Neighborhood Cancer Rate Evaluation
Elevated Environmental Heavy Metal Levels
SE and North Portland, Multnomah County, OR, 1999–2013
March 31, 2016

1. HISTORY

In January 2016, the Oregon Department of Environmental Quality (DEQ) released preliminary data from air quality monitoring that showed elevated levels of arsenic and cadmium near Southeast 22nd Avenue and Southeast Powell Boulevard in Portland, OR. The DEQ concluded that these air toxics were likely related to emissions from the Bullseye Glass Company manufacturing facility located at 3722 SE 21st Avenue.

In February 2016, as a continuation of the investigation into elevated environmental levels of heavy metals (e.g. cadmium and arsenic) in the Portland metro area, the Multnomah County Health Department (MCHD) released maps showing elevations in estimated levels of cadmium in the air near North Kerby Avenue and North Thompson Street in North Portland. Unlike the inner SE Portland area, no elevated environmental levels of arsenic have been reported to date in this area of North Portland. Oregon DEQ concluded that the cadmium levels detected in moss samples, and the estimated air cadmium concentrations, were likely related to emissions from the Uroboros Glass Studio facility located at 2139 North Kerby Avenue.

Response to these findings has been a collaborative effort among various Oregon agencies, including DEQ, the Oregon Health Authority (OHA), the Multnomah County Health Department (MCHD), and the U.S. Forest Service. One of OHA's roles in this response is to assess the public health risk posed by these air toxics.

This report includes analyses of lung and bladder cancer rates for Census tracts in SE and North Portland with the highest estimated environmental levels of heavy metals reported to date. These cancers were selected for analysis due to their known association with the types of environmental exposures that could potentially occur in the identified areas of SE and North Portland. Bladder cancer is specifically associated with oral ingestion of arsenic, and was included in the analyses for North Portland even though no elevated environmental levels of arsenic have been reported to date in that area. We included analyses of bladder cancer for North Portland in order to offer comparable information for the two areas of Portland being assessed.

2. BACKGROUND

Cadmium and arsenic are both recognized human carcinogens.[1,2]

With regard to cadmium, there is suggestive evidence of an increased risk of lung cancer in humans following prolonged inhalation exposure.

With regard to arsenic, there is evidence from many epidemiological studies that inhalation exposure to inorganic arsenic increases the risk of lung cancer. In addition, there is convincing evidence that oral ingestion of inorganic arsenic is associated with an increased risk of skin cancer, and growing evidence that it is associated with bladder cancer.

The Oregon State Cancer Registry (OSCaR), established by the Oregon State Legislature in 1995, collects data on newly-diagnosed cancers among Oregon residents. Data for this neighborhood cancer rate evaluation were available in the OSCaR registry for lung and bladder cancers; the types of skin cancers associated with arsenic exposure are not reportable to OSCaR.

3. SUMMARY FINDINGS

Rates of lung and bladder cancer were generally consistent with expected rates in the identified Census tracts in SE and North Portland during 1999–2013.

For the years 1999-2003, there was a small, statistically significant increase in the rate of bladder cancer in one area of North Portland. This rate was based on a small number of bladder cancer cases. Bladder cancer rates in this area in subsequent years were not elevated.

The results of the analysis presented in this document should be considered in the context of the on-going environmental assessment performed by the U. S. Forestry Service and Oregon DEQ.

4. METHODS

A. Identifying Census tracts for neighborhood cancer rate evaluations

Environmental monitoring information was used to identify the Census tracts that would be the focus of neighborhood cancer rate evaluations.

Preliminary environmental monitoring information came from two sources:

1. The map of estimated levels of cadmium in the air, released by MCHD on February 11, 2016: (http://multco.maps.arcgis.com/apps/SimpleViewer/index.html?appid=fc1b6465dfad408281c37f6301d756ac).

2. The map of estimated levels of arsenic in moss, provided by MCHD, dated February 17, 2016 (see Exhibit 1, Appendix).

Figures 1 through 4 below show the relationship between Census tracts in SE and North Portland and estimated heavy metal levels in these areas. These include estimated air concentrations of cadmium (Figures 1 and 3), and estimated levels of arsenic in moss collected from the areas (Figures 2 and 4).

Based on the available environmental data, the following Census tracts were considered for this evaluation: SE Portland: Census tracts 1000, 9.01, and 9.02; North Portland: Census tracts 23.03 and 22.03. Census tract 9800, immediately to the northwest of Census tracts 23.03 and 22.03 in North Portland (Figures 3 and 4) was not included in the neighborhood cancer rate evaluation because it represents an industrial area with virtually no residential population.

The identified Census tracts included the areas with the highest estimated cadmium concentrations in the air (Census tract 1000 in SE Portland; Census tract 23.03 in North Portland), and locations of particular concern for the community (the CCLC at Fred Meyer [day care], Cleveland High School, and Winterhaven School in SE Portland; the Harriet Tubman School and the Boise-Eliot/Humboldt Elementary School in North Portland).

B. Identifying cancer types for neighborhood cancer rate evaluations

Lung and bladder cancer were considered for this evaluation. These cancers were identified based on reference documents from the Agency for Toxic Substances and Disease Registry (ATSDR)[1,2] that review and summarize scientific evidence on the health effects of cadmium and arsenic exposure.

As previously noted, no elevated environmental levels of arsenic have been reported to date in the area of interest in North Portland. However, for North Portland, OHA included an evaluation of rates of bladder cancer, which is associated with oral ingestion of arsenic, for the sake of consistency with the evaluation done for SE Portland. Initial results from the SE Portland evaluation were published on February 18, 2016,[3] and initial North Portland results were published on March 14, 2016.[4]

C. Selecting observed cancer cases from the Oregon State Cancer Registry (OSCaR)

Newly-diagnosed cases of lung and bladder cancer among residents of Multnomah County were identified from the Oregon State Cancer Registry (OSCaR) database in 5-year intervals for the period of 1999–2013. Residence on the date of cancer diagnosis was used for case assignment to county and Census tract.

D. Estimating expected numbers of cancer cases for the selected Census tracts

The expected number of cancer cases for a specific geographic area is calculated according to standard methods recommended by the Centers for Disease Control and Prevention (CDC).* This calculation involves assessing the number of cases that would occur in an area if the rate were similar to that of the larger population, in this case, the Multnomah County population.

Rates of lung and bladder cancer in Multnomah County for the period of 1999–2013 were used in 5-year intervals to estimate the expected number of cases for these cancers in the identified Census tracts in SE and North Portland during the same time.

Observed cases of lung and bladder cancer in Multnomah County for 1999–2013 were identified in OSCaR, as described above. Rates for these cancers in Multnomah County were then calculated using population data from the 2000 and 2010 U.S. Census, as appropriate.

Multnomah County lung and bladder cancer rates were then extrapolated to the identified Census tracts in SE and North Portland in 5-year intervals to estimate the expected number of cases of these cancers in these Census tracts from 1999–2013.

*Centers for Disease Control and Prevention. Investigating suspected cancer clusters and responding to community concerns. MMWR 2013:62;1-26. (see http://www.cdc.gov/mmwr/pdf/rr/rr6208.pdf)

Standardized Incidence Ratios (SIR)[†] were calculated by comparing the observed number of cases of a particular cancer identified in OSCaR for the selected Census tract to the expected number of cases calculated for the same area (SIR = Observed cases ÷ Expected cases).

[†] Standardized Incidence Ratios (SIR) indicate whether the number of cancer cases observed in a particular area is less than, equal to, or greater than the expected number of cases in that area during a specific time period. An SIR less than 1.0 indicates that the number of cases is less than expected. An SIR greater than 1.0 indicates that the number of cases is greater than expected. The SIR is considered statistically significant when the 95% confidence interval does not include the number 1.0.

Figure 1. Estimated air concentrations of cadmium in identified Census tracts in SE Portland

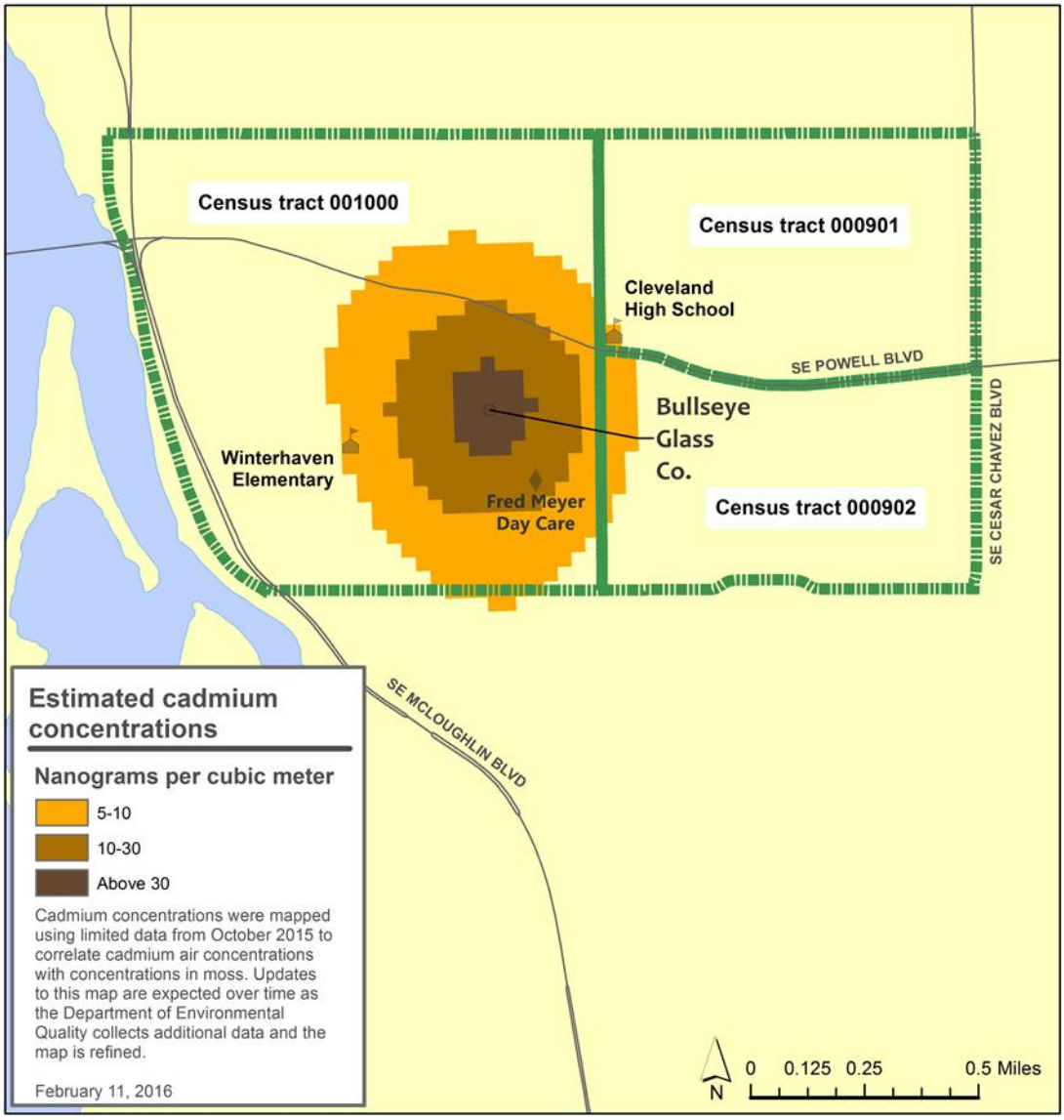


Figure 2. Estimated arsenic concentrations in moss in identified Census tracts in SE Portland

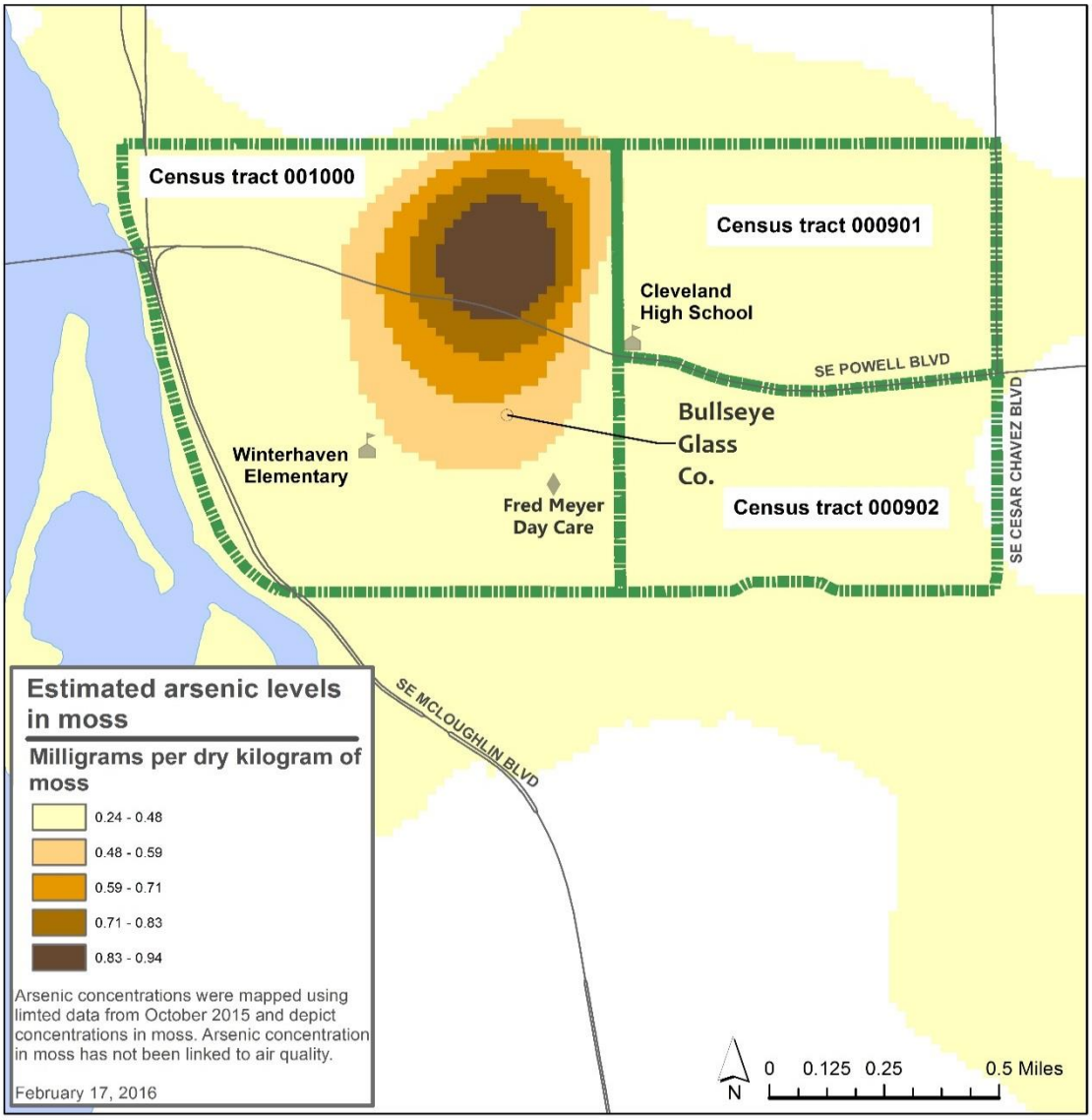


Figure 3. Estimated air concentrations of cadmium in identified Census tracts in North Portland

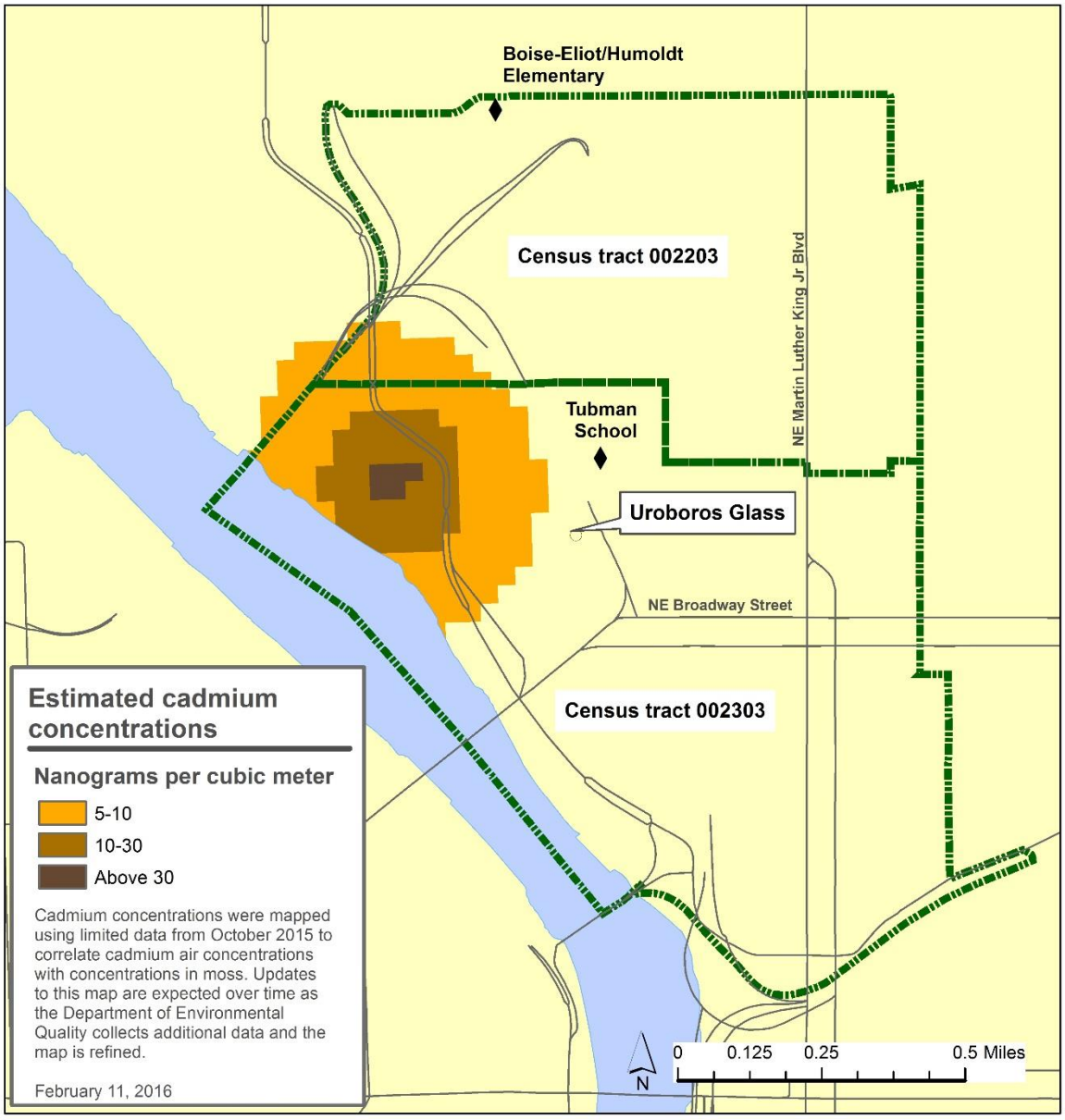
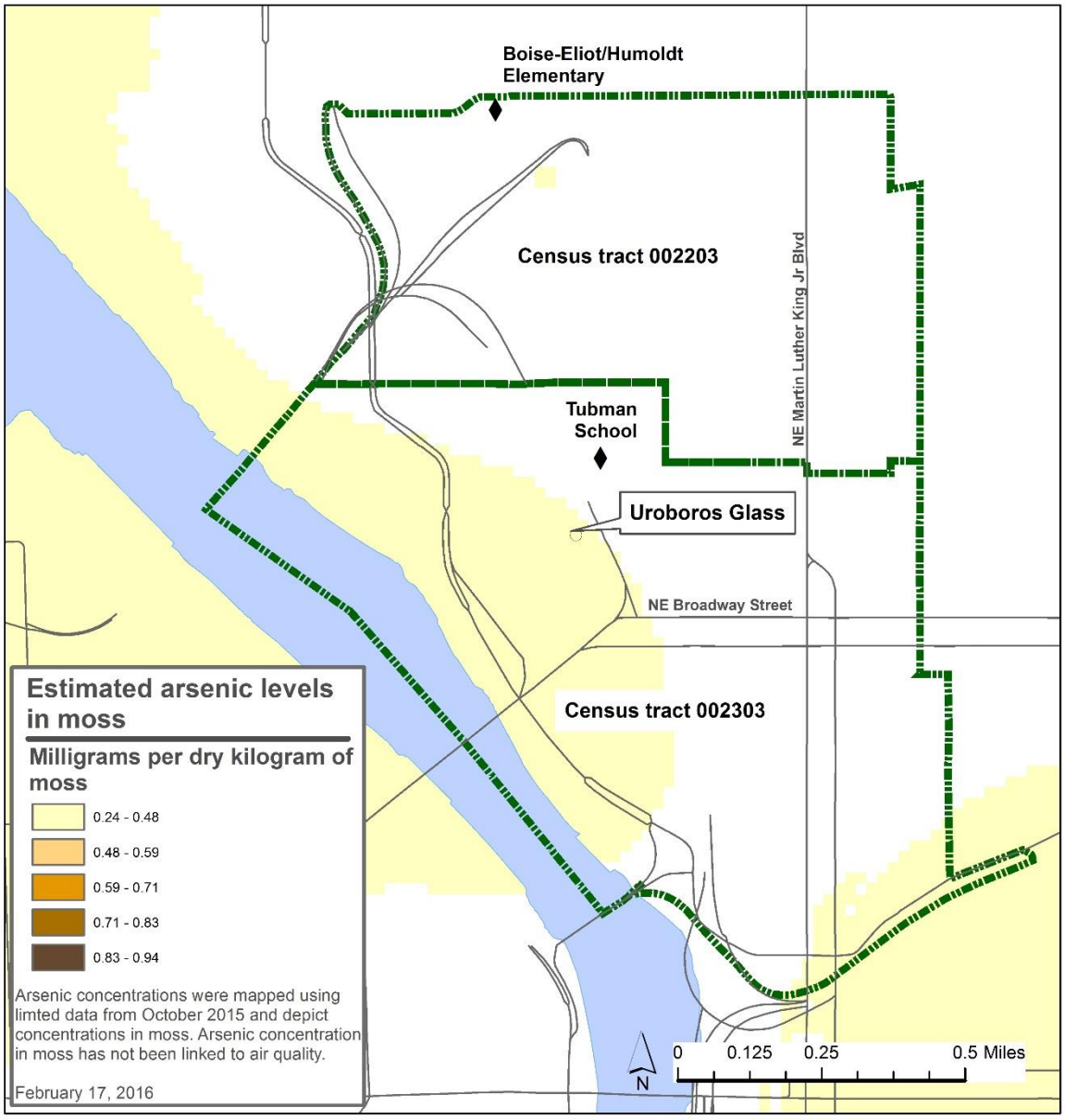


Figure 4. Estimated arsenic concentrations in moss in identified Census tracts in North Portland



5. RESULTS

1. SE Portland

A. SE Portland, Census tract 1000

During 1999–2013, observed cases of lung cancer in Census tract 1000 in SE Portland (Figures 1 and 2) ranged from 9 to 15 (Table 1).

Using Multnomah County lung cancer rates, the expected number of lung cancer cases was calculated for each 5-year period, ranging from 10.3 to 11.4 (Table 1).

Comparing the observed versus expected number of lung cancer cases during this time resulted in Standardized Incidence Ratios that were similar to 1.0 for each 5-year period (Table 1).

These results indicate that there was no substantial difference between the observed and expected number of lung cancer cases in Census tract 1000 during 1999–2013. This conclusion is supported by the fact that the observed versus expected number of lung cancer cases was similar for all 5-year periods from 1999–2013, with SIRs similar to 1.0, and 95% confidence intervals for the calculated SIRs that included 1.0.

Table 1. Lung cancer, newly-diagnosed cases and Standardized Incidence Ratios (SIR),[#] Census tract 1000, SE Portland, OR, 1999–2013

	Years		
	1999–2003	2004–2008	2009–2013
	Census tract 1000	Census tract 1000	Census tract 1000
Observed lung cancer cases	15	12	9
Expected lung cancer cases	11.4	11.2	10.3
Standardized Incidence Ratio[#] (95% Confidence Interval)	1.3 (0.7, 2.2)	1.1 (0.6, 1.9)	0.9 (0.4, 1.7)

[#]The Standardized Incidence Ratio (SIR) indicates whether the number of cancer cases observed in a particular area is less than, equal to, or greater than the number of cases expected for that area during a specific time period. An SIR less than 1.0 indicates that the number of cases is less than expected. An SIR greater than 1.0 indicates that the number of cases is greater than expected. The SIR is considered statistically significant when the 95% confidence interval does not include the number 1.0.

During 1999–2013, observed cases of bladder cancer in Census tract 1000 in SE Portland (Figures 1 and 2) ranged from 1 to 4 (Table 2).

Using Multnomah County bladder cancer rates, the expected number of bladder cancer cases was calculated for each 5-year period, ranging from 3.2 to 3.4 (Table 2).

Comparing the observed versus expected number of bladder cancer cases during this time resulted in Standardized Incidence Ratios that were similar to 1.0 for each 5-year period (Table 2).

These results indicate that there was no substantial difference between the observed and expected number of bladder cancer cases in Census tract 1000 during 1999–2013. This conclusion is supported by the fact that the observed versus expected number of bladder cancer cases was similar for all 5-year periods from 1999–2013, with SIRs similar to 1.0, and 95% confidence intervals for the calculated SIRs that included 1.0.

Table 2. Bladder cancer, newly-diagnosed cases and Standardized Incidence Ratios (SIR),[#] Census tract 1000, SE Portland, OR, 1999–2013

	Years		
	1999–2003	2004–2008	2009–2013
	Census tract 1000	Census tract 1000	Census tract 1000
Observed bladder cancer cases	1	1	4
Expected bladder cancer cases	3.4	3.2	3.3
Standardized Incidence Ratio[#] (95% Confidence Interval)	0.3 (0.0, 1.6)	0.3 (0.0, 1.7)	1.2 (0.3, 3.1)

[#]The Standardized Incidence Ratio (SIR) indicates whether the number of cancer cases observed in a particular area is less than, equal to, or greater than the number of cases expected for that area during a specific time period. An SIR less than 1.0 indicates that the number of cases is less than expected. An SIR greater than 1.0 indicates that the number of cases is greater than expected. The SIR is considered statistically significant when the 95% confidence interval does not include the number 1.0.

B. SE Portland, Census tracts 1000, 9.01, and 9.02

During 1999–2013, observed cases of lung cancer in Census tracts 1000, 9.01, and 9.02 in SE Portland (Figures 1 and 2) ranged from 25 to 38 (Table 3).

Using Multnomah County lung cancer rates, the expected number of lung cancer cases was calculated for each 5-year period, ranging from 29.1 to 35.3 (Table 3).

Comparing the observed versus expected number of lung cancer cases during this time resulted in Standardized Incidence Ratios that were similar to 1.0 for each 5-year period (Table 3).

These results indicate that there was no substantial difference between the observed and expected number of lung cancer cases in Census tracts 1000, 9.01, and 9.02 during 1999–2013. This conclusion is supported by the fact that the observed versus expected number of

lung cancer cases was similar for all 5-year periods from 1999–2013, with SIRs similar to 1.0, and 95% confidence intervals for the calculated SIRs that included 1.0.

Table 3. Lung cancer, newly-diagnosed cases and Standardized Incidence Ratios (SIR),[#] Census tracts 1000, 9.01, and 9.02, SE Portland, OR, 1999–2013

	Years		
	1999–2003	2004–2008	2009–2013
	Census tracts 1000, 9.01, and 9.02	Census tracts 1000, 9.01, and 9.02	Census tracts 1000, 9.01, and 9.02
Observed lung cancer cases	25	38	26
Expected lung cancer cases	35.3	34.6	29.1
Standardized Incidence Ratio[#] (95% Confidence Interval)	0.7 (0.5, 1.0)	1.1 (0.8, 1.5)	0.9 (0.6, 1.3)

[#]The Standardized Incidence Ratio (SIR) indicates whether the number of cancer cases observed in a particular area is less than, equal to, or greater than the number of cases expected for that area during a specific time period. An SIR less than 1.0 indicates that the number of cases is less than expected. An SIR greater than 1.0 indicates that the number of cases is greater than expected. The SIR is considered statistically significant when the 95% confidence interval does not include the number 1.0.

During 1999–2013, observed cases of bladder cancer in Census tracts 1000, 9.01, and 9.02 in SE Portland (Figures 1 and 2) ranged from 3 to 11 (Table 4).

Using Multnomah County bladder cancer rates, the expected number of bladder cancer cases was calculated for each 5-year period, ranging from 9.5 to 10.7 (Table 4).

Comparing the observed versus expected number of bladder cancer cases during this time resulted in Standardized Incidence Ratios that were similar to 1.0 for each 5-year period (Table 4).

These results indicate that there was no substantial difference between the observed and expected number of bladder cancer cases in Census tracts 1000, 9.01, and 9.02 during 1999–

2013. This conclusion is supported by the fact that the observed versus expected number of bladder cancer cases was similar for all 5-year periods from 1999–2013, with SIRs similar to 1.0, and 95% confidence intervals for the calculated SIRs that included, or were slightly less than, 1.0.

Table 4. Bladder cancer, newly-diagnosed cases and Standardized Incidence Ratios (SIR),[#] Census tracts 1000, 9.01, and 9.02, SE Portland, OR, 1999–2013

	Years		
	1999–2003	2004–2008	2009–2013
	Census tracts 1000, 9.01, and 9.02	Census tracts 1000, 9.01, and 9.02	Census tracts 1000, 9.01, and 9.02
Observed bladder cancer cases	7	3	11
Expected bladder cancer cases	10.7	10.1	9.5
Standardized Incidence Ratio[#] (95% Confidence Interval)	0.7 (0.3, 1.4)	0.3 (0.1, 0.9)	1.2 (0.6, 2.1)

[#]The Standardized Incidence Ratio (SIR) indicates whether the number of cancer cases observed in a particular area is less than, equal to, or greater than the number of cases expected for that area during a specific time period. An SIR less than 1.0 indicates that the number of cases is less than expected. An SIR greater than 1.0 indicates that the number of cases is greater than expected. The SIR is considered statistically significant when the 95% confidence interval does not include the number 1.0.

2. North Portland

A. North Portland, Census tract 23.03

During 1999–2013, observed cases of lung cancer in Census tract 23.03 in North Portland (Figures 3 and 4) ranged from 5 to 6 (Table 5).

Using Multnomah County lung cancer rates, the expected number of lung cancer cases was calculated for each 5-year period, ranging from 7.5 to 7.8 (Table 5).

Comparing the observed versus expected number of lung cancer cases during this time resulted in Standardized Incidence Ratios that were similar to 1.0 for each 5-year period (Table 5).

These results indicate that there was no substantial difference between the observed and expected number of lung cancer cases in Census tract 23.03 during 1999–2013. This conclusion is supported by the fact that the observed versus expected number of lung cancer cases was similar for all 5-year periods from 1999–2013, with SIRs similar to 1.0, and 95% confidence intervals for the calculated SIRs that included 1.0.

Table 5. Lung cancer, newly-diagnosed cases and Standardized Incidence Ratios (SIR),[#] Census tract 23.03, North Portland, OR, 1999–2013

	Years		
	1999–2003	2004–2008	2009–2013
	Census tract 23.03	Census tract 23.03	Census tract 23.03
Observed lung cancer cases	5	6	5
Expected lung cancer cases	7.6	7.8	7.5
Standardized Incidence Ratio[#] (95% Confidence Interval)	0.7 (0.2, 1.5)	0.8 (0.3, 1.7)	0.7 (0.2, 1.6)

[#]The Standardized Incidence Ratio (SIR) indicates whether the number of cancer cases observed in a particular area is less than, equal to, or greater than the number of cases expected for that area during a specific time period. An SIR less than 1.0 indicates that the number of cases is less than expected. An SIR greater than 1.0 indicates that the number of cases is greater than expected. The SIR is considered statistically significant when the 95% confidence interval does not include the number 1.0.

During 1999–2013, observed cases of bladder cancer in Census tract 23.03 in North Portland (Figures 3 and 4) ranged from 1 to 7 (Table 6).

Using Multnomah County bladder cancer rates, the expected number of bladder cancer cases was calculated for each 5-year period, ranging from 2.7 to 3.0 (Table 6).

Comparing the observed versus expected number of bladder cancer cases during this time resulted in Standardized Incidence Ratios (SIRs) that were similar to 1.0 for each 5-year period (Table 6). Of note, while the SIRs for 1999-2003 and 2004-2008 appear to be elevated, at 2.4 and 2.2 respectively, these SIRs are characterized as similar to 1.0 because the 95% confidence interval for each SIR includes 1.0.

These results indicate that there was no substantial difference between the observed and expected number of bladder cancer cases in Census tract 23.03 during 1999–2013. This conclusion is supported by the fact that the observed versus expected number of bladder cancer cases was similar for all 5-year periods from 1999–2013, with SIRs similar to 1.0, and 95% confidence intervals for the calculated SIRs that include 1.0.

Table 6. Bladder cancer, newly-diagnosed cases and Standardized Incidence Ratios (SIR),[#] Census tract 23.03, North Portland, OR, 1999–2013

	Years		
	1999–2003	2004–2008	2009–2013
	Census Tract 23.03	Census Tract 23.03	Census Tract 23.03
Observed bladder cancer cases	7	6	1
Expected bladder cancer cases	2.9	2.7	3.0
Standardized Incidence Ratio[#] (95% Confidence Interval)	2.4 (1.0, 5.0)	2.2 (0.8, 4.8)	0.3 (0.0, 1.8)

[#]The Standardized Incidence Ratio (SIR) indicates whether the number of cancer cases observed in a particular area is less than, equal to, or greater than the number of cases expected for that area during a specific time period. An SIR less than 1.0 indicates that the number of cases is less than expected. An SIR greater than 1.0 indicates that the number of cases is greater than expected. The SIR is considered statistically significant when the 95% confidence interval does not include the number 1.0.

B. North Portland, Census tracts 23.03 and 22.03

During 1999–2013, observed cases of lung cancer in Census tracts 23.03 and 22.03 in North Portland (Figures 3 and 4) ranged from 11 to 13 (Table 7).

Using Multnomah County lung cancer rates, the expected number of lung cancer cases was calculated for each 5-year period, ranging from 13.3 to 15.4 (Table 7).

Comparing the observed versus expected number of lung cancer cases during this time resulted in Standardized Incidence Ratios that were similar to 1.0 for each 5-year period (Table 7).

These results indicate that there was no substantial difference between the observed and expected number of lung cancer cases in Census tracts 23.03 and 22.03 during 1999–2013. This conclusion is supported by the fact that the observed versus expected number of lung cancer cases was similar for all 5-year periods from 1999–2013, with SIRs similar to 1.0, and 95% confidence intervals for the calculated SIRs that include 1.0.

Table 7. Lung cancer, newly-diagnosed cases and Standardized Incidence Ratios (SIR),[#] Census tracts 23.03 and 22.03, North Portland, OR, 1999–2013

	Years		
	1999–2003	2004–2008	2009–2013
	Census tracts 23.03 and 22.03	Census tracts 23.03 and 22.03	Census tracts 23.03 and 22.03
Observed lung cancer cases	12	13	11
Expected lung cancer cases	15.3	15.4	13.3
Standardized Incidence Ratio[#] (95% Confidence Interval)	0.8 (0.4, 1.4)	0.9 (0.5, 1.5)	0.8 (0.4, 1.5)

[#]The Standardized Incidence Ratio (SIR) indicates whether the number of cancer cases observed in a particular area is less than, equal to, or greater than the number of cases expected for that area during a specific time period. An SIR less than 1.0 indicates that the number of cases is less than expected. An SIR greater than 1.0 indicates that the number of cases is greater than expected. The SIR is considered statistically significant when the 95% confidence interval does not include the number 1.0.

During 1999–2013, observed cases of bladder cancer in Census tracts 23.03 and 22.03 in North Portland (Figures 3 and 4) ranged from 3 to 12 (Table 8).

Using Multnomah County bladder cancer rates, the expected number of bladder cancer cases was calculated for each 5-year period, ranging from 4.9 to 5.2 (Table 8).

Comparing the observed versus expected number of bladder cancer cases during this time resulted in Standardized Incidence Ratios that were similar to 1.0 for each 5-year period from 2004 through 2013 (Table 8). For 1999-2003, there was a small, statistically significant increase in the SIR.

These results indicate that bladder cancer rates were generally consistent with expected rates in Census tracts 23.03 and 22.03 during 1999–2013. This conclusion is supported by several findings. For the years 2004–2013, the observed versus expected number of

bladder cancer cases was similar for each 5-year period, with SIRs similar to 1.0, and 95% confidence intervals for the calculated SIRs that include 1.0.

For the years 1999–2003, there was a small, statistically significant increase in the SIR for bladder cancer. This SIR was based on a small number of observed and expected cases. The SIRs in subsequent years were consistently similar to 1.0, suggesting no sustained elevation in the observed number of bladder cancer cases in this region.

Table 8. Bladder cancer, newly-diagnosed cases and Standardized Incidence Ratios (SIR),[#] Census tracts 23.03 and 22.03, North Portland, OR, 1999–2013

	Years		
	1999–2003	2004–2008	2009–2013
	Census Tracts 23.03 and 22.03	Census Tracts 23.03 and 22.03	Census Tracts 23.03 and 22.03
Observed bladder cancer cases	12	7	3
Expected bladder cancer cases	5.2	4.9	4.9
Standardized Incidence Ratio[#] (95% Confidence Interval)	2.3 (1.2, 4.1)	1.4 (0.6, 3.0)	0.6 (0.1, 1.8)

[#]The Standardized Incidence Ratio (SIR) indicates whether the number of cancer cases observed in a particular area is less than, equal to, or greater than the number of cases expected for that area during a specific time period. An SIR less than 1.0 indicates that the number of cases is less than expected. An SIR greater than 1.0 indicates that the number of cases is greater than expected. The SIR is considered statistically significant when the 95% confidence interval does not include the number 1.0.

6. INTERPRETATION

Rates of lung and bladder cancer were generally consistent with expected rates during 1999–2013 in the areas of SE and North Portland where environmental levels of heavy metals were found to be elevated.

This conclusion is supported by several findings. For nearly every 5-year time period, the observed versus expected number of cancer cases in SE and North Portland was similar for both lung and bladder cancer, with SIRs similar to 1.0, and 95% confidence intervals for the calculated SIRs that included 1.0.

One exception was for bladder cancer in Census tracts 23.03 and 22.03 in North Portland for the years 1999–2003. During this time, there was a small, statistically significant increase in the SIR for bladder cancer. This SIR was based on a small number of observed and expected cases. The SIRs in subsequent years were consistently similar to 1.0, suggesting no sustained elevation in bladder cancer rates in this area.

Cancer rate analyses like these offer broad overview information about cancer rates in specific geographic areas, but cannot determine the reasons why cancer cases occur. When environmental information is not available, SIR calculations are sometimes used to identify areas where environmental assessment may be needed. In this instance, geographic areas for environmental assessment have been identified, as have contaminants of concern. These results therefore provide context for the on-going environmental assessment in the areas of concern.

7. CONCLUSIONS

Rates of lung and bladder cancer were generally consistent with expected rates in the identified Census tracts in SE and North Portland during 1999–2013.

For the years 1999-2003, there was a small, statistically significant increase in the rate of bladder cancer in one area of North Portland. This rate was based on a small number of bladder cancer cases. The bladder cancer rates in subsequent years in this area were not elevated.

8. FOLLOW UP

Continue to follow rates of lung and bladder cancer in the areas of interest in Portland, and in the state and Multnomah County over time.

Continue to collaborate with Oregon DEQ, MCHD, and other agencies on the on-going environmental assessment in the areas of concern in Portland.

9. REFERENCES

1. Agency for Toxic Substances and Disease Registry (ATSDR). 2012. *Toxicological Profile for Cadmium.* Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.
2. Agency for Toxic Substances and Disease Registry (ATSDR). 2007. *Toxicological Profile for Arsenic.* Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.
3. Oregon State Cancer Registry (OSCaR). 2016. Elevated Environmental Arsenic and Cadmium Levels, Cancer Incidence Evaluation, Southeast Portland, Multnomah County, 2009-2013. Portland, OR. Public Health Division, Oregon Health Authority. (See: http://public.health.oregon.gov/DiseasesConditions/ChronicDisease/Cancer/oscar/Documents/se-portland-cadmium-arsenic-report-2009-2013.pdf).
4. Oregon State Cancer Registry (OSCaR). 2016. Neighborhood Cancer Evaluation, Elevated Environmental Cadmium Levels, North Portland, Multnomah County, 2009-2013. Portland, OR. Public Health Division, Oregon Health Authority. (See: http://public.health.oregon.gov/DiseasesConditions/ChronicDisease/Cancer/oscar/Documents/n-portland-cadmium-arsenic-report-2009-2013.pdf).

10. APPENDIX

Exhibit 1.