured contaminant concentrations for potential health risks using established CVs, and evaluated further if the 95th percentile upper confidence limit of the mean concentration (UCL) at the monitor with the highest mean concentrations exceeded CVs. Naphthalene and benzo[a]pyrene were the only substances with non-cancer CVs. Non-cancer CVs used were ATSDR's minimal risk level (MRL) for chronic exposure to naphthalene and the U.S. Environmental Protection Agency's (EPA) reference concentration (RfC) for benzo[a]pyrene. PAHs generally have a low degree of acute toxicity; for some PAHs, the most significant health endpoint is cancer. Studies have explored the effects of chronic PAH mixture inhalation, but uncertainty exists in whether and how chronic PAH exposure to other individual PAHs or PAH mixtures impacts health. Oregon's cancer-based ambient benchmark concentrations (ABCs), which are set to reflect an estimated theoretical lifetime cancer risk of 1 extra case in a population of one million, were used as CVs for cancer risk.

Non-cancer health hazard assessment. Exposure to ambient air concentrations of naphthalene and benzo[a]pyrene did not pose chronic non-cancer public health risks. The UCLs for these chemicals were less than the CVs at the monitor with the highest mean concentrations. Non-cancer effects of inhaling PAHs other than naphthalene and benzo[a]pyrene and effects of inhaling PAH mixtures were not evaluated.

Cancer health hazard assessment. Concentrations of naphthalene and benzo[a]pyrene toxicity equivalency factor (TEF)-adjusted total PAHs exceeded ABCs. ATSDR estimated cancer risks for naphthalene and PAHs with methods congruent with DEQ guidance [DEQ 2017a]. ATSDR calculated

cancer risk based on a lifetime that has 33 years of exposure to the UCL from the neighborhood monitor with the highest measured concentrations. Other exposure scenarios were also evaluated.

The theoretical estimated additional cancer risk for residents' exposures to the UCL at the Old Dufur Road monitor was two cancer diagnoses in 100,000 lifetimes for naphthalene and less than one additional cancer diagnosis in 1,000,000 lifetimes for PAHs. The total additional risk of cancer is within EPA's decision-making risk range, and was primarily due to naphthalene. Over a lifetime, between 1/3 to 1/2 of all people will develop cancer. The theoretical additional risk is much smaller than a typical individual's overall risk of cancer. Moreover, the evidence supporting naphthalene's ability to cause cancer in humans has limitations; actual risk may be lower than calculated. Other scenarios evaluated had similar or lower risk.

Odors. Odors have been a concern for some members of the community. In general, most substances in the outdoor air that cause odors are not at levels that can harm health. Even if odors aren't at levels that can harm health, they still may affect quality of life. For some individuals, odors may lead to physical health symptoms that resolve after the odor is removed. DEQ has collected information from odor surveys and odor complaints to help define the nuisance from odors. ATSDR acknowledges that concerns about odors are a challenging issue in The Dalles, and that challenge may be compounded because we did not identify what substances are associated with individuals' increased sense of odor. There are also substantial limitations in scientifically evaluating odors and limitations in understanding how odors can impact health. ATSDR acknowledges the efforts that DEQ, residents of The Dalles, AmeriTies and others have taken to understand and reduce odors and emissions thus far.

Summary. ATSDR concludes that no apparent public health hazard existed, based on the evaluation of the DEQ's air monitoring results prior to treatment formula change. Ambient air concentrations of naphthalene and benzo[a]pyrene did not pose chronic non-cancer public health risks; the UCL of the monitor measuring the highest concentrations was below the chronic MRL for naphthalene and EPA's RfC for benzo[a]pyrene. Applying Oregon's cancer-based framework suggests that the theoretical estimated increased cancer risk for a lifetime of exposure is two diagnoses in 100,000 lifetimes. ATSDR acknowledges DEQ's expertise and authority to assess and reduce odors.

ATSDR recommends:

- DEQ repeats sampling for naphthalene and other PAHs at similar locations and during similar weather conditions to help assess the impact of changing the treatment formula.
- DEQ samples for additional air toxic substances, as resources are available, to provide residents with information about other substances that are present in The Dalles.
- DEQ continues odor surveys to help provide objective data to the extent that the methodology allows.
- Residents who smoke reduce smoking which can also reduce PAH exposure.

Background: Site Overview and History

The Dalles, Oregon (population 15,340) is located on the Columbia River in north-central Oregon [Census 2017a; City of The Dalles 2017]. The median household income ($41,311) in The Dalles is lower than median household income in Oregon and the United States [Census 2017a]. The Dalles is the county seat and largest city within Wasco County [City of The Dalles 2017] and the three-county area served by the North Central Public Health District (NCPHD). Once known as "the town at the end of the

Oregon Trail," The Dalles now is at the intersection of a major highway and freeway in north-central Oregon, and it is on a major rail corridor [City of The Dalles 2017].

AmeriTies (the site) is on the rail corridor and near the freeway (Attachment, Figures 1 and 2); it is a large manufacturer of railroad ties and employs over 50 people. Railroad tie manufacturing and treatment began at the site in 1922 and has continued with changes in ownership and name of the facility over time. Figure 3 from 1934 and photo 1 from the 1950s illustrate the area's topography and the past development; figure 4 is from 2016. The population around AmeriTies has increased between 2000 and 2010 (Figure 2). AmeriTies has been recognized by the Occupational Health and Safety Administration (OSHA) through their Voluntary Protection Programs as a meeting the Star Program criteria [OSHA 2016], including having injury and illness rates at or below their industry's national average and having a comprehensive safety and health program [OSHA 2009].

The topography and meteorology of The Dalles may impact the dispersion of emissions from any source. AmeriTies is located between the Columbia River and a bluff. Further upland from the bluff is a residential area of The Dalles. In the low-lying area between the river and the bluff is a freeway, AmeriTies, a rail corridor, and commercial establishments, including a tire shop and Wasco County Public Works. The Columbia River Gorge creates an east-west connection across the Cascade Mountains and is world-renowned for its strong, steady winds created by atmospheric pressure differences across the Cascades. The area is semi-arid; average temperatures range from 35°F to 90°F [NOAA 2017].

AmeriTies has recently produced between 600,000 to 1,200,000 railroad ties each year. Emission sources within the facility include off-gassing from treated ties stored at the facility and volatile contaminants that escape when pressurized cylinders used to simultaneously treat 735 ties are opened to remove ties. The treatment cylinders are located on the western side of the site. Both treated and untreated ties are stored on the eastern side of the site. Typically, untreated ties are stacked and dried for about 6 months. While treated ties do not require any further drying or ventilation after leaving the treatment cylinder, a supply of treated ties are stored on site to meet peaks in demand.

In addition to the current concerns about odors and air emissions, AmeriTies and environmental agencies developed and implemented strategies to control and monitor groundwater, sediment, and soil contamination [DEQ 2017c]. A 1996 EPA Record of Decision describes the background and actions [EPA 1996]. Drinking water and residential soil were not impacted and control strategies were implemented for soil, sediment, and groundwater [DEQ 2017c]. Analysis of this data and work was outside of the scope of this letter health consultation.

Other potential sources of naphthalene and PAHs in the immediate vicinity of AmeriTies include road and rail emissions. Average annual daily traffic (AADT) in 2013 for the Interstate 84 segment adjacent to the facility was 21,300; AADT for Highway 197 to the east was 6,200 [ODOT 2014]. AADT for Highway 30 to the south was not available, but in another part of The Dalles, AADT for this road was 5,900 [ODOT 2014]. The number of train cars passing through the Dalles was not available, but an estimated 20-35 trains per day pass through Mosier, a city on the same rail line to the immediate west [Mulvihill 2016].

In the three county region that includes Wasco, Sherman, and Gilliam counties, NCPHD efforts to improve public health focus on prevention, including preventing unintended pregnancy, malnutrition, low birth weight babies, outbreaks of disease, tobacco use, and poor response to public health emergencies [NCPHD 2012]. The total population served in Wasco, Sherman, and Gillam counties was 28,849 in 2010 [Census 2017b]. While the potentially impacted geography and population from site-related emissions was likely smaller than the geographies and populations for which health data exists, available baseline health data for the area provides context. Naphthalene at high concentrations can be

a respiratory irritant, and asthma was mentioned by community members as a concern. Animal studies have indicated that some female mice that breathed high concentrations of naphthalene vapors daily for a lifetime developed lung tumors. Relevant similarities and differences in available respiratory health risk factors and outcomes compared to Oregon as a whole are summarized below:

- Age-adjusted adult asthma rates (2012-2015) were 11.2% in the 3 county region compared to 10.9% in Oregon as a whole [OHA 2017a].
- Asthma prevalence rates in the 3 counties and Oregon were 13.4% versus 13.1%, respectively, for 11th graders [OHA 2017c], and 10.8% versus 12.2% for 8th graders [OHA 2017b].
- Emergency room utilization for asthma symptoms by adults and children on the Oregon Health Plan was higher in Wasco county than in Oregon [NCPHD 2012].
- Smoking rates by adults in 2006-2009 were higher in the 3 counties served by the health department (23%) than in Oregon (17%) [NCPHD 2012]; from 2012-2015, age-adjusted adult smoking rates were 20% in the 3 counties and 18% in Oregon [OHA 2017d].
- The Dalles (Zip Code 97058) had a moderate risk of elevated indoor radon levels [OHA 2015].
- Age-adjusted lung cancer incidence rates for the 3 counties (70.4 cases per 100,000 population) were higher than Oregon (59.4 cases per 100,000 population) [OHA 2016].

Additionally, risk factors differ between the three counties and the adjacent Hood River County. Age-adjusted survey data from 2012-2015 identified that 80% of adults in the three counties have one or more chronic disease risk factors, compared to 47% in Hood River and 77% in Oregon [OHA 2017d].

Community Concerns and the Letter Health Consultation

Odors and emissions attributed to the railroad tie treatment facility have led to engagements among community members, environmental and health agencies, and the facility to make improvements. Prior to AmeriTies ownership of the facility, during a permit renewal process in 2002, a workgroup formed that attempted to correlate plant activities with odor. No consistent pattern emerged with plant activities; in general, most odor events occurred on warm days with little wind [DEQ 2017b]. The previous owner implemented improvements to reduce odors [DEQ 2017b]. In February 2015, a DEQ Odor Nuisance Strategy was triggered because of odor complaints; the subsequent odor investigation led to an April 2016 Mutual Agreement and Final Order and its October 2016 amendment between DEQ and AmeriTies to reduce odors [DEQ 2016a, 2016b]. Multiple strategies were implemented by AmeriTies, including changing post-treatment stacking to reduce spacing between ties and changing tie treatment formulation in December 2016 [DEQ 2017b]. AmeriTies implemented stacking changes prior to DEQ's air sampling. These strategies, developed by AmeriTies and DEQ, may reduce emissions as well as odors. DEQ continues to conduct odor surveys.

On July 29, 2016, ATSDR Region 10 received a letter from OHA requesting assistance from ATSDR in assessing health risks associated with chemicals in the ambient air around AmeriTies. On October 31, 2016, NCPHD requested assistance from the Oregon Health Authority to conduct a health consultation because community members in The Dalles and surrounding areas were concerned about the possibility of health effects from airborne emissions from AmeriTies West. Throughout and prior to these formal requests, DEQ, the lead environmental regulatory agency, had engaged OHA for technical assistance.

Community concerns were identified through public meetings, phone calls, and letters. These included:

- Variability of the strength of the smell
- Composition and potential hazards of the new treatment formula
- Specific short and long-term symptoms and health problems that people attribute to exposure

- Possibility of a study of where health problems are occurring
- Short and long term risks of exposure
- Indoor versus outdoor risks
- Consumption of fruit and vegetables grown at nearby, off-site locations
- Impact on vulnerable populations
- Specific locations and health concerns in those locations (e.g. asthma in a school)
- Desire for health information of AmeriTies workers to be shared with community
- How to interpret Oregon's Ambient Benchmark Concentrations
- Other emissions that are not monitored and desire for more comprehensive air toxic sampling
- Impact of mixtures of chemicals
- Whether the facility is deliberately reducing emissions/production on sampling days

Of particular concern to some individuals were the symptoms they experience that occur in relationship with peaks in odor (and presumed peaks in exposure) and the chronic health effects that they attributed to exposure to the facility's emissions. To the extent possible, this letter attempts to address the community concerns raised. Some questions are beyond the scope of the assessment.

Outdoor Air Sampling and Emissions

Starting in June 2016, DEQ deployed monitors to collect air samples in the vicinity of AmeriTies. Locations were based on proximity, odor complaints and availability. Samples were analyzed for naphthalene and other PAHs likely associated with tie treatment. Sampled PAHs included some that Oregon DEQ identifies as carcinogenic (cPAHs) and others that are not carcinogenic. DEQ staff deployed 3 monitors and a meteorological station to collect temperature, wind speed, and wind direction data [Pillsbury 2017].

Initially, three monitoring stations (Figure 4) were set up: Cherry Heights (2.5 miles from AmeriTies's treatment cylinders), City Park (0.2 miles), and Wasco County Public Works (0.4 miles). Although farther from the treatment cylinders, the Wasco County Public Works monitor was located across the railroad tracks from AmeriTies, approximately 60 yards from the fenceline, near the tie storage area, and at the same elevation as AmeriTies. The locations were selected to capture background, neighborhood, and near source air, respectively. All three collected one 24-hour air quality sample every three days from June 2, 2016 through August 1, 2016 using polyurethane foam/XAD air toxics sampling systems [Pillsbury 2017]. Based on community input and to improve assessment of air contaminants throughout The Dalles, DEQ moved the City Park monitor to two additional locations, east and west of City Park. On August 4, 2016, this sensor was moved to Old Dufur Road until September 6, 2016. On September 24, 2016, the monitor was relocated from Old Dufur Road to Clark Street. The monitor began collecting data on September 24 and continued through November 18. Samples were continually collected at the Cherry Heights and Wasco County Public Works locations until November 19. Samplers were scheduled to collect a sample every three days, however equipment maintenance, holidays and logistical factors led to occasional diversions from the regular sampling schedule [Pillsbury 2017]. During the monitoring period a meteorological station was set up between the City Park sampling location and AmeriTies that captured temperature, wind speed, and wind direction [Pillsbury 2017].

The monitoring plan had strengths and limitations. It captured 6 months of air concentrations over a variety of meteorological conditions. DEQ placed neighborhood monitors based on complaint data, proximity, and community input. DEQ collected other variables, including production records and temperature, which could influence measured concentrations. As with any sampling strategy, limitations existed. DEQ used information about the production to target sampling toward those chemicals most

likely to be of concern; other chemicals could have been present. The size of the site and the different potential sources of emissions within and around the site could make it challenging to place a monitor that best captures the highest concentrations to which community members might be exposed. The laboratory detection limit for all individual PAHs was 0.0004 micrograms per cubic meter ($\mu g/m^3$). For two of the most toxic PAHs, benzo[a]pyrene and dibenzo[a,h]anthracene, the detection limit was near or above the ABC for the total concentration of benzo[a]pyrene-TEF-adjusted cPAHs (adjusted cPAHs). The detection limit for benzo[a]pyrene was approximately half of the ABC for adjusted cPAHs, and the laboratory detection limit for dibenzo[a,h]anthracene was approximately 4 times the ABC for adjusted cPAHs.

The only other air monitoring information located was a consultant's report of 2 days of data collection in 2011 and 2012 [Beadie and Wall 2012]. Air monitoring for naphthalene occurred on September 7, 2011 (8-hour samples) at 4 locations, including one location on site and within 100 feet of the treatment cylinders (Figure 5). Air monitoring occurred in February 2012 for one day at 5 locations; one neighborhood location was the same as the location of a September 2011 measurement.

AmeriTies reports data to EPA's Toxic Release Inventory (TRI). Releases reported in 2015 included 8,074 pounds of creosote, 6.8 pounds of PAHs, and 0 pounds of benzo(G,H,I)perylene [EPA 2017b]. In 2015, AmeriTies released 0.9% of the creosote it used, compared to 1% for all wood-preserving industries that reported to TRI [EPA 2017b], and AmeriTies released 0.007% of the PAHs used, compared to 0.2% for all wood-preserving industries that reported to TRI [EPA 2017b]. The 2011 National Air Toxics Assessment (NATA) indicates that the total theoretical estimated cancer risk from toxic emissions in the area surrounding AmeriTies is 31 cases per million people [EPA 2017a]. AmeriTies's 0.00285 tons/year of total PAH emissions in 2011 are included in the NATA data [EPA 2016].

Air Sampling Data Summary

Concentrations of naphthalene and PAHs detected in 2016 at Wasco County Public Works and Old Dufur Road and health-based CVs for chronic exposures are shown in Table 1. Chemicals for which the CVs exceeded the maximum concentration detected are highlighted in grey. The UCL for naphthalene at the Wasco County Public Works site, the location of the highest concentrations, was below the ATSDR MRL for chronic exposure. Concentrations of naphthalene and adjusted cPAHs at the Wasco site were above Oregon's ABCs. Fluoranthene was the primary contributor to the adjusted cPAH level. The TEF-adjusted UCL of fluoranthene exceeded the OHA ABC. Individually, the maximum detected TEF-adjusted concentrations of other PAHs did not exceed the ABC. Dibenzo[a,h]anthracene was not detected; however, the detection limit was above the ABC.

All sampling data was used in the analyses, except four samples where the sample blank was contaminated at the City Park and Cherry Heights locations and samples on days when power failure prevented an accurate collection.

Table 2 summarizes the 2016 sampling data for all five sampled locations and includes the number of detections, detections above the CV, and the maximum concentration for each chemical. As expected, because the monitor was closest to the source, the Wasco County Public Works monitoring location had the highest levels detected for all chemicals. Figure 6 compares concentrations of naphthalene and cPAHs at the neighborhood monitors to Wasco County Public Works during the same time periods. Table 3 summarizes the carcinogenicity classifications for each tested chemical. Naphthalene is classified as possibly carcinogenic to humans; it is not classified as a mutagen. Notably, DEQ has developed a TEF for fluoranthene, which indicates that DEQ considers fluoranthene to be a carcinogen and a mutagen.

The International Agency for Research on Cancer, the EPA, and the National Toxicology Program have not classified fluoranthene as to human carcinogenicity nor as a mutagen.

Table 4 shows concentrations of naphthalene measured in 2011 and 2012. The highest levels were observed within the facility's property. Although measured naphthalene concentrations generally appeared greater than those measured in 2016, direct comparison to the 2016 data is challenging for several reasons. As indicated in the table, many of the samples were collected for 8 hours during the day, different than the 24 hours of sampling done in 2016. Record high temperatures above 100° F were observed on the September 2011 sampling day [NOAA 2017]. Locations of measurement also differed. Additionally, given the short sampling timeframe (8 hours for all but 2 samples taken outside of the facility), the 2011 and 2012 data were not compared to health-based CVs.

Identification of Sensitive Populations

MRLs are set below levels that might cause adverse health effects in most people, including sensitive populations. Sensitive populations include children, people with pre-existing respiratory conditions, pregnant women, and the elderly. Proximal locations where sensitive populations may congregate were identified. The closest school is a private school 1/3 miles south from the treatment cylinders. The closest daycare facility is ½ miles southwest of the treatment cylinders. A senior living facility is located on the bluff to the southeast of the facility 1 ¼ miles from the treatment cylinders and 1/3 miles from the eastern edge of the facility (Figure 4).

Assessment Approach

The letter health consultation examined the potential long-term health impacts from past (2016) air concentrations of measured contaminants. Current air concentrations may be different because of the treatment formula change that occurred in December, 2016. The health consultation process compared contaminant concentrations to known CVs. The location with the highest measured concentrations, Wasco County Public Works, was used to establish exposure concentrations to determine if further assessment of health risks was needed.

ATSDR's chronic air exposure comparison value for naphthalene is an MRL of 3.7 $\mu g/m^3$ [ATSDR 1995a]. This MRL is based on a lowest observed adverse effect level (LOAEL) of 52 milligrams per cubic meter (mg/m^3) (human equivalent concentration (HEC) of about 10 mg/m^3) for nose and respiratory lesions in rats [ATSDR 1995a]. To account for uncertainty in identifying a safe level for humans, the MRL includes uncertainty factors that reduce the HEC by over 3 orders of magnitude. The UCL of naphthalene (2.7 $\mu g/m^3$) at the location with the highest levels was below the ATSDR MRL for chronic exposure. Additionally, the UCL was below the EPA RfC of 3 $\mu g/m^3$ for chronic exposure, which is based on respiratory and nasal lesions in mice exposed to 52 mg/m^3 [EPA 1998]. MRLs and RfCs are estimates of exposure concentrations below which are likely to be without an appreciable risk of adverse events over a duration of exposure. For a chronic MRL, the duration is 365 days or longer; for an RfC it is a lifetime (70 years).

For this health consultation, carcinogenic PAHs (cPAHs) refer to the sampled PAHs for which DEQ has developed TEFs [DEQ 2017a]. The UCLs of naphthalene and adjusted cPAHs were used to evaluate exposure. Each sample's concentration of adjusted cPAHs was calculated by summing the individual TEF-adjusted concentrations of measured cPAHs. Naphthalene does not have a TEF and was evaluated separately. ATSDR assumed that PAHs that were not detected in individual samples were present at half the detection limit, except those PAHs that were not detected in any sample. Benzo[a]pyrene, dibenzo[a,h]anthracene, and benzo[g,h,i]perylene were not detected in any sample; their concentration

was assumed to be zero. Evaluating exposure based on the UCL and using the location with the highest measured concentrations were protective of health because these methods err towards assuming higher levels of exposure.

Estimated theoretical cancer risks for naphthalene were calculated based on the unit risk estimate (URE) of 3.4 E-5 $(\mu g/m^3)^{-1}$ from California Office of Environmental Health Hazard Assessment (OEHHA) [DEQ 2010]. This URE is based on rodent nasal epithelial adenomas and olfactory neuroblastomas.

Estimated cancer risks for adjusted cPAHs were calculated using DEQ's proposed methodology [DEQ 2017a]. This methodology sets the URE for adjusted cPAHs at 0.0006 $(\mu g/m^3)^{-1}$, which is the same as EPA's 2017 URE for benzo[a]pyrene. EPA's 2017 benzo[a]pyrene URE is derived from a 1981 study that assessed the occurrence of upper respiratory and upper digestive tract (forestomach) tumors in male hamsters chronically exposed by inhalation to benzo[a]pyrene [EPA 2017c]. A benzo[a]pyrene toxicity adjusted concentration for total cPAHs is estimated using proposed TEFs from DEQ [DEQ 2017a]. To account for potential mutagenicity of cPAHs, age-dependent adjustment factors (ADAF) of 10, 3, and 1 for 0-2, >2-16, and >16 years of age were used. To estimate cancer risks for adult residents, a residency period of 33 years was used. This period was based on the 95th percentile residency period in EPA's Exposure's Factor Handbook [EPA 2011]. Census data suggests that residency in The Dalles has been similar; 2011-2015 surveys showed that 94% of residents in The Dalles moved into their current residence on or after 1980 [Census N.D.]. The UCLs of both adjusted cPAHs and naphthalene from the neighborhood location with the highest concentrations were used to calculate risk. Theoretical risks from other exposure scenarios, including childhood exposures and exposures while working at Wasco County Public Works were also estimated.

Non-cancer Health Hazard Assessment

The UCL for naphthalene was below ATSDR's MRL; naphthalene exposure was unlikely to pose an appreciable risk of non-cancer toxicologically-mediated health effects even for exposures longer than one year. Benzo[a]pyrene was not detected, and the detection limit was lower than EPA's RfC of 0.002 $\mu g/m^3$ [EPA 2017c]; therefore, it was unlikely to pose an appreciable risk of non-cancer-mediated health effects. The other measured PAHs do not have non-cancer comparison values for inhalation. Although animal and epidemiologic studies have evaluated links between chronic exposures to PAHs to a number of health outcomes, methodological challenges have precluded the identification of definitive links and non-cancer comparison values for most PAHs. PAHs generally have a low degree of systemic toxicity; the most significant PAH endpoint is cancer.

Cancer Health Hazard Assessment

Naphthalene and adjusted cPAH concentrations exceeded Oregon's ABCs, which are set to reflect an estimated theoretical lifetime cancer risk of 1 extra case in one million population [DEQ 2010], prompting further evaluation of cancer risks.

Theoretical cancer risk per lifetime was estimated based on a 33-year exposure for an adult to the UCL of naphthalene and adjusted cPAHs at the Old Dufur Road monitoring location. Old Dufur Road was the neighborhood monitoring location with the highest measured concentrations. The theoretical estimated increased cancer risk for this exposure was two additional cancer diagnoses in 100,000 lifetimes for naphthalene and less than one additional cancer diagnosis in 1,000,000 lifetimes for cPAHs. This additional estimated cancer risk is within EPA's decision making risk range for cleanup, and was primarily

due to naphthalene. Over a lifetime, between 1/3 to 1/2 of all people develop cancer. The theoretical additional risk is much smaller than a typical individual's overall risk of cancer.

Theoretical cancer risk was also estimated for a child residing in a nearby neighborhood and for an adult working a career at Wasco County Public Works and living nearby. Theoretical additional cancer risk for a child was based on exposure to the UCL at Old Dufur Road for the first 21 years of life. For this scenario, estimated cancer risk was one additional diagnoses in 100,000 lifetimes for exposure to naphthalene and one additional diagnosis in 1,000,000 lifetimes for PAHs. If this child scenario was extended 12 additional years into adulthood for a total of 33 years, estimated cancer risk was two additional diagnoses in 100,000 lifetimes for exposure to naphthalene and two additional cancer diagnoses in 1,000,000 lifetimes for cPAHs. Theoretical cancer risk for a career Wasco County Public Works employee was based on 33 years of eight hours per workday exposure to the UCL at Wasco County Public Works and the remainder to the UCL at Old Dufur Road. For this scenario, estimated additional cancer risk was two diagnoses in 100,000 lifetimes for naphthalene and less than one diagnoses in 1,000,000 lifetimes for cPAHs. In all exposure scenarios, naphthalene was the primary contributor to the estimated additional cancer risk.

The applied framework may have overestimated cancer risk. The evidence supporting human carcinogenicity of naphthalene has limitations. Nationally, rates of nasal epithelial adenomas and olfactory neuroblastoma in humans are lower than might be predicted based on population exposures, suggesting that human cancer risk values derived from animal studies may be conservative [Magee et al. 2010]. The classification of PAHs as mutagens or human carcinogens differs among organizations. This health consultation's analysis considered PAHs for which DEQ developed a TEF to be both carcinogenic and mutagenic. In this health consultation, fluoranthene was the PAH primarily contributing to the adjusted cPAH concentration. Because DEQ developed a TEF for fluoranthene, while other organizations (Table 3) have not classified fluoranthene as a human carcinogen or as a mutagen, cancer risks from cPAHs may be overestimated. Finally, the monitor at Old Dufur Road only collected 15 samples during the summer months when concentrations are likely higher because of higher temperatures. The UCL from this period may be substantially higher than actual yearly mean concentrations.

Odors

Odors and their relationship to health were a concern for the community. The tie treatment formula includes diesel and creosote. The formula is a mixture of chemicals, including naphthalene, which has a strong mothball odor. The characteristics of odors reported in the community varied, but some reported similar odors to naphthalene.

Odors can have physical effects without a known toxicological mechanism. People may have experience with odors inducing increased salivation after smelling warm cookies. This odor-related symptom is not due to toxic effects of chemicals; odors may create symptoms without disease. Odors do not necessarily mean that a chemical is toxic, but some chemicals with odors can have toxic effects through mechanisms that are unrelated to the odor. In general, the most common symptoms reported from environmental odors are headache and nausea. Some situations may trigger symptoms in some people at lower levels than other people. ATSDR's fact sheet on odors and health is attached and provides additional information.

Some chemicals have odor thresholds reported in the literature; studies on the same chemical may have differing findings. ATSDR's Toxicological Profile for naphthalene identifies 440 $\mu g/m^3$ as the lowest

concentration that people can smell it [Amoore and Hautala 1983; ATSDR 1995a]; studies have reported odor thresholds ranging from 50-5,340 µg/m^3 [EPA 1992]. This wide range reflects the difficulty in determining odor thresholds and may reflect individual variability to odor perception. Concentrations of naphthalene, phenanthrene, and acenaphthalene were lower than their respective odor thresholds [EPA 1992]. Odor detection limits for other measured PAHs were not identified.

Explanations for why residents experienced odors despite measured concentrations lower than the odor thresholds may include the following:

- Monitors captured a 24-hour sample creating an average value for 24 hours, not a peak value.
- Residents detected odors below the published odor thresholds.
- Mixtures of compounds may have created odors at lower levels than individual compounds.
- Other measured PAHs contributed to odors; published odor detection limits were not identified.
- Unmeasured chemicals that might be present, such as phenols (e.g. cresols), may have contributed to odors. These can have odor thresholds much lower than levels that cause toxicologically-mediated health problems. For example, cresol mixtures may be detected by some people at 0.05 µg/m3 [Brown 2017]. The OEHHA Chronic Reference Exposure Level (REL) for cresol mixtures is 600 µg/m3 [OEHHA 2016]; exposures below this concentration are not expected to cause harm. (See attachment "Are Environmental Odors Toxic.")

Using the provided data, we cannot definitively identify a compound or set of compounds that cause the odors that residents have associated with AmeriTies; however, elucidating which compounds are related to the odors for each individual may not be possible or necessary to protect people from toxic exposures. Because of individual variation in odor perception, linking odors to specific compounds can be difficult. Odors are perceived differently; one person may experience an unpleasant odor while another does not perceive any odor. As an example, continuous exposure to odorous chemicals may lead to a decreased ability to smell these chemicals [EPA 1992].

Limitations

This letter health consultation is subject to several limitations.

- Comparison values (CVs) are primarily based on single pollutant, high-dose exposures to animals. Available studies on humans provide context. The dose where no effect is seen in animals (or, in some cases, the LOAEL dose) is used as a starting point for the derivation of a CV. That level is lowered by uncertainty factors to account for undetermined information, such as potential differences between species. As with naphthalene and benzo[a]pyrene, uncertainty factors can lead to CVs that are orders of magnitude lower than the doses that were given to the test animals. Uncertainties include:
    - Mixtures may act differently than individual pollutants, leading to effects at lower or higher levels than individual pollutants.
    - Except for naphthalene and benzo[a]pyrene, no PAH non-cancer CVs were identified. The absence of a CV does not necessarily mean that exposures will not create health risk.
    - The derived CV provides a concentration or dose that is reasonably assured not to be a risk for health. Exposures that are higher than the CV may also not be a health risk.
    - The uncertainty factors used to derive a CV could over or underestimate risk. For example, if people were as susceptible to the harmful effects as the animals in the study, the application of uncertainty factors would overestimate risk. If people were much more susceptible to harmful effects than animals, risk could be underestimated.

- Cancer-based CVs have additional uncertainty. Development involves applying a mathematical model to the data from studies on animals given relatively high doses, and using the model to extrapolate cancer risk information for lower exposures for humans.
- Differences exist between people's exposure to chemicals and the levels from air sampling. Sampling occurred for 6 months, but the cancer risk calculations assumed years of exposure. If concentrations were higher in the past, risk may be underestimated; if concentrations were lower in the past, risk may be overestimated. Furthermore, while the sampling locations were picked to provide samples in locations where higher concentrations could be expected, there could be differences between measured values and individual exposure. For example, air sampling was not done indoors.
- The analysis was based on the data provided and the limitations of that data collection effort.
- The chemical or chemicals creating perceived odors have not been definitively identified.
- The health consultation does not attempt to attribute a specific source for the detected chemicals in the air or the perceived odors. ATSDR recognizes the expertise and authority of environmental agencies to make final determinations of relevant sources of contamination.
- Locations of schools, daycares, and nursing homes were based on an internet map search and not otherwise verified for accuracy.

Conclusions

Based on the data evaluated, residents were not chronically exposed to concentrations of naphthalene and benzo(a)pyrene that pose a public health hazard. The theoretical estimated additional cancer risk for residential exposure to naphthalene and other PAHs was 2 cancer diagnoses in 100,000 lifetimes. This means that if 100,000 people had similar exposures to the 33-year exposure scenario, during their lifetimes, cancer could impact two more of the 100,000 people than what would normally be expected.

Recommendations

- ATSDR recommends DEQ repeat sampling for naphthalene and other PAHs at similar locations and during similar weather conditions to help assess the impact of changing the treatment formula.
- ATSDR recommends DEQ sample for additional air toxic substances, as resources are available, to provide residents with information about other substances that are present in The Dalles.
- ATSDR recommends DEQ continue odor surveys to help provide objective data to the extent that the methodology allows.
- ATSDR recommends residents continue efforts to reduce smoking which can reduce PAH exposure.

Please do not hesitate to contact me at 206-553-0454, if you have any questions regarding this letter.

Sincerely,

CDR Arthur M. Wendel, MD, MPH
Regional Representative, ATSDR Region 10
Division of Community Health Investigations

Attachment - Questions and answers to address potential community concerns

If a person has headache, asthma attack, or other adverse health effect after noticing an odor, which indicates that some type of chemical exposure is occurring, why is the odor's associated chemical exposure not a public health hazard?

- The assessment of whether the measured chemicals are a public health hazard is based on how their concentration compares to concentrations used in toxicological studies. The concentrations of naphthalene and benzo[a]pyrene did not exceed chronic non-cancer comparison values, indicating that non-cancer health effects are not likely from these substances.
- Odor-related symptoms may occur through other, less well-understood physiological pathways. A framework to assess whether an odor is a public health hazard is not well-defined; rather, odors are primarily characterized based on the perceived level of nuisance. As has been collected in The Dalles by DEQ, information from odor surveys and odor complaints are strategies, with their own set of limitations, that can help define the nuisance. ATSDR recognizes the expertise and authority of environmental agencies to make final determinations of relevant sources of odors and impact of odors.

If the community has reported health issues, why is information about health outcomes not being collected to see if disease rates differ from other communities or to see if they cluster in areas close to the facility?

- The scope of this letter health consultation is to examine the air sampling data collected from June 2016 – November 2016.
- Available data on asthma, lung cancer, and risk factors were presented in this letter health consultation, but rates were not available to compare among neighborhoods in The Dalles.
- Collecting environmental data is the means of determining if levels of chemicals in the air pose a toxicological health risk.
- Many factors could create elevated rates of diseases in an area; an elevated rate of disease does not prove than an environmental problem exists. Similarly, a lack of elevation of disease rates does not prove that an environmental risk factor for those diseases is absent.
- The direct method, in this case, for determining whether an environmental risk factor for disease is present in the air is to sample the air for the environmental risk factor.
- Local health departments in Oregon track information about rates of diseases and risk factors in their jurisdictions. If a community has a concern about an apparent cluster of disease, the North Central Public Health district can be consulted. The approach for understanding if and why diseases appear more frequently than expected can encompass risk factors beyond environmental health risk factors.

How can there not be a health problem if a number of people are experiencing health issues related to the emissions?

- The air sampling data indicates that naphthalene and benzo[a]pyrene are unlikely to be a risk factor for chronic non-cancer toxicologically-mediated health effects. Inhalation comparison

values for the other measured PAHs do not exist for non-cancer health effects. PAHs generally have a low degree of acute toxicity; the most significant PAH endpoint is cancer.

- Limitations exist in the health assessment process. For example, non-cancer comparison values for most of the measured PAHs were not available. Future research on these chemicals and synthesis of that research might help define health risks of these chemicals.
- This health consultation used the health assessment framework to determine whether toxicologically-mediated health risks were expected from the concentrations measured in air samples. It did not provide or seek to provide an answer for the cause of symptoms in individuals. Based on the findings, no apparent public health hazard existed and toxicologically-mediated health effects from the measured contaminants were unlikely.

If there are no comparison values for mixtures or for some of the PAHs, and if there could be emissions that are not captured by the air sampling, why wouldn't a study on health outcomes in The Dalles help?

- The limitations of a study would not provide additional clarity to causally link exposure to health outcomes in the community. These limitations would include challenges with exposure assessment, challenges with controlling for other risk factors, and potential recall bias.
- An academic study that included multiple similar communities with PAH exposure and high-quality exposure assessment might be capable of discerning if health impacts could be related to similar exposures.

How do the measured levels of naphthalene compare to levels in other locations?

Location or Comparison Value	**Concentration ($\mu g/m^3$)**
Oregon ABC	0.03
Modeled for Portland Ambient Air* [Portland Air Toxics Solutions Advisory Committee 2011]	0.3
Average Cherry Heights	0.068
Average City Park	0.51
Average Clark Street	0.6
Average Old Dufur Road	1.1
In Busses [Batterman et al. 2002]	1.2
Average Wasco County Public Works	2.4
UCL Wasco County Public Works	2.7
EPA Reference Concentration	3.0
ATSDR Chronic MRL	3.7
In Vehicle [Löfgren et al. 1991]	4.5
Indoor Residential Air [ATSDR 1995a]	0.3-10

*Modeled air in Portland reported as more than 10 times above the benchmark. The concentration in specific locations may be higher.

Can I eat fruit and vegetables from gardens in the area?

- In general, fruit and vegetable consumption and gardening are beneficial to health.
- Limited information exists to directly evaluate this question.
    - Neither soil nor produce sampling data are available from gardens from recent sampling.
    - PAHs can deposit on plants, or deposit on soil and be taken up by plants from the soil; soil uptake rates are low [ATSDR 1995b].
    - Naphthalene degrades faster than many other PAHs in the soil; its half-life is estimated at just over 2 days, other PAHs have half-lives in the soil closer to one year [ATSDR 1995b].
    - Atmospheric deposition of PAHs on aboveground plant parts may be the primary route for PAH accumulation [ATSDR 1995b].
    - If the vegetables are grilled, the cooking process will add PAHs.
    - Washing produce and peeling root vegetable prior to consumption may reduce exposure to contaminants, if they are present.
- Given the low levels of PAHs in the air and the benefits of fruit and vegetable consumption, consuming fruit and vegetables from gardens is unlikely to cause harm.

Attachments – Tables, Figures, and Photos

Table 1: Air concentrations of naphthalene and other PAHs at Wasco County Public Works (measured by DEQ June-Nov 2016) and Old Dufur Road (measured by DEQ Aug-Sept 2016) and comparison values.

	Wasco County Public Works			Old Dufur Road					
Contaminant Name	**Mean concentration*, µg/m³**	**95% UCL, ND=1/2DL, µg/m³**	**Max concentration µg/m³**	**Mean concentration*, µg/m³**	**95% UCL, ND=1/2DL, µg/m³**	**Max concentration µg/m³**	**Non-cancer comparison value µg/m³**	**Cancer-based comparison value µg/m³‡**	**Chemical of potential concern?**
Naphthalene	2.4	2.7	5.8	1.1	1.3	2.0	3.7	0.03	**Yes**
Total PAHs†	0.0044	0.0053	0.023	0.0024	0.0029	0.0048	n/a	0.0009	**Yes**
Benzo[a]anthracene	NC	NC	0.0014	ND	ND	ND	n/a	0.0045	No
Benzo[a]pyrene	ND	ND	ND	ND	ND	ND	0.002	0.0009	No
Benzo[b]fluoranthene	NC	NC	0.0007	ND	ND	ND	n/a	0.0011	No
Benzo[g,h,i]perylene	ND	ND	ND	ND	ND	ND	n/a	0.1	No
Benzo[k]fluoranthene	NC	NC	0.0005	NC	NC	0.0004	n/a	0.03	No
Chrysene	0.0007	NC	0.0034	NC	NC	0.0009	n/a	0.009	No
Dibenzo[a,h]anthracene	ND	ND	ND	ND	ND	ND	n/a	0.00009	No
Fluoranthene	0.051	0.062	0.27	0.027	0.033	0.052	n/a	0.011	**Yes**
Indeno[1,2,3-cd]pyrene	NC	NC	0.0005	ND	ND	ND	n/a	0.013	No

Chemicals of potential concern (detected at concentrations exceeding the comparison value) are highlighted grey. ProUCL used to calculate 95% upper confidence levels of the mean. Although other PAHs were measured, individual PAHs included in this table have an assigned toxicity equivalency factor (TEF)

*Mean concentrations are shown with non-detects set at one-half of the detection limit; means were not calculated (NC) if chemical was not detected in more than half of the samples. Detection limit was 0.0004 µg/m³ for PAHs. The highest mean concentrations detected were at the Wasco County Public Works location; data presented is from this monitor. Chemicals detected infrequently only have the maximum value listed.

†PAHs converted to benzo[a]pyrene toxicity equivalency using TEFs.

‡Cancer-based CVs for individual PAHs (excluding naphthalene) were converted from the Ambient Benchmark Concentration using their TEF.

DL = Detection Limit

µg/m³ = micrograms per cubic meter

n/a = Not available

NC = Not calculated due to frequent non-detects

ND = Not detected

UCL = Upper confidence level

Table 2. 2016 Air sampling data summary by location. Maximum values for total PAH assume ND = ½ DL. Grey indicates where maximum value exceeds CV.

	Location Dates	Cherry Heights 6/2/2016 – 11/18/2016				City Park 6/2/2016 – 8/1/2016			
Contaminant Name	CV µg/m³	Number of samples	Number of detections	Number of detections above CV[¶]	Max µg/m³	Number of samples	Number of detections	Number of detections above CV[¶]	Max µg/m³
Naphthalene	3.7[†], 0.03[‡]	59*	59	0, 38	0.41	19	19	0, 19	1.7
Total PAHs[2]	0.0009[‡]	62	61	0	0.0004	19	19	13	0.0042
Acenaphthene	None	59*	58		0.051	18*	18		0.71
Acenaphthylene	None	62	18		0.0032	19	17		0.0042
Anthracene	None	62	24		0.0013	19	19		0.016
Benzo[a]anthracene	0.0045[§]	62	0	0		19	1	0	0.0006
Benzo[a]pyrene	0.002**, 0.0009[§]	62	0	0, 0		19	0	0, 0	
Benzo[b]fluoranthene	0.0011[§]	62	0	0		19	0	0	
Benzo[e]pyrene	None	62	0			19	0		
Benzo[g,h,i]perylene	0.1[§]	62	0	0		19	0	0	
Benzo[k]fluoranthene	0.03[§]	62	1	0	0.0005	19	0	0	
Chrysene	0.009[§]	62	2	0	0.0004	19	9	0	0.0019
Coronene	None	62	0			19	0		
Dibenzo[a,h]anthracene	0.00009[§]	62	0	0		19	0	0	
Dibenzofuran	None	59*	59		0.042	19	19		0.38
Dibenzothiophene	None	62	44		0.0018	19	19		0.018
Fluoranthene	0.011[§]	62	47	0	0.002	19	19	12	0.061
Fluorene	None	59*	59	0	0.027	19	19		0.25
Indeno[1,2,3-cd]pyrene	0.013[§]	62	3		0.0004	19	0	0	
Perylene	None	62	0			19	0		
Phenanthrene	None	59*	59		0.018	19	19		0.26
Pyrene	None	62	28		0.0011	19	19		0.036

	Location Dates	Clark Street 9/24/2016 – 11/18/2016 First 3 samples at 8th and Harris				Old Dufur Road 8/4/2016 – 9/6/2016			
Contaminant Name	CV µg/m³	Number of samples	Number of detections	Number of detections above CV[¶]	Max µg/m³	Number of samples	Number of detections	Number of detections above CV[¶]	Max µg/m³
Naphthalene	3.7[†], 0.03[‡]	15	15	0, 15	1.1	15	15	0, 15	1.95
Total PAHs[2]	0.0009[‡]	15	15	1	0.0009	15	15	15	0.0044
Acenaphthene	None	15	15		0.21	15	15		1.2
Acenaphthylene	None	15	14		0.005	15	15		0.0074
Anthracene	None	15	15		0.0044	15	15		0.028
Benzo[a]anthracene	0.0045[§]	15	2	0	0.0005	15	0	0	
Benzo[a]pyrene	0.002**, 0.0009[§]	15	0	0, 0		15	0	0, 0	
Benzo[b]fluoranthene	0.0011[§]	15	4	0	0.0005	15	0	0	
Benzo[e]pyrene	None	15	0			15	0		
Benzo[g,h,i]perylene	0.1[§]	15	0	0		15	0	0	
Benzo[k]fluoranthene	0.03[§]	15	1	0	0.0004	15	1	0	0.0004
Chrysene	0.009[§]	15	9	0	0.0007	15	5	0	0.0009
Coronene	None	15	0			15	0		
Dibenzo[a,h]anthracene	0.00009[§]	15	0	0		15	0	0	
Dibenzofuran	None	15	15		0.12	15	15		0.73
Dibenzothiophene	None	15	15		0.0038	15	15		0.032
Fluoranthene	0.011[§]	15	15	0	0.0057	15	15	15	0.052
Fluorene	None	15	15		0.078	15	15		0.53
Indeno[1,2,3-cd]pyrene	0.013[§]	15	5	0	0.0005	15	0	0	
Perylene	None	15	0			15	0		
Phenanthrene	None	15	15		0.042	15	15		0.61
Pyrene	None	15	15		0.0032	15	15		0.030

Contaminant Name	Location Dates / CV µg/m³	Wasco County Public Works 6/2/2016 – 11/18/20166/2/2016 – 11/19/2016 Number of samples	Number of detections	Number of detections above CV[¶]	Max µg/m³
Naphthalene	3.7[†], 0.03[‡]	64	64	13, 64	5.8
Total PAHs[2]	0.0009[‡]	64	64	64	0.023
Acenaphthene	None	64	64		4.6
Acenaphthylene	None	64	64		0.027
Anthracene	None	64	64		0.11
Benzo[a]anthracene	0.0045[§]	64	12	0	0.0014
Benzo[a]pyrene	0.002**, 0.0009[§]	64	0	0, 0	
Benzo[b]fluoranthene	0.0011[§]	64	8	0	0.0007
Benzo[e]pyrene	None	64	1		0.0004
Benzo[g,h,i]perylene	0.1[§]	64	0	0	
Benzo[k]fluoranthene	0.03[§]	64	2	0	0.0005
Chrysene	0.009[§]	64	43	0	0.0034
Coronene	None	64	0		
Dibenzo[a,h]anthracene	0.00009[§]	64	0	0	
Dibenzofuran	None	64	64		2.4
Dibenzothiophene	None	64	64		0.13
Fluoranthene	0.011[§]	64	64	54	0.27
Fluorene	None	64	64		2.0
Indeno[1,2,3-cd]pyrene	0.013[§]	64	5	0	0.0005
Perylene	None	64	0		
Phenanthrene	None	64	64		2.1
Pyrene	None	64	64		0.15

[*]Some samples did not meet quality standards for analysis

[†]ATSDR Chronic minimal risk level (MRL)

[‡]OHA Ambient Benchmark Concentration based on cancer risk

[§]Converted from total PAH comparison value using TEF

[¶]For naphthalene, the numbers are the number of detections above is the ATSDR Chronic MRL and the number of detections above the OHA ABC, respectively

**EPA RfC non-cancer for Benzo[a]pyrene

CV = Comparison value

µg/m³ = micrograms per cubic meter

Table 3: Carcinogenicity classifications of PAHs

Contaminant Name	Detected	Detected above CV*	Mutagen	EPA	NTP	IARC
Naphthalene	Yes	Yes		CN	**2**	2B
Acenaphthene	Yes					3
Acenaphthylene	Yes					
Anthracene	Yes			D		3
Benzo[a]anthracene	Yes	No	M	B2	2	2B
Benzo[a]pyrene	No	No	M	B2	2	1
Benzo[b]fluoranthene	Yes	No	M	B2	2	2B
Benzo[e]pyrene	Yes					
Benzo[g,h,i]perylene	No	No		D		3
Benzo[k]fluoranthene	Yes	No	M	B2	2	2B
Chrysene	Yes	No	M	B2		2B
Coronene	No					
Dibenzo[a,h]anthracene	No	No	M	B2	2	2A
Dibenzofuran	Yes					
Dibenzothiophene	Yes					
Fluoranthene	Yes	Yes		D		3
Fluorene	Yes			D		3
Indeno[1,2,3-cd]pyrene	Yes	No	M	B2	2	2B
Perylene	No					
Phenanthrene	Yes			D		3
Pyrene	Yes			D		3

Source – ATSDR Air Comparison Values (CV) and Inhalation Health Guidelines [ATSDR 2017]

Chemicals of potential concern (detected at concentrations exceeding the comparison value) are highlighted grey

*Cancer-based CVs for individual PAHs (excluding naphthalene) were converted from the Ambient Benchmark Concentration using their TEF. PAHs with a CV (excluding naphthalene) are treated as mutagenic in this analysis.

M = Mutagen

EPA = Environmental Protection Agency

- B2 = Probably carcinogenic to humans, little or no human data
- CN = Carcinogenic potential cannot be determined
- D = Not classifiable as to human carcinogenicity

NTP = National Toxicology Program

- 2 = Reasonably anticipated to be a human carcinogen

IARC = International Agency for Research on Cancer

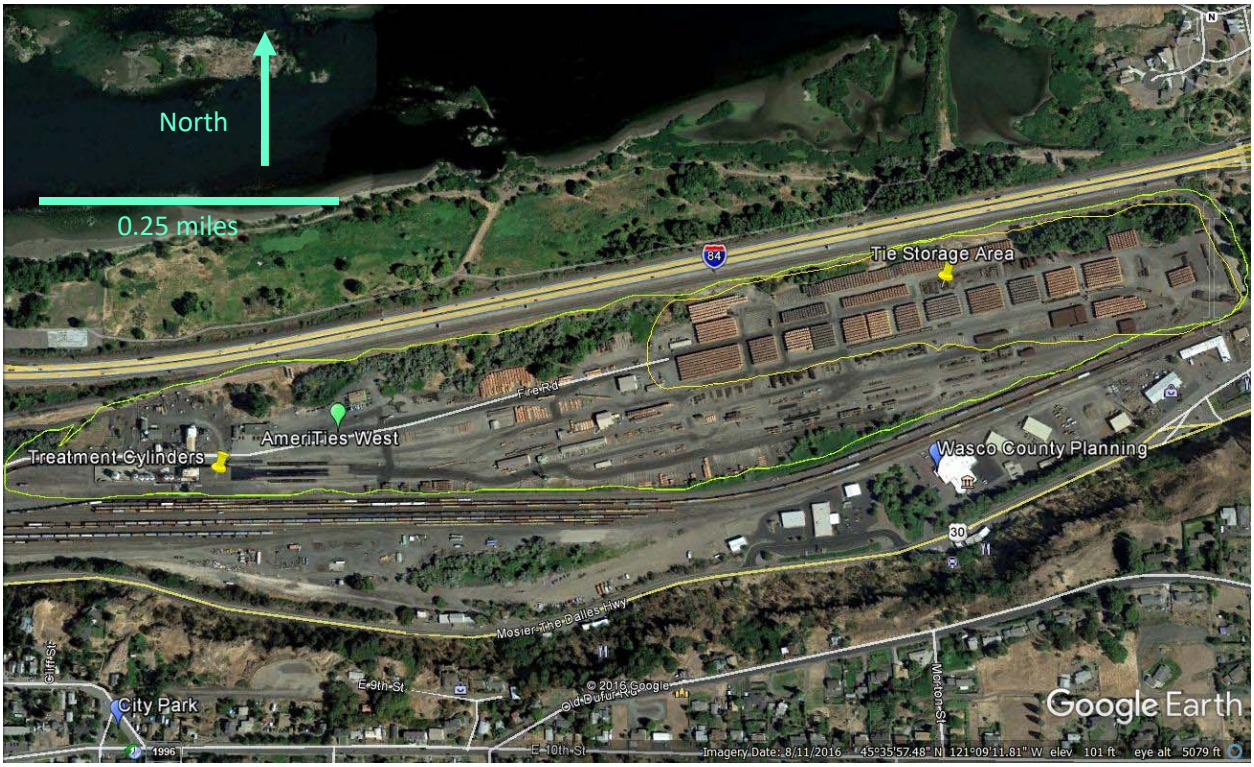
- 1 = Carcinogenic to humans
- 2A = Probably carcinogenic to humans
- 2B = Possibly carcinogenic to humans
- 3 = Not classifiable as to its carcinogenicity to humans

Table 4: Naphthalene Air Concentrations measured by consultant on single days, September 2011 and February 2012 [Beadie and Wall 2012] Samples were collected for 8 hours during the day, unless otherwise noted. See Figure 5 for geographic location of sampling.

Sample Location	September 2011 Concentration µg/m^3	February 2012 Concentration µg/m^3
On-site, near treatment cylinder, 24-hour		53
On-site, near treatment cylinder	290	56
Riverfront park (between facility/freeway and river)	13	
E 11th Street	13	
E 11th Street, 24-hour		1.0
E 20th Street	7.8	
E 14th Street, 24-hour		0.88
Cherry Heights/10th Street		0.72

µg/m^3 = micrograms per cubic meter

Figure 1: AmeriTies West (outlined in green) and immediate vicinity [Google N.D.-b]



Legend

	Locations of 2016 air sampling; Wasco County Planning is the same as Wasco County Public Works
	Sources of emissions within AmeriTies
	AmeriTies label and site boundary

Figure 2: General site profile map for AmeriTies

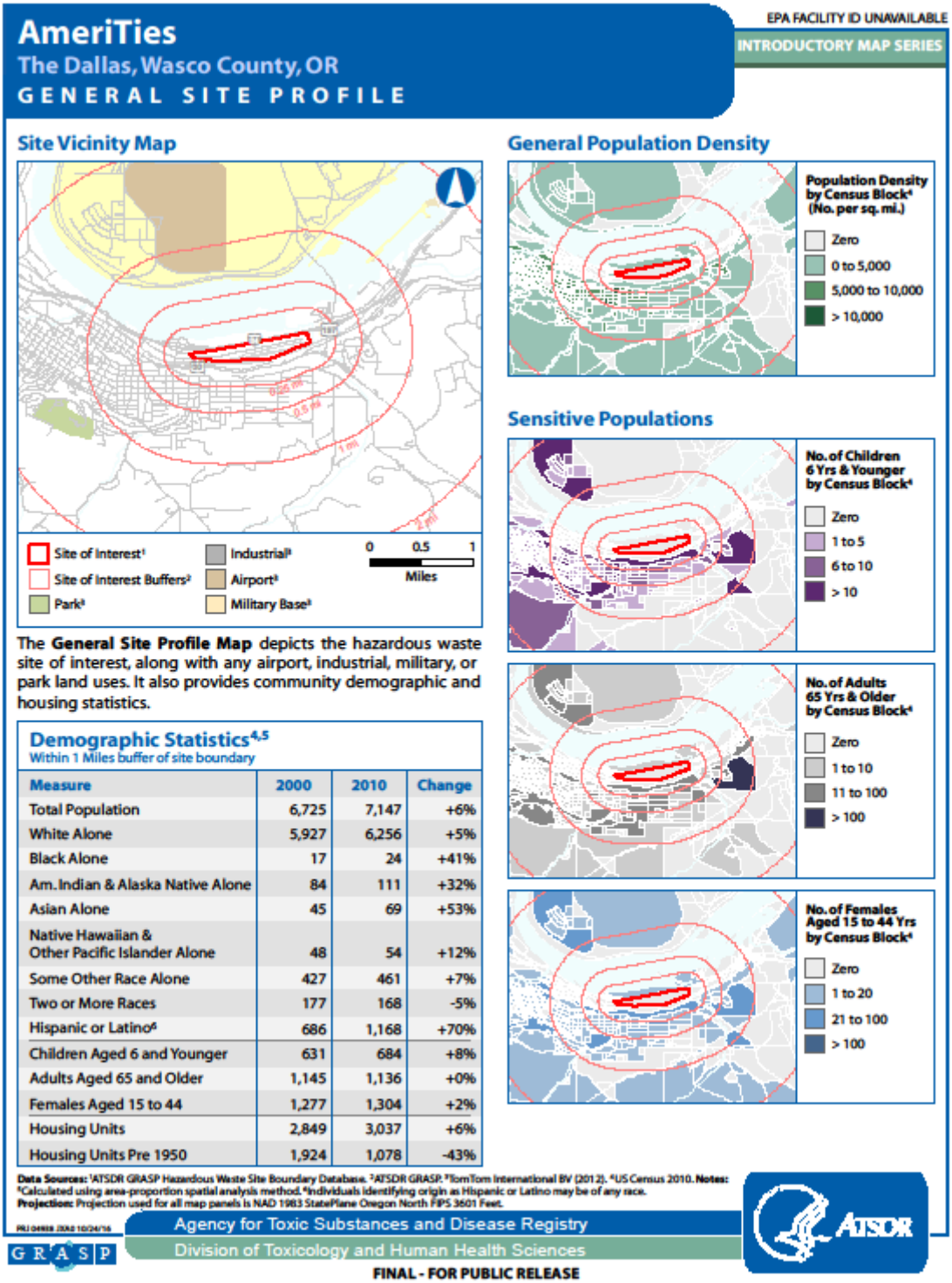


Figure 3: USGS topographical map of The Dalles, 1934 [USGS 1934]

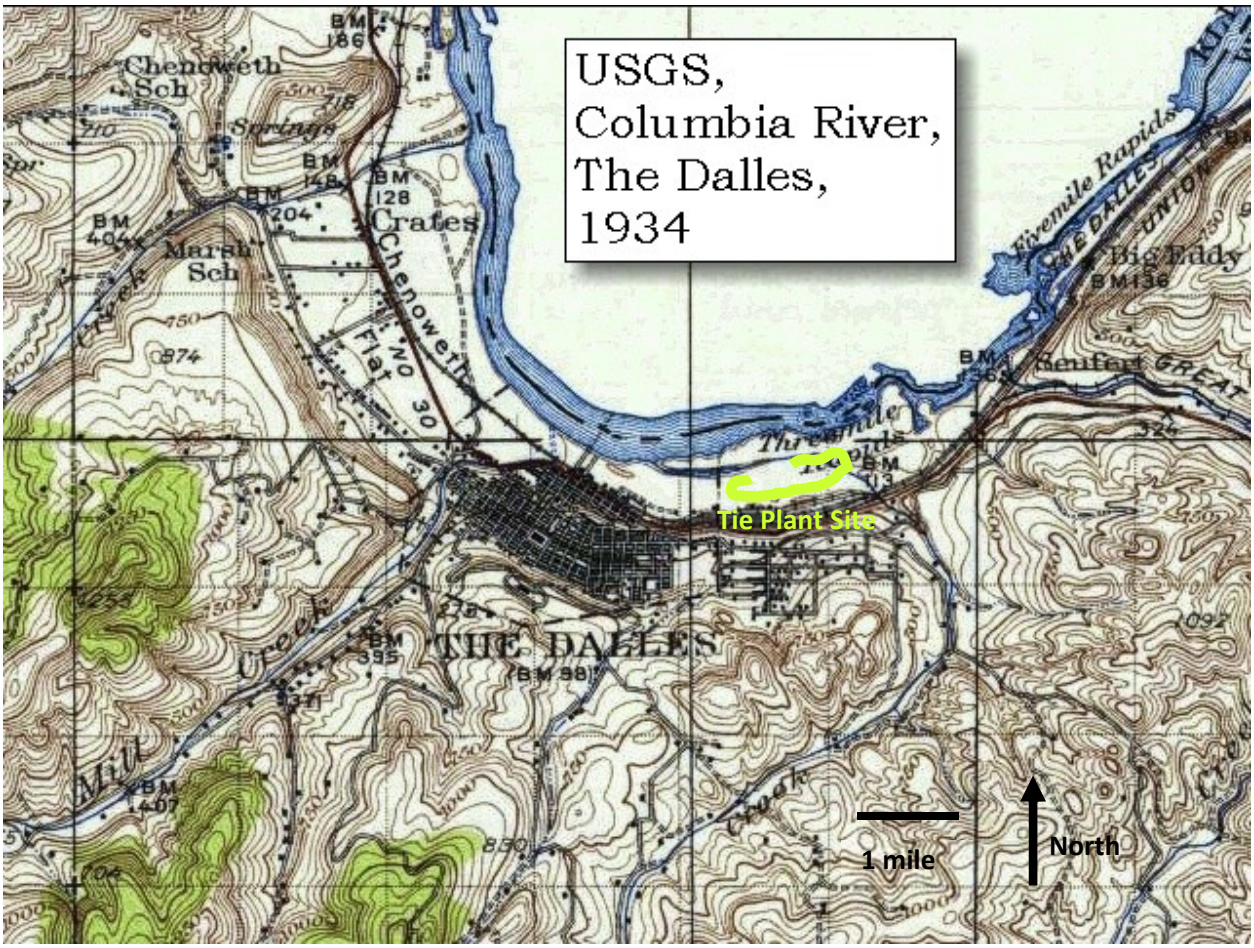
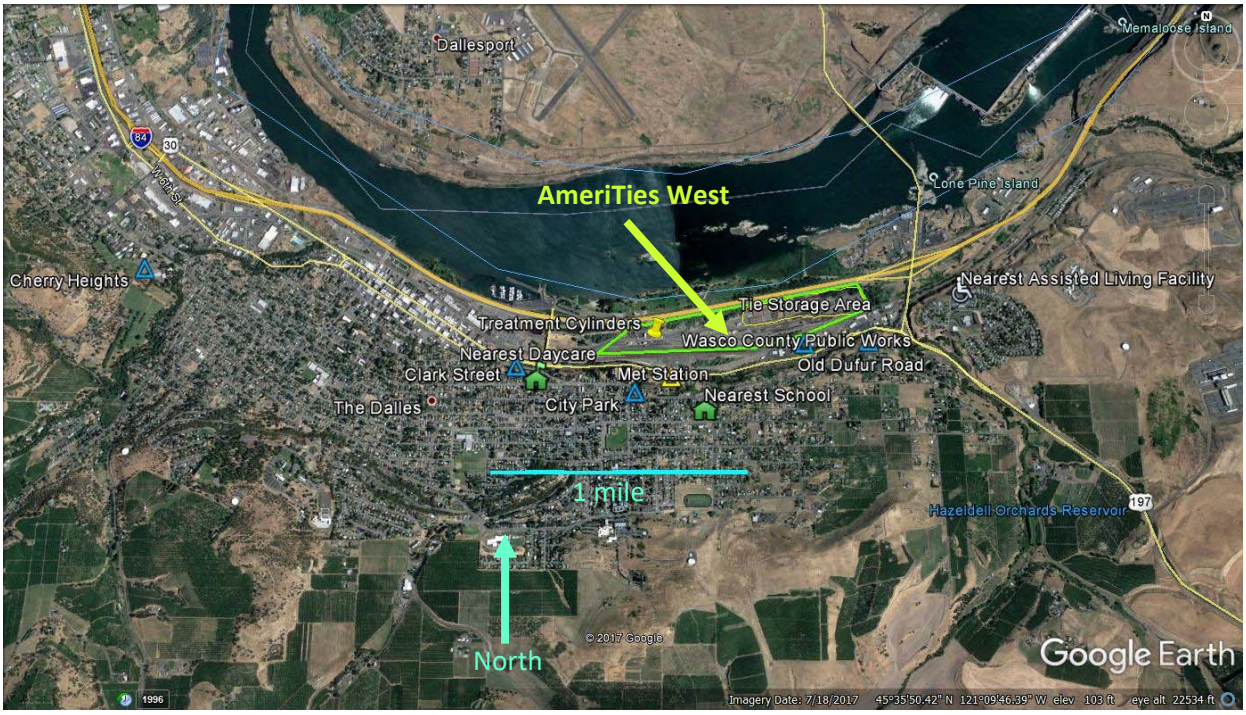


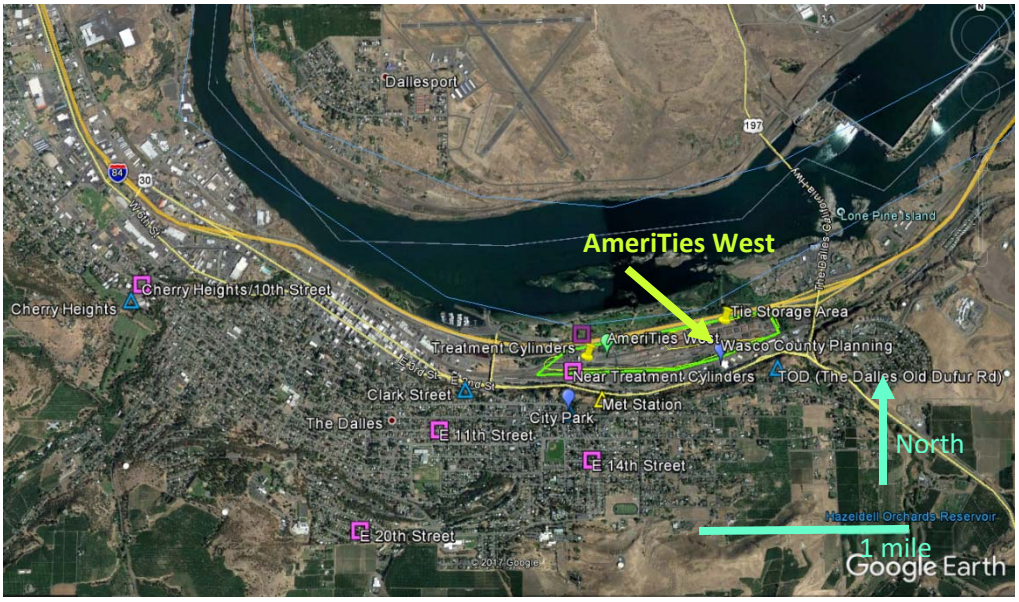
Figure 4: 2016 DEQ air monitoring locations*. [Google N.D.-b]



Legend

	Locations of 2016 air sampling
	Meteorological station location during 2016 sampling
	Nearest school, daycare, and assisted care facility
	Sources of emissions within AmeriTies
	AmeriTies site boundary

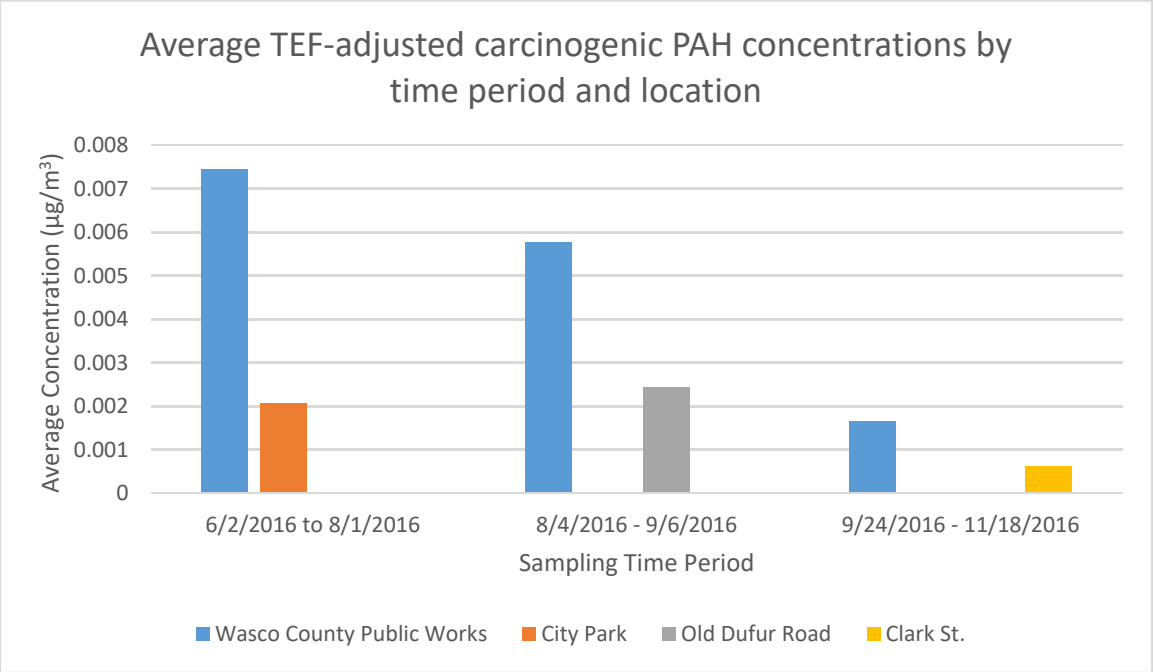
Figure 5: Sampling locations for both the 2016 samples (blue triangles) and the 2011-12 consultant samples (pink squares). [Google N.D.-a]

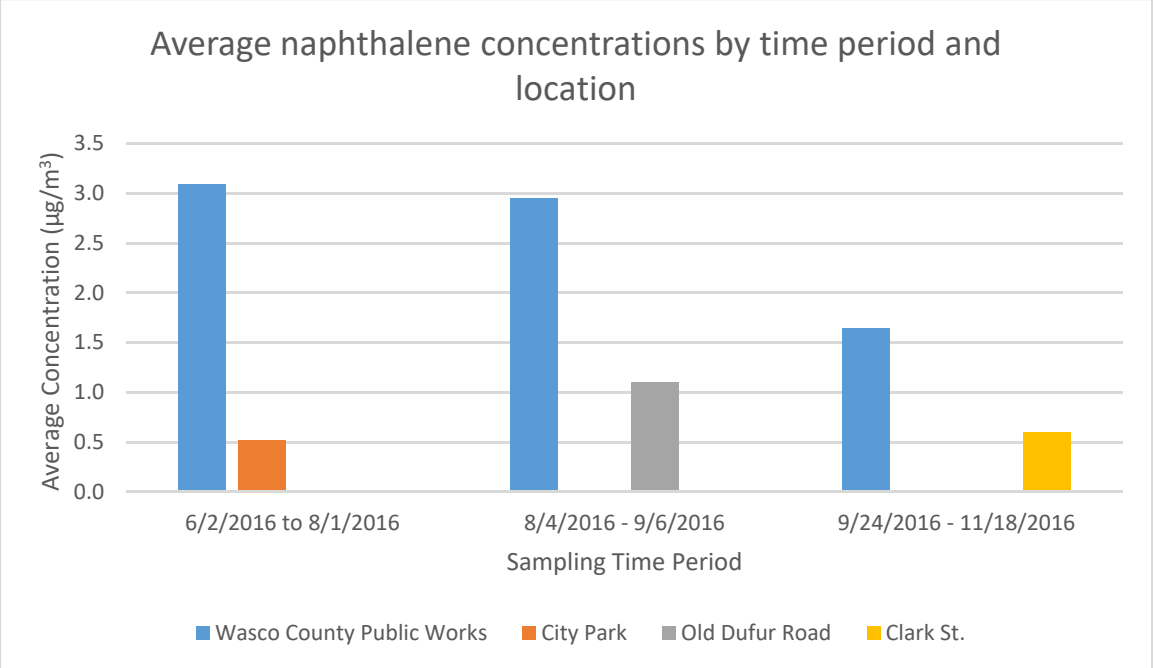


Legend

	Locations of 2016 air sampling; Wasco County Planning was the original label given to the Wasco County Public Works monitoring location
	Meteorological station location during 2016 sampling
	Locations of 2011-2012 air sampling
	Sources of emissions within AmeriTies
	AmeriTies label and site boundary

Figure 6: TEF-adjusted carcinogenic PAH concentration and naphthalene concentrations measured at Wasco Public Works and neighborhood locations





µg/m^3 = micrograms per cubic meter

Photo 1: Site of the Railroad Tie Plant, 1953. Construction of the I-84 freeway had not occurred. Development on the bluffs to the south and east of the plant was more limited. [Anonymous 2015]

https://www.atsdr.cdc.gov/odors/docs/are_environmental_odors_toxic_508.pdf

Are Environmental Odors Toxic?

In general, most substances that cause odors in the outdoor air (environmental odors) are not at levels that can harm your health.

Even if environmental odors aren't at levels that can harm your health, they can still affect your quality of life.

An odor is caused by a substance in the air that you can smell. Odors, or smells, can be either pleasant or unpleasant. In general, most substances that cause odors in the outdoor air are not at levels that can cause serious injury, long-term health effects, or death. However, odors may affect your quality of life and sense of well-being. Sometimes environmental odors can affect entire communities.

You may have signs and symptoms when exposed to environmental odors, but the symptoms usually go away when the odor is gone.

Common Symptoms

Substances that produce odors can sometimes trigger physical symptoms. Symptoms usually occur when the substance is present at "irritation levels". However, you can sometimes have symptoms when the substance in air is below levels of irritation.

The most common symptoms from environmental odors are headache and nausea. Others include

- **Dizziness**
- **Watery eyes, stuffy nose, irritated throat**
- **Cough or wheeze, especially if you have allergies, asthma, and other chronic lung problems**
- **Sleep problems due to throat irritation and cough**

Environmental odors can also cause stress; you may feel anxious, helpless, discouraged, sad, or depressed.

The following conditions may trigger symptoms when odors are below irritation levels:

- **If the odor has a very unpleasant smell**
- **If you've had a previous bad experience with the odor**
- **If you believe the odor is harmful**
- **If you feel stressed by the odor**

These signs and symptoms may be from other causes as well. For example, watery eyes and a stuffy nose may also be related to seasonal allergies, and depression may be the sign of other stressful events or problems. As always, you should see a doctor if you have questions about signs and symptoms.

Sensitive Populations

Not everyone reacts to environmental odors the same way. In general, if you are young or female, you may be more sensitive to odors. If you don't smoke, you are usually more sensitive to odors than smokers. If you suffer from depression and anxiety disorders, or have migraines, allergies, asthma, and other chronic lung conditions, you may feel worse when you smell unpleasant odors over a long time.

Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations

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Reducing Exposure to Odors

You can reduce your exposure to odors by

- **Exercising indoors during days with more environmental odors**
- **Staying indoors when your allergies, asthma, and/or chronic lung problems are acting up**
- **Leaving the area for a few hours if possible**

Odor Control Solutions

Communities and industries can work together to control odors using

- **Odor control laws and ordinances**
- **Odor control technologies**

(Watch the Odor Control Solutions and Requesting Action videos on ATSDR's Environmental Odors website. For more information visit http://www.atsdr.cdc.gov/odors/videos.html).

You may come into contact with environmental odors in your community if you live near industries that produce odors or use materials that produce odors. The chart below provides a short list of industries or processes and the odor-producing substances related to them.

Industries or processes and the odor-producing substances related to them	
Production of semi-conductors, pharmaceuticals, textiles (e.g., fabric, printing, dyes), paper, rubber, fertilizer	Ammonia
Food processing plants, livestock feeding facilities, paper mills, and landfills	Hydrogen sulfide
Wood treatment facilities	Pentachlorophenol and creosote, hydrogen sulfide, sulfur oxides
Petroleum refineries	Hydrogen sulfide, sulfur oxides, benzene, toluene, xylene
Coal-fired power plants, vehicle exhaust	Formaldehyde, sulfur dioxide

For more information about environmental odors, please contact the Agency for Toxic Substances and Disease Registry (ATSDR) at 1-800-CDC-INFO (236-4636) or visit the environmental odors website: www.atsdr.cdc.gov/odors

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