DEQ
State of Oregon Department of Environmental Quality

Application for a

Solid Waste Beneficial Use Determination

DEQ USE ONLY – BUSINESS OFFICE
Date Received: NOV 28 2018
Amount Received: 5000.00
Check No.: 0287142
Deposit No.:
Forward confirmation of fee payment for:
Eastern Region to DEQ, The Dalles
Northwestern Region to DEQ-NWR, Portland
Western Region to DEQ, Salem

A. REFERENCE INFORMATION *(Please type or print clearly.)*

Oregon Department of Transportation
Legal name of applicant

Business name of applicant if different

4040 Fairview Industrial Drive SE
Mailing address

Salem
City

OR
State

97302
Zip

503-986-3508
Phone

503-679-2866
Mobile

susan.haupt@odot.state.or.us
E-mail

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Oregon Department of Transportation Attn: Susan Haupt
Generator of solid waste (may be same as applicant)

4040 Fairview Industrial Drive SE
Mailing address

Salem
City

OR
State

97302
Zip

503-986-3508
Phone

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Fax

B. TYPE OF BENEFICIAL USE DETERMINATION REQUESTED Beneficial Use Determination applications are categorized based on the type of information and potential amount of work required by DEQ staff to review application materials and render a decision. A tiered review and fee system has been established in rule. The tiers are:

Tier 1 For a beneficial use of a solid waste that does not contain hazardous substances significantly exceeding the concentration in a comparable raw material or commercial product and that will be used in a manufactured product;

Tier 2 For a beneficial use of a solid waste that contains hazardous substances significantly exceeding the concentration in a comparable raw material or commercial product, or involves application on the land;

Tier 3 For a beneficial use of a solid waste that requires research, such as a literature review or risk assessment, or for a demonstration project to demonstrate compliance with this rule.

I am applying for a ☐ Tier 1 ☐ Tier 2 ☒ Tier 3 determination.

C. DOES THIS PROPOSED BENEFICIAL USE INVOLVE LAND APPLICATION OF ANY MATERIAL?
☒ Yes ☐ No

D. SIGNATURE I hereby certify by my signature below that the information contained in this application, and the documents I have attached, are true and correct to the best of my knowledge and belief.

Signature of legally authorized representative | Susan Haupt | Print name | Chief Env. Officer | Title | 10/9/18 | Date

E. REQUIRED ATTACHMENTS TO THIS APPLICATION *(For an application to be complete, it must provide the required information for each listed item of the tier which is being applied for.)*

Tier 1

- [X] A description of the material, manner of generation, and estimated quantity to be used each year;
- [X] A description of the proposed use;
- [X] A comparison of the chemical and physical characteristics of the material proposed for use with the material it will replace;
- [X] A demonstration of compliance with the performance criteria in OAR 340-093-0280 based on knowledge of the process that generated the material, properties of the finished product, or testing; and
- [X] Any other information that DEQ may require to evaluate the proposal.

Tier 2

- [X] The information required for a Tier 1 application;
- [X] Sampling and analysis that provides chemical, physical, and biological characterization of the material and that identifies potential contaminants in the material or the end product, as applicable;
- [X] A risk screening comparing the concentration of hazardous substances in the material to existing, DEQ approved, risk-based screening level values, and demonstrating compliance with acceptable risk levels;
- [X] Location or type of land use where the material will be applied, consistent with the risk scenarios used to evaluate risk;
- [X] Contact information of property owner(s) if this is a site-specific land application proposal, including name, address, phone number, e-mail, site address and site coordinates (latitude and longitude); and
- [X] A description of how the material will be managed to minimize potential adverse impacts to public health, safety, welfare, or the environment.

Tier 3

- [X] The information required for a Tier 1 & 2 application;
- [X] A discussion of the justification for the proposal;
- [X] An estimate of the expected length of time that would be required to complete the project, if it is a demonstration; and
- [X] If it is a demonstration project, the methods proposed to ensure safe and proper management of the material.

F. PERFORMANCE CRITERIA *(For all tiers - An application for a beneficial use determination must demonstrate satisfactory compliance with the following performance criteria.)*

The use is productive, including:

- There is an identified or reasonably likely use for the material that is not speculative;
- The use is a valuable part of a manufacturing process, an effective substitute for a valuable raw material or commercial product, or otherwise authorized by DEQ, and does not constitute disposal; and
- The use is in accordance with applicable engineering standards, commercial standards, and agricultural or horticultural practices.

The use will not create an adverse impact to public health, safety, welfare, or the environment, including:

- The material is not a hazardous waste under ORS 466.005;
- Until the time the material is used in accordance with a beneficial use determination, the material will be managed, including any storage, transportation, or processing, to prevent releases to the environment or nuisance conditions;
- Hazardous substances in the material do not significantly exceed the concentration in a comparable raw material or commercial product, or do not exceed naturally occurring background concentrations, or do not exceed acceptable risk levels, including evaluation of persistence and potential bioaccumulation, when the material is managed according to a beneficial use determination.

The use will not result in the increase of a hazardous substance in a sensitive environment.

The use will not create objectionable odors, dust, unsightliness, fire, or other nuisance conditions.

The use will comply with all applicable federal, state, and local regulations.

G. FEES *(Must accompany the application for it to be considered complete)*

☐	Tier 1 beneficial use determination	$1,000
☐	Tier 2 beneficial use determination	$2,000
☒	Tier 3 beneficial use determination	$5,000

Make checks out to: **Oregon DEQ**

Total fees included: _____

H. APPLICATION PROCEDURE

Step 1
Contact a DEQ staff person for assistance with the preparation of the application. DEQ staff will help with: 1) Determination of the eligibility for a beneficial use determination of a particular waste or process; and, 2) If eligible, establish the tier of beneficial use determination review required and associated fee to submit with the application.

Step 2
Mail the original signed application, all attachments, including the fee payment plus one extra copy to the appropriate regional office (see listing below.) Note that DEQ review work will not begin until a complete application packet is received. Incomplete applications may be returned. DEQ recommends the applicant keep a full copy of all application materials to guard against possible loss in transit.

Step 3
DEQ will contact the applicant, acknowledging receipt of the application, and will identify the staff person assigned to carryout the review. This staff person will contact the applicant if any additional information is needed.

Region	Counties Served	Address & Phone
Eastern Region	Baker, Crook, Deschutes, Gilliam, Grant, Harney, Hood River, Jefferson, Klamath, Lake, Malheur, Morrow, Sherman, Umatilla, Union, Wallowa, Wasco, and Wheeler	Eastern Region Department of Environmental Quality 400 E Scenic Drive, Ste 2.307 The Dalles, OR 97058 (541) 298-7255 ext. 221
Northwest Region	Clatsop, Clackamas, Columbia, Multnomah, Tillamook, and Washington	Northwest Region DEQ Solid Waste Programs 700 NE Multnomah Street, Suite 600 Portland, OR 97232 (503) 229-5353
Western Region	Benton, Coos, Curry, Douglas, Jackson, Josephine, Lane, Lincoln, Linn, Marion, Polk, and Yamhill	Western Region DEQ Solid Waste Programs 750 Front St. NE Suite 120 Salem, OR 97301 (503) 378-5047

Cascadia Associates, LLC

Attachments for Beneficial Use Determination Application Oregon Statewide Highway Shoulder Soil

October 2018

Cascadia Associates, LLC

Contents

Table

Figures

1.0 INTRODUCTION

This document supports the application for an Oregon Department of Environmental Quality (DEQ) Solid Waste Beneficial Use Determination (BUD) for highway shoulder soil as defined below in Section 2.0. The application was prepared on behalf of the Oregon Department of Transportation (ODOT) by Cascadia Associates, LLC (Cascadia). The following information is provided in Section 3 of this document, to satisfy the requirements of a Tier 3 BUD Application:

- Tier 1 BUD Application Requirements (Section 3.1);
- Tier 2 BUD Application Requirements (Section 3.2); and
- Tier 3 BUD Application Requirements (Section 3.3).

2.0 BACKGROUND

For the purpose of this BUD, the term "highway shoulder soil" consists of soil outside of the current highway pavement and within highway rights of way generated during highway maintenance or construction activities. This BUD application does not encompass highway shoulder soil exhibiting indications of contamination (e.g., staining, odor) or soil affected by known potential contaminant source areas (e.g., industrial facilities or service stations), and such soil is subject to additional testing.

As discussed below, highway shoulder soil may be affected by traffic-related hazardous constituents, such as lead or benzo(a)pyrene. The concentrations of hazardous substances in highway shoulder soil in Oregon have been evaluated based on data collected from 60+ ODOT projects and two statewide sampling programs conducted on behalf of ODOT. The results of the evaluation and recommendations for soil management were presented in the *2016 Statewide Highway Shoulder Soil Evaluation Results Report* (Results Report; Cascadia, 2017). The following subsections provide a summary of the highway shoulder soil evaluations conducted to date by ODOT and the conclusions and recommendations that have been developed based on that work.

2.1 HAZARDOUS CONSTITUENTS IN HIGHWAY SHOULDER SOIL

Elevated concentrations of traffic-related hazardous constituents are widespread in highway shoulder soil in many parts of the world, including Oregon. In most cases, the impacted soil poses no threat to human health and the environment when it is in-place (i.e., on the shoulders or near highways). However, during construction projects, it is often necessary to excavate and export highway shoulder soil. If exported soil is disposed of or reused in inappropriate locations, constituents in soil could potentially pose a risk to human and ecological health. Therefore, a management plan for highway shoulder soil is necessary.

2.2 CURRENT MANAGEMENT OF OREGON HIGHWAY SHOULDER SOIL

Currently, highway shoulder soil under ODOT's jurisdiction is managed under ODOT Directive GE 14-01(D) (ODOT, 2014). As detailed in the directive, soil excavated from the surface to 1.5 feet below the ground surface (bgs) within the ODOT right-of-way must be characterized prior to export

from the construction area. Many local agencies in Oregon (e.g., counties and cities) manage highway shoulder soil consistent with ODOT Directive GE 14-01(D). Soil that meets DEQ clean fill[1] criteria can be managed unrestricted (e.g., used as fill for other construction projects). Excavated soil that does not meet clean fill criteria requires special management as solid waste (e.g., reuse through a solid waste letter of authorization from DEQ). In practice, soil that does not meet clean fill criteria is often disposed of at licensed landfills. The application of ODOT Directive GE 14-01(D) leads to increased characterization and construction costs, reduced landfill capacity, and reductions in project sustainability metrics.

DEQ's Clean Fill Internal Management Directive (IMD) notes that if statistical analyses of soil data do not show that "the material is substantially like clean fill" interested parties should "explore other disposal options such as site-specific or material-specific disposal determinations (solid waste letter authorization, permit exemption, mine reclamation material, restricted beneficial use as fill, or restricted uses such as use as fill at Cleanup sites with deed restrictions, etc.)" (DEQ, 2014). This application for a BUD has been prepared consistent with that recommendation.

2.3 2015 HIGHWAY SHOULDER SOIL EVALUATION

In 2015, as an initial step in understanding highway shoulder soil quality in Oregon, soil chemical data from 64 ODOT highway construction projects were evaluated. The goal of the evaluation was to develop a general understanding of the types, magnitude, and extent of constituents in highway shoulder soil and to identify data gaps that could potentially be resolved through a supplemental sampling effort. Data gaps that were identified included: (1) the influence of sampling variables (e.g., depth of sample, physiographic province, distance from edge of pavement, and average annual daily traffic [AADT]) on the detected concentrations of constituents of interest (COIs); and (2) which traffic related COIs were likely to be present in shoulder soil at concentrations greater than clean fill criteria. To address these data gaps and to expand the soil dataset, a highway shoulder soil sampling effort was conducted in May 2015.

Following the 2015 evaluation and as described in the *ODOT State-Wide Highway Shoulder Soil Data Analysis* (Apex, 2015), lead and benzo(a)pyrene were determined to be the only two COIs that were both traffic-related and regularly exceeded clean fill criteria. Lead and benzo(a)pyrene have been identified as traffic-related constituents in a number of other studies in the United States and other countries.

2.4 2016 SHOULDER SOIL EVALUATION

The scope of a subsequent 2016 highway shoulder soil evaluation was developed in coordination with ODOT and DEQ following statistical evaluation of the pre-2016 ODOT lead and benzo(a)pyrene

[1] The term "clean fill" is used herein to describe soil that meets DEQ clean fill criteria outlined in the DEQ *Clean Fill Determinations – Internal Management Directive* (DEQ, 2014).

dataset. The methods for the 2016 soil evaluation were detailed in the *Sampling and Analysis Plan – Statewide Highway Shoulder Soil Evaluation* (Cascadia, 2016).

To develop the 2016 sampling plan, the ODOT shoulder soil lead and benzo(a)pyrene dataset (described in Section 2.3) was evaluated with random forest and classification tree models, using the R programming language (R Core Team, 2015). The goal of this evaluation was to determine how the sampling variable (e.g., sampling depth, distance from pavement) or combination of variables influence the dataset, and which combination of these variables are most likely to correspond with lead and benzo(a)pyrene concentrations less than the corresponding clean fill criteria.

COI concentrations were usually well below the clean fill criteria (based on the 90% upper confidence limit [UCL] of the data) in the Basin and Range, Blue Mountains, and Deschutes Columbia physiographic provinces and therefore, these areas were targeted for the collection and analysis of additional soil data in 2016.

Based on the statistical characteristics (mean, variance, and distributional form) displayed by the previously collected data, a sample size of 25 for each combination of depth and distance from the edge of pavement was determined to be sufficient to characterize the COI concentrations in highway shoulder at a range of depths and distances from the edge of pavement.

Incremental sampling methodology (ISM) processing techniques (i.e., grinding and subsampling the grab sample volume) were incorporated into the 2016 sampling program. Because composite ISM samples would be difficult to evaluate statistically alongside the existing discrete soil sampling data, ISM sampling (e.g., collection and analysis of 30-point composite samples), was not conducted, only ISM laboratory processing techniques were used.

2.5 CONCLUSIONS

Summaries of the highway shoulder soil datasets (sample size, mean concentrations, 90% UCL, maximum, minimum) for physiographic provinces in Oregon are presented in Table 1. Sampling locations are shown on Figure 1, and box plots for lead and benzo(a)pyrene data are shown on Figures 2 and 3, respectively[2]. Conclusions regarding how COI concentrations in Oregon highway shoulder soil data compare to clean fill criteria and other risk-based screening criteria were detailed in the Results Report, and are summarized below.

- Statewide, concentrations of lead and benzo(a)pyrene in highway shoulder soil very rarely exceed occupational, construction worker, or excavation worker risk-based concentrations (RBCs; DEQ, 2015) and the vast majority of highway shoulder soil would be appropriate for use for non-residential purposes. Less than 1% of lead results and less than 2% of

[2] Box plots present only data for soil samples for which adequate information regarding depth and distance from pavement are available.

benzo(a)pyrene concentrations exceed the occupational, construction worker, or excavation worker RBCs.

- Statistically significant and balanced datasets for lead and benzo(a)pyrene concentrations in highway shoulder soil have been developed for the Basin and Range, Blue Mountains, and Deschutes Columbia physiographic provinces.
- Region-specific management of highway shoulder soil is appropriate, as concentration trends relative to clean fill criteria and RBCs vary by physiographic province and the quality of datasets for each physiographic province is variable (i.e., datasets for some provinces are unbalanced and/or limited in size).
- Highway shoulder soil in the Basin and Range and Blue Mountains physiographic provinces typically contains lead and benzo(a)pyrene at concentrations less than clean fill criteria.
- The Owyhee Uplands physiographic province abuts the Basin and Range and Blue Mountains physiographic provinces. Based on the similar AADT categories and clean fill criterion for lead (30 mg/kg) in the Owyhee Uplands province, relative to the Basin and Range and Blue Mountain provinces, it is likely that the concentrations of lead and benzo(a)pyrene meet the clean fill criteria.
- In the Deschutes Columbia physiographic province, highway shoulder soil typically contains lead and benzo(a)pyrene concentrations that are less than clean fill criteria, with the exception of surface and subsurface soil (surface to 18 inches bgs) within 15 feet of the pavement and shallow soil (surface to 6 inches bgs) within 30 feet of the pavement. All detected COI concentrations in Deschutes Columbia physiographic province highway shoulder soil are below occupational RBCs.
- While the highway shoulder soil datasets are unbalanced for the Portland Basin and South Willamette Valley physiographic provinces, COI concentrations in highway shoulder soil in these provinces generally exceed clean fill criteria; however, COI concentrations detected in South Willamette Valley soil have consistently been less than occupational and construction worker RBCs. Detected COI concentrations in Portland Basin soil are nearly always lower than construction worker RBCs.
- The soil datasets for the Cascade Range, Coast Range, High Lava Plains, Klamath Mountains, and Owyhee Uplands physiographic provinces are limited in size and insufficient to draw conclusions regarding COI concentrations in shoulder soil. While the High Lava Plains physiographic province dataset is limited in size, the mean concentrations of lead and benzo(a)pyrene in the dataset are below clean fill criteria. Mean concentrations of lead and benzo(a)pyrene in the limited Coast Range and Cascade Range datasets are less than occupational RBCs. Little to no shoulder soil data are available for the Klamath Mountains and Owyhee Uplands physiographic provinces.

Overall, these conclusions showed that COI concentrations in highway shoulder soil in some parts of the state (e.g., the Basin and Range and Blue Mountains physiographic provinces) consistently meet clean fill criteria; COI concentrations in highway shoulder soil in other parts of the state (High Lava Plains and Owyhee Uplands) are likely to consistently meet clean fill criteria; and statewide (except for the Portland Basin physiographic province), COI concentrations in highway shoulder soil are, with very few exceptions, less than RBCs for occupational, construction, and excavation worker soil exposure scenarios. These conclusions were used to develop the proposed beneficial uses for highway shoulder soil in Oregon.

3.0 APPLICATION INFORMATION

The following subsections contain the information required for a Tier 3 BUD application. Sections 3.1, 3.2, and 3.3 present the information required for Tier 1, Tier 2, and Tier 3 BUD applications, respectively.

3.1 TIER 1 APPLICATION REQUIREMENTS

Description of the Material, Manner of Generation, and Estimated Quantity to be Used Each Year

The material, highway shoulder soil, is generated during road construction and maintenance conducted by ODOT and others (e.g., local agencies). The material consists of soil, organic matter (grass, roots, etc.), and rock. Based on estimates from recent years, ODOT generates approximately 100,000 to 200,000 cubic yards of highway shoulder soil annually. The quantity of highway shoulder soil generated annually by local agencies is unknown.

Description of the Proposed Use

As noted in Section 2, the concentrations of COI in highway shoulder soil vary based on physiographic province, depth, and distance from pavement; therefore, proposed reuses vary based on the origin of the soil (i.e., physiographic province), and the depth and distance of the soil from the edge of pavement. Table 2 proposes beneficial use categories for highway shoulder soil that are expected to be protective of human health and the environment based on the detailed evaluation summarized in Section 2.5. Table 3 lists examples of proposed beneficial uses within each category.

As summarized in Table 2:

- Unrestricted reuse of highway shoulder soil is proposed only for physiographic provinces in which extensive and balanced datasets demonstrate that highway shoulder soil meets clean fill criteria.
- Reuse of highway shoulder soil in areas not subject to current or future residential uses is proposed for physiographic provinces in which highway shoulder soil datasets are limited and/or unbalanced, except for the Portland Basin. The reuse of soil from these physiographic provinces is expected to be protective for non-residential uses because the statewide highway shoulder soil dataset demonstrates that, overall, hazardous substance concentrations in highway shoulder soil are less than non-residential RBCs.

- Highway shoulder soil in the Portland Basin occasionally exceeds residential and occupational RBCs; therefore, reuse of soil for mine/quarry fill is proposed for the Portland Basin. In the event that project-specific sample data from the Portland Basin (or other physiographic province) indicate that concentrations of COI in shoulder soil are less than the occupational RBCs, the shoulder soil from that project will qualify for reuse as non-residential fill under this BUD (see footnote in Table 2).

These data and conclusions are further discussed in Section 3.2.

Highway shoulder soil may also be managed in accordance with the DEQ Clean Fill IMD and outside of this BUD, if project-specific data demonstrates that constituent concentrations in soil are below clean fill criteria.

Comparison of the Chemical and Physical Characteristics of the Material Proposed for Use with the Material it will Replace

The physical characteristics of the highway shoulder soil will vary depending on the origin of the soil. Prior to use, the physical characteristics will be evaluated to confirm that the soil is appropriate for the desired beneficial use. For example, soil that contains insignificant quantities of organic material may be used as structural fill. Other soil may be used for top soil, visual barriers, or other purposes.

The chemical characteristics of highway shoulder soil and the proposed reuse alternatives are summarized in Section 2.5 and described in more detail in Section 3.2. In summary, reuse alternatives were proposed that ensure chemical concentrations in highway shoulder soil will not exceed applicable RBCs.

A Demonstration of the Compliance with the Performance Criteria in OAR 340-093-0280 Based on Knowledge of the Process that Generated the Material, Properties of the Finished Product, or Testing

If managed as proposed earlier in this section, highway shoulder soil meets the performance criteria in OAR 340-093-0280. Compliance with OAR 340-093-0280(C), in particular, has been demonstrated through extensive testing and analysis of highway shoulder soil, as documented in the *2016 Statewide Highway Shoulder Soil Evaluation – Results Report* (Cascadia, 2017).

While highway shoulder soil deeper than 1.5 feet bgs was not included in the 2016 highway shoulder soil evaluation, highway construction or maintenance projects may include generation of soil from deeper depths. Because the sources of impacts to highway shoulder soil originate at the ground surface (e.g., surface runoff, vehicle splash), deeper soil is anticipated to contain lower concentrations of hazardous constituents and therefore, existing data provide a conservative interpretation of highway shoulder soil quality.

Overall, testing has shown that highway shoulder soil meets clean fill criteria or contains COI concentrations that are less than occupational screening levels, except for soil in the Portland Basin. In the Portland Basin, COI concentrations in highway shoulder soil occasionally exceed occupational screening levels but are consistently less than construction and excavation worker

screening levels. The reuse of highway shoulder soil in accordance with the categories proposed in Table 2 will be protective of human and ecological health.

3.2 TIER 2 APPLICATION REQUIREMENTS

Sampling and Analysis that Provides Chemical, Physical, and Biological Characterization of the Material and that Identifies Potential Contaminants in the Material or the End Product as Applicable

A Risk Screening Comparing the Concentration of Hazardous Substances in the Material to Existing, DEQ Approved, Risk-Based Screening Level Values, and Demonstrating Compliance with Acceptable Risk Levels

Available highway shoulder soil data has been evaluated extensively, as reported in the Results Report (Cascadia, 2017). As noted previously, traffic related hazardous constituents that are detected above clean fill criteria in more than 5% of highway shoulder soil samples are lead and benzo(a)pyrene.

For highway shoulder soil across the state, concentrations of lead and benzo(a)pyrene very rarely exceed occupational, construction worker, or excavation worker screening criteria and the vast majority of soil would be appropriate for use as non-residential fill. The following sections provide an evaluation of the available chemical data for each of the physiographic provinces in Oregon and a comparison of the data to clean fill and other risk-based screening criteria.

Basin and Range

The Basin and Range dataset consists of 241 samples, 232 of which can be categorized into predictor variable categories. Of the 232 samples, which are generally evenly distributed across depth and distance from pavement categories, concentrations of lead and benzo(a)pyrene are consistently below clean fill criteria. Of the Basin and Range province samples collected and analyzed for lead, 94 percent contained lead concentrations below the clean fill criterion. Of the samples collected in the Basin and Range province and analyzed for benzo(a)pyrene, 97 percent contained concentrations below the clean fill criterion, as shown below.

The mean, median, and upper quartile concentrations of lead and benzo(a)pyrene are well below the clean fill criteria (Table 1). Uncertainty in the mean estimates is reflected in the 90% UCLs shown in Table 1. These values are also generally below the clean fill criteria, providing additional assurance that the true mean is below the screening level. These data indicate that highway shoulder soil from the Basin and Range physiographic province does not require special management and could be appropriately reused as clean fill.

Blue Mountains

The 230 samples that have been collected in the Blue Mountains physiographic province are generally evenly distributed across depth and distance from pavement categories. An additional 13 samples were collected which cannot be categorized by depth and distance from pavement. Concentrations of lead and benzo(a)pyrene in the 230 Blue Mountains highway shoulder soil are consistently below clean fill criteria. Of the 230 samples collected and analyzed for lead, 87 percent

of the samples contained lead concentrations below the clean fill criterion. Of the 201 samples analyzed for benzo(a)pyrene, 97 percent of samples contained concentrations below the clean fill criterion. The mean, median, and upper quartile concentrations of lead and benzo(a)pyrene are consistently below the clean fill criteria, except for the upper quartile concentrations of lead in the 0 to 15-foot distance interval. The upper quartile lead concentrations are similar to the clean fill criterion concentration. Uncertainty in the mean estimates is reflected in the 90% UCLs. These upper bound estimates for the mean are also generally below the clean fill criteria, with a few exceptions. Similar to the Basin and Range physiographic province, sampling data indicate that highway shoulder soil from the Blue Mountains could be appropriately reused as clean fill without special management

Owyhee Uplands

No lead or benzo(a)pyrene data are available for highway shoulder soil in the Owyhee Uplands physiographic province.

As noted previously, the Owyhee Uplands physiographic province abuts the Basin and Range and Blue Mountains physiographic provinces, in which lead and benzo(a)pyrene concentrations in highway shoulder soil are less than clean fill criteria. Based on the similar AADT categories and clean fill criterion for lead (30 mg/kg) in the Owyhee Uplands province, relative to the Basin and Range and Blue Mountain provinces, concentrations of lead and benzo(a)pyrene are expected to meet the clean fill criteria.

Deschutes Columbia

The 236 samples collected in the Deschutes Columbia physiographic province are generally evenly distributed across depth and distance from pavement categories. An additional 7 samples were collected which cannot be categorized by depth and distance from pavement. Concentrations of lead and benzo(a)pyrene in Deschutes Columbia highway shoulder soil are consistently below clean fill criteria, with the exception of the samples collected within 15 feet of the pavement (all depths) and, to a lesser extent, the samples collected from the surface to 0.5 feet bgs between 15 and 30 feet from the pavement surface. All lead and benzo(a)pyrene concentrations are below occupational RBCs.

Within 15 feet of the pavement surface, 60 percent of samples exceeded the clean fill criterion for lead and 26 percent exceeded the benzo(a)pyrene clean fill criterion. In the shallow depth interval between 15 and 30 feet from the pavement surface, 38 percent and 19 percent of samples exceeded the lead and benzo(a)pyrene clean fill criteria, respectively. In other distance and depth intervals, 94 percent and 93 percent of samples were below clean fill criteria for lead and benzo(a)pyrene, respectively.

The mean and median concentrations of lead in soil samples collected within 15 feet of the pavement (all depths) are equal to or exceed the clean fill criterion. The mean and median lead concentrations in shallow soil (0 to 0.5-foot depth) between 15 and 30 feet from the pavement surface also exceed the clean fill criterion. When uncertainty in the mean estimates, as reflected by

the 90% UCLs (Table 1) is considered, no additional groups of samples (i.e., depth and distance from pavement categories) are expected to have mean concentrations above the clean fill criterion for lead.

Mean concentrations of benzo(a)pyrene were generally more favorable relative to the clean fill criterion, with only the mean concentration in the 0.5 to 1-foot depth interval within 15 feet of the pavement surface exceeding the clean fill criterion. For benzo(a)pyrene, the 90% UCL indicates that samples from the surface to 0.5-foot depth interval within 30 feet of the pavement, and from the surface to 0.5-foot and 1 to 1.5-foot depth intervals within 15 feet of the pavement may have mean concentrations above the clean fill criterion.

Data indicate that highway shoulder soil in the Deschutes Columbia physiographic province consistently meets the standards for non-residential reuse. Additionally, highway shoulder soil greater than 30 feet from the pavement or soil deeper than 6 inches bgs between 15 and 30 feet from the pavement could be managed unrestricted as clean fill.

Cascade Range

While 51 samples have been collected in the Cascade Range, only four samples of the samples can be categorized based on depth and distance from pavement. Of the 51 lead results, the 90% UCL lead concentration was below the clean fill criterion and none of the detected concentrations exceeded the residential RBC of 400 mg/kg for lead.

Of the 42 samples from the Cascade Range that were analyzed for benzo(a)pyrene, benzo(a)pyrene was detected in 37 samples. Details for these samples including depth and distance from pavement are unknown. The mean and upper quartile of benzo(a)pyrene concentrations were well below the DEQ occupational RBC. Five samples out of 42 contained benzo(a)pyrene at a concentration above the occupational RBC (0.290 mg/kg) and one of the samples contained benzo(a)pyrene at a concentration that was also above the construction RBC (2.4 mg/kg). Because sampling details are unknown and the mean and upper quartile of benzo(a)pyrene concentrations in the Cascade Range are well below the occupational RBC, these five samples are considered anomalous. Overall, data from the Cascade Range indicate that highway shoulder soil from the Cascade Range meets standards for non-residential reuse.

Coast Range

The Coast Range dataset contains lead and benzo(a)pyrene data for 54 samples, 40 of which can be categorized into predictor variable categories. As shown on Figures 2 and 3, all of the 40 lead and benzo(a)pyrene samples in this province with depth and distance information were collected within 15 feet from the pavement. The lead concentrations (mean, median, and 90% UCL) are typically above the clean fill criterion, whereas the benzo(a)pyrene concentrations are typically below the clean fill criterion. Additional sampling and analysis would be necessary to evaluate lead and benzo(a)pyrene concentrations in soil more than 15 feet from the pavement.

While the lead concentrations in Coast Range soil within 15 feet of the pavement commonly exceed the clean fill criterion, the median, mean, and 90% UCL lead concentrations are below the

residential RBC for lead (400 mg/kg). Only one of 54 samples contains a lead concentration above the residential RBC, but well below the occupational RBC. These data indicate that non-residential reuse of Coast Range highway shoulder soil would be appropriate and protective of human health.

High Lava Plains

The High Lava Plains physiographic province dataset contains 36 lead and benzo(a)pyrene samples, 31 of which can be categorized into predictor variable (i.e., depth, distance, and AADT) categories. Of the 31 samples, the majority (19 samples) were collected within 15 feet of the pavement.

Benzo(a)pyrene was detected in only one of 36 samples; that concentration exceeded the clean fill criterion. The mean lead concentrations are below the clean fill criterion, but the 90% UCL lead concentration in soil within 15-feet of pavement is above the clean fill criterion. All detected lead and benzo(a)pyrene concentrations are below occupational RBCs.

Therefore, these data as well as statewide data indicate that highway shoulder soil from the High Lava Plains physiographic province can appropriately be re-used as non-residential fill.

Klamath Mountains

Little data have been collected in the Klamath Mountains physiographic province. The Klamath Mountains province dataset consist of eleven soil samples. Sampling detail information (e.g., depth) are not available for these samples. Of the 11 samples, lead was not detected above the residential RBC, the mean and upper quartile lead concentrations are lower than the clean fill criterion, and the 90% UCL for lead is similar to clean fill criterion. Benzo(a)pyrene was not detected above the laboratory method reporting limit in any of the samples. These data, although limited, indicate highway shoulder soil from the Klamath Mountains could be appropriately used as non-residential fill.

Portland Basin

The Portland Basin dataset includes 306 lead soil samples and 145 benzo(a)pyrene soil samples (Table 1). Of the 189 lead samples and 107 benzo(a)pyrene samples that could be categorized by depth and distance, the vast majority (172 lead samples and 93 benzo(a)pyrene samples) were collected within 15 feet of the pavement.

Mean lead and benzo(a)pyrene concentrations are generally above the clean fill criteria in the Portland Basin. The 90% UCL concentrations benzo(a)pyrene in soil in all depth and distance categories exceed residential RBCs and the majority exceed occupational RBCs, but all are less than the construction worker and excavation worker RBCs. The 90% UCL concentrations for lead in soil in all depth and distance categories are below residential and occupational RBCs. Therefore, soil from the Portland Basin soil could be safely reused at facilities not subject to recreational and occupational exposure scenarios (e.g., mine or quarry).

Because much of the highway shoulder soil in the Portland Basin contains COI concentrations less than occupational RBCs, project-specific data may be used to demonstrate that soil generated during that project can be appropriately managed as non-residential fill.

South Willamette Valley

The South Willamette Valley dataset includes 136 lead soil samples and 116 benzo(a)pyrene soil samples (Table 1). Of the 105 lead samples and 93 benzo(a)pyrene samples that could be categorized by depth and distance, the vast majority (65 lead samples and 62 benzo(a)pyrene samples) were collected within 15 feet of the pavement.

Lead concentrations typically exceed the clean fill criterion in the samples collected within 15 feet of the pavement. The mean concentrations of lead in samples collected deeper than 0.5 feet and greater than 15 feet from the pavement are less than clean fill criterion. Benzo(a)pyrene was not detected above the laboratory detection limit in most samples collected in the South Willamette Valley province. The limited number of benzo(a)pyrene concentrations that exceed the clean fill criterion were detected in the 0 to 0.5-foot depth interval, within 15 feet of the pavement.

Similar to the Portland Basin, the dataset for the Willamette Valley, especially within 15 feet of the pavement, is large. While the lead and benzo(a)pyrene concentrations in Willamette Valley soil within 15 feet of the pavement commonly exceed the clean fill criteria, it is important to note that the mean, 90% UCL, and maximum lead and benzo(a)pyrene concentrations in all depth categories are below the RBCs for occupational and construction worker exposure. Therefore, soil from the South Willamette Valley could be used as non-residential fill without an increase in risk to human receptors.

Location or Type of Land Use where the Material Will be Applied, Consistent with the Risk Scenarios Used to Evaluate Risk

The precise location of material application is unknown as highway shoulder soil will be generated at multiple locations statewide. Use of soil that has been characterized as clean fill will be unrestricted, subject to the limitations of Oregon Clean Fill IMD (DEQ, 2014). Highway shoulder soil from the following physiographic provinces is considered clean fill: Basin and Range, Blue Mountains, portions of Deschutes Columbia, and Owyhee Uplands (based on the results of the Basin and Range and Blue Mountains). Soil that has been characterized as appropriate for non-residential uses will be applied only at locations that are currently used for non-residential purposes and are expected to remain in non-residential use in the future. Soil that has been characterized as appropriate for non-residential and non-occupational use (i.e., the Portland Basin highway shoulder soil) will only be applied at locations that are currently or reasonably likely to be subject to residential or occupational exposure, but may be subject to construction worker and excavation worker exposure (e.g., mines and quarries).

Contact Information of Property Owner(s) if this Site-Specific Land Application Proposal, including Name, Address, phone number, e-mail, site address, and site coordinates

This is not a site-specific land application proposal.

A Description of How the Material will be Managed to Minimize Potential Adverse Impacts to Public Health, Safety, Welfare, or the Environment

The owner of excavated highway shoulder soil will be required to reuse the soil in a manner consistent with the reuse scenarios listed in Tables 2 and 3. Reused soil will be managed so that it will not create an adverse impact on groundwater, surface water, or public health or safety. Highway shoulder soil, regardless of which beneficial use is determined to be the most appropriate, will not be placed in wetlands or within 300 feet of rivers and streams, per ODOT *2018 Standard Specification for Construction* 00330.41(a).

If excavated highway shoulder soil is to be stockpiled for future use by ODOT, stockpiles will be maintained on ODOT-controlled property. Stockpiles will be managed in accordance with the procedures and best management practices outlined in the ODOT Routine Road Maintenance Program *2014 Water Quality and Habitat Guide for Best Management Practices,* and *The Environmental Management System* (EMS) Manual (2013, revised every 5 years).

If excavated highway shoulder soil is to be transported via truck, transport will be conducted in accordance with ODOT Motor Carrier Division Rules and Regulations.

3.3 TIER 3 APPLICATION REQUIREMENTS

A Discussion of the Justification for the Proposal

Thousands of cubic yards of highway shoulder soil are generated annually in Oregon. Commonly, this soil contains concentrations of lead and benzo(a)pyrene that are less than occupational screening levels but exceed clean fill criteria. Due to an absence of disposal alternatives, soil that exceeds clean fill criteria is commonly disposed of at licensed landfills. This practice is extremely costly, reduces project sustainability metrics, accelerates the filling of landfills, and often provides little benefit to human health and the environment.

The Oregon Clean Fill IMD (DEQ, 2014) notes that if statistical analyses of soil data do not show that "the material is substantially like clean fill" interested parties should "explore other disposal options such as site-specific or material-specific disposal determinations (solid waste letter authorization, permit exemption, mine reclamation material, restricted beneficial use as fill, or restricted uses such as use as fill at Cleanup sites with deed restrictions, etc.)." This application has been prepared consistent with that guidance, to propose other reuse options for highway shoulder soil.

An Estimate of the Expected Length of Time that Would be Required to Complete the Project, if it is a Demonstration

The generation and reuse of highway shoulder soil is ongoing, thus this application for a beneficial use determination is indefinite. The protectiveness of the proposed determination will be evaluated by periodically updating the soil database with soil data generated during future construction projects. Once new data are incorporated into the database, the revised dataset will be re-evaluated regarding the likelihood of soil to contain lead and benzo(a)pyrene at

concentrations below clean fill criteria or applicable RBCs. The beneficial use for highway shoulder soil from a physiographic province will be modified as needed.

A five-year re-evaluation period is proposed. Five years is expected to be a sufficient timeframe to collect enough additional data to re-evaluate the protectiveness of the proposed BUD and to modify approved beneficial uses, if warranted.

If it is a Demonstration Project, the Methods Proposed to Ensure Safe and Proper Management of the Material.

As discussed above, samples of highway shoulder soil will be collected and analyzed periodically to confirm that the approved beneficial uses remain protective of human health and the environment. Samples may be collected during highway construction and maintenance projects or as needed to improve the statewide soil database.

Additional soil analytical data will be collected for two purposes:

1. To confirm that COI concentrations in soil do not exceed the levels considered protective for each of the beneficial use categories listed in Table 2; and
2. To expand the statewide soil database and potentially modify the beneficial uses listed in Table 2.

Confirmation samples will be collected from one to five projects from each physiographic province during each five-year re-evaluation period, unless no highway shoulder soil is generated for export within the province. If lead is detected in shoulder soil at concentrations exceeding 100 mg/kg, the sample with the highest lead result will also be analyzed for leachable lead using the Toxicity Characteristic Leaching Procedure (TCLP) to ensure that concentrations do not exceed the 5 milligram per liter (mg/L) threshold for hazardous waste. Additional samples may be collected to expand the statewide soil database.

4.0 REFERENCES

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TABLES

Table 1

Summary Statistics[1] of Lead and Benzo(a)pyrene by Physiographic Province

Physiographic Province[2]	Analyte	Depth (feet bgs)	Distance from Pavement (feet)	Number of Samples[3]	Number of Non-Detect Samples	Min Detected Value	Max Detected Value	Min Detection Limit	Max Detection Limit	Median	Mean	Third Quartile	Standard Error	Clean Fill Criteria	90UCL for the mean[4]		Non-Normality Suggested?[5]	Chebyshev 90UCL > Clean Fill Criteria
						Concentration in milligrams per kilogram (mg/kg, DW)									Student's-t	Chebyshev		
Basin and Range	Lead	0-0.5	0-15	31	0	1.02	160	NA	NA	9.0	14.4	13.0	5.01	29	21	29	Yes	Yes
		0-0.5	15-30	26	0	3.34	44.2	NA	NA	9.6	13.1	14.8	2.15	29	16	20		
		0-0.5	>30	27	0	2.96	66.1	NA	NA	8.7	12.2	14.1	2.47	29	15	20	Yes	
		0.5-1	0-15	26	0	2.42	61	NA	NA	9.9	13.5	14.7	2.65	29	17	22	Yes	
		0.5-1	15-30	25	0	2.88	132	NA	NA	6.8	15.0	8.46	5.41	29	22	31	Yes	Yes
		0.5-1	>30	25	0	2.33	119	NA	NA	6.1	11.3	8.76	4.54	29	17	25	Yes	
		1-1.5	0-15	22	0	3.26	29.3	NA	NA	8.4	10.9	17.0	1.51	29	13	15		
		1-1.5	15-30	25	0	2.58	90.4	NA	NA	6.6	12.0	9.56	3.76	29	17	23	Yes	
		1-1.5	>30	25	0	2.72	11.2	NA	NA	5.1	5.7	7.56	0.50	29	6.4	7.2		
		Other[6]		9	0	6.9	150	NA	NA	27.0	51.1	70	16.3	29	73.9	100		Yes
	Benzo(a)pyrene	0-0.5	0-15	31	28	0.00837	0.0194	0.00185	0.33	NA	0.00912	NA	0.000648	0.015	0.01	0.011	Yes	
		0-0.5	15-30	26	21	0.00307	0.0149	0.0019	0.0146	NA	0.00451	NA	0.00078	0.015	0.0055	0.007		
		0-0.5	>30	27	24	0.00377	0.00531	0.00176	0.0149	NA	0.003862	NA	8.11E-05	0.015	0.0040	0.004	Yes	
		0.5-1	0-15	26	23	0.00636	0.0119	6.00E-04	0.32	NA	0.00683	NA	0.000392	0.015	0.0074	0.008	Yes	
		0.5-1	15-30	25	20	0.00254	0.019	0.00182	0.0146	NA	0.0146	NA	0.001034	0.015	0.0160	0.018		Yes
		0.5-1	>30	25	21	0.0021	0.0292	0.0019	0.00554	NA	0.00345	NA	0.00124	0.015	0.0051	0.007	Yes	
		1-1.5	0-15	22	18	0.00234	0.0106	6.00E-04	0.067	NA	0.00291	0.00234	0.000518	0.015	0.0036	0.005	Yes	
		1-1.5	15-30	25	23	0.00242	0.0326	0.00185	0.015	NA	NA	NA	NA	0.015	NA	NA		
		1-1.5	>30	25	24	0.00482	0.00482	0.00178	0.014	NA	NA	NA	NA	0.015	NA	NA		
		Other[6]		9	9	NA	NA	0.0064	0.32	NA	NA	NA	NA	0.015	NA	NA		
Blue Mountains	Lead	0-0.5	0-15	24	0	2.6	74	NA	NA	9.5	19.7	21.0	4.32	21	25	33		Yes
		0-0.5	15-30	24	0	1.27	37	NA	NA	8.7	13.1	19.0	1.82	21	16	19		
		0-0.5	>30	26	0	1.48	37.3	NA	NA	8.9	9.6	11.9	1.37	21	11	14	Yes	
		0.5-1	0-15	24	0	3.1	43	NA	NA	11.0	17.0	21.0	2.53	21	20	25		Yes
		0.5-1	15-30	24	0	0.84	23.8	NA	NA	6.1	8.2	13.0	1.20	21	9.8	12		
		0.5-1	>30	25	0	0.729	52.1	NA	NA	6.7	7.9	7.82	1.91	21	10	14	Yes	
		1-1.5	0-15	29	0	2.8	73	NA	NA	10.0	19.5	23.0	3.63	21	24	30		Yes
		1-1.5	15-30	28	0	0.593	29.4	NA	NA	5.9	7.4	6.76	1.22	21	9	11	Yes	
		1-1.5	>30	26	0	0.825	29.8	NA	NA	5.7	6.3	7.21	1.04	21	7.7	9.4	Yes	
		Other[6]		13	0	1.8	78	NA	NA	5.0	17.8	22.0	7.05	21	27.4	39.0		Yes
	Benzo(a)pyrene	0-0.5	0-15	24	20	0.001	0.11	6.00E-04	0.13	NA	0.00603	0.0015	0.00534	0.015	0.013	0.02		Yes
		0-0.5	15-30	24	17	0.00096	0.033	0.00193	0.082	0.00096	0.00343	0.00346	0.00155	0.015	0.0055	0.01	Yes	
		0-0.5	>30	26	19	0.00208	0.0156	0.0019	0.00522	NA	0.00274	0.00208	0.00055	0.015	0.0035	0.00	Yes	
		0.5-1	0-15	24	23	0.063	0.063	0.0006	0.072	NA	NA	NA	NA	0.015	NA	NA		
		0.5-1	15-30	24	20	0.00205	0.03	0.0006	0.035	NA	0.00337	NA	0.00137	0.015	0.0052	0.01	Yes	
		0.5-1	>30	25	23	0.00237	0.00385	0.0018	0.00224	NA	NA	NA	NA	0.015	NA	NA		
		1-1.5	0-15	29	27	0.0022	0.062	0.0006	0.13	NA	NA	NA	NA	0.015	NA	NA		
		1-1.5	15-30	28	26	0.00222	0.016	0.0006	0.0076	NA	NA	NA	NA	0.015	NA	NA		
		1-1.5	>30	26	25	0.00217	0.00217	0.0019	0.00218	NA	NA	NA	NA	0.015	NA	NA		
		Other[6]		0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		

Refer to notes at end of table.

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Table 1

Summary Statistics[1] of Lead and Benzo(a)pyrene by Physiographic Province

Physiographic Province[2]	Analyte	Depth (feet bgs)	Distance from Pavement (feet)	Number of Samples[3]	Number of Non-Detect Samples	Min Detected Value	Max Detected Value	Min Detection Limit	Max Detection Limit	Median	Mean	Third Quartile	Standard Error	Clean Fill Criteria	90UCL for the mean[4]		Non-Normality Suggested?[5]	Chebyshev 90UCL > Clean Fill Criteria
						Concentration in milligrams per kilogram (mg/kg, DW)									Student's-t	Chebyshev		
Cascade Range	Lead	0-0.5	0-15	2	0	17	40	NA	NA	NA	NA	NA	NA	34	NA	NA		
		0-0.5	15-30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	34	NA	NA		
		0-0.5	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	34	NA	NA		
		0.5-1	0-15	2	0	2.6	5.7	NA	NA	NA	NA	NA	NA	34	NA	NA		
		0.5-1	15-30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	34	NA	NA		
		0.5-1	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	34	NA	NA		
		1-1.5	0-15	0	0	NA	NA	NA	NA	NA	NA	NA	NA	34	NA	NA		
		1-1.5	15-30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	34	NA	NA		
		1-1.5	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	34	NA	NA		
		Other[6]		47	0	1	75.6	NA	NA	7.8	16.7	18.7	2.89	34	21	25		
	Benzo(a)pyrene	0-0.5	0-15	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		0-0.5	15-30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		0-0.5	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		0.5-1	0-15	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		0.5-1	15-30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		0.5-1	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		1-1.5	0-15	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		1-1.5	15-30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		1-1.5	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		Other[6]		42	5	0.00054	2.8	0.00024	0.007	0.0146	0.168	0.0728	0.0753	0.015	0.27	0.39	Yes	Yes
Coast Range	Lead	0-0.5	0-15	13	0	14	200	NA	NA	65.0	84.1	102	16.43	34	110	133		Yes
		0-0.5	15-30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	34	NA	NA		
		0-0.5	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	34	NA	NA		
		0.5-1	0-15	13	0	21	420	NA	NA	69.0	103.9	110	30.06	34	150	194	Yes	Yes
		0.5-1	15-30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	34	NA	NA		
		0.5-1	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	34	NA	NA		
		1-1.5	0-15	14	0	4.7	360	NA	NA	57.0	84.3	110	25.03	34	120	159	Yes	Yes
		1-1.5	15-30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	34	NA	NA		
		1-1.5	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	34	NA	NA		
		Other[6]		14	0	16	230	NA	NA	38.0	66.3	92.0	16.25	34	88	115	Yes	Yes
	Benzo(a)pyrene	0-0.5	0-15	13	13	NA	NA	0.0083	0.21	NA	NA	NA	NA	0.015	NA	NA		
		0-0.5	15-30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		0-0.5	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		0.5-1	0-15	13	13	NA	NA	0.008	0.17	NA	NA	NA	NA	0.015	NA	NA		
		0.5-1	15-30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		0.5-1	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		1-1.5	0-15	14	13	0.16	0.16	0.0083	0.16	NA	NA	NA	NA	0.015	NA	NA		
		1-1.5	15-30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		1-1.5	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		Other[6]		14	12	0.032	0.076	0.0093	0.18	NA	NA	NA	NA	0.015	NA	NA		

Refer to notes at end of table.

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Table 1

Summary Statistics[1] of Lead and Benzo(a)pyrene by Physiographic Province

Physiographic Province[2]	Analyte	Depth (feet bgs)	Distance from Pavement (feet)	Number of Samples[3]	Number of Non-Detect Samples	Min Detected Value	Max Detected Value	Min Detection Limit	Max Detection Limit	Median	Mean	Third Quartile	Standard Error	Clean Fill Criteria	90UCL for the mean[4]		Non-Normality Suggested?[5]	Chebyshev 90UCL > Clean Fill Criteria
						Concentration in milligrams per kilogram (mg/kg, DW)									Student's-t	Chebyshev		
Deschutes Columbia	Lead	0-0.5	0-15	24	0	5.4	170	NA	NA	23.0	37.3	46.0	8.09	18	48	62	Yes	Yes
		0-0.5	15-30	26	0	5.74	95	NA	NA	10.7	23.2	30.2	4.69	18	29	37	Yes	Yes
		0-0.5	>30	25	0	4.06	40.1	NA	NA	9.3	11.6	12.4	1.53	18	14	16	Yes	
		0.5-1	0-15	24	0	4.7	160	NA	NA	31.0	51.4	65.0	9.47	18	64	80		Yes
		0.5-1	15-30	25	0	4.2	40.9	NA	NA	7.3	11.0	11.8	1.83	18	13	17	Yes	
		0.5-1	>30	27	0	3.8	14	NA	NA	6.7	7.3	8.13	0.47	18	7.9	8.7		
		1-1.5	0-15	33	0	5	120	NA	NA	18.0	27.1	30.0	4.13	18	33	40	Yes	Yes
		1-1.5	15-30	26	0	2.89	16.9	NA	NA	7.6	8.1	9.32	0.72	18	9	10		
		1-1.5	>30	26	0	3.11	13	NA	NA	6.3	7.0	8.82	0.57	18	7.7	8.7		
		Other[6]		7	0	5.8	16	NA	NA	8.5	8.8	9.4	1.32	18	10.7	12.8	Yes	
	Benzo(a)pyrene	0-0.5	0-15	24	15	0.00094	0.056	0.0006	0.14	0.0027	0.0131	0.016	0.00477	0.015	0.019	0.03		Yes
		0-0.5	15-30	26	9	0.0011	0.0595	0.0006	0.00212	0.00264	0.0103	0.0109	0.00306	0.015	0.014	0.02	Yes	Yes
		0-0.5	>30	25	15	0.0012	0.0274	0.0006	0.00208	0.0012	0.00521	0.00421	0.00165	0.015	0.0074	0.01	Yes	
		0.5-1	0-15	24	11	0.00087	0.073	0.003	0.14	0.0038	0.0169	0.03	0.00523	0.015	0.024	0.03		Yes
		0.5-1	15-30	25	15	0.00095	0.0471	0.0006	0.00207	0.00095	0.00449	0.00347	0.00202	0.015	0.0072	0.01	Yes	
		0.5-1	>30	27	16	0.001	0.0502	0.0006	0.00212	0.001	0.00592	0.0056	0.00217	0.015	0.0088	0.01	Yes	
		1-1.5	0-15	33	23	0.00076	0.1	0.0006	0.073	0.0012	0.00966	0.0032	0.00402	0.015	0.015	0.02		Yes
		1-1.5	15-30	26	19	0.001	0.0148	0.0006	0.00211	NA	0.00249	0.001	0.00072	0.015	0.0034	0.00	Yes	
		1-1.5	>30	26	22	0.00393	0.015	0.0006	0.00213	NA	0.00476	NA	0.000575	0.015	0.0055	0.01	Yes	
		Other[6]		0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
High Lava Plains	Lead	0-0.5	0-15	9	0	2.8	36	NA	NA	9.2	13.3	18.0	3.85	21	19	25		Yes
		0-0.5	15-30	2	0	13	16	NA	NA	NA	NA	NA	NA	21	NA	NA		
		0-0.5	>30	2	0	16	17	NA	NA	NA	NA	NA	NA	21	NA	NA		
		0.5-1	0-15	5	0	9.4	30	NA	NA	24.0	20.9	27.0	3.93	21	27	33		Yes
		0.5-1	15-30	2	0	14	30	NA	NA	NA	NA	NA	NA	21	NA	NA		
		0.5-1	>30	2	0	12	12	NA	NA	NA	NA	NA	NA	21	NA	NA		
		1-1.5	0-15	5	0	6	27	NA	NA	15.0	14.1	16.0	3.83	21	20	26		Yes
		1-1.5	15-30	2	0	8.5	24	NA	NA	NA	NA	NA	NA	21	NA	NA		
		1-1.5	>30	2	0	12	13	NA	NA	NA	NA	NA	NA	21	NA	NA		
		Other[6]		5	0	6	48	NA	NA	14.0	20.4	21.0	7.30	21	32	42	Yes	Yes
	Benzo(a)pyrene	0-0.5	0-15	9	8	0.21	0.21	0.03	0.13	NA	NA	NA	NA	0.015	NA	NA		
		0-0.5	15-30	2	2	NA	NA	0.00060	0.0060	NA	NA	NA	NA	0.015	NA	NA		
		0-0.5	>30	2	2	NA	NA	0.00060	0.0012	NA	NA	NA	NA	0.015	NA	NA		
		0.5-1	0-15	5	5	NA	NA	0.003	0.03	NA	NA	NA	NA	0.015	NA	NA		
		0.5-1	15-30	2	2	NA	NA	0.0006	0.0060	NA	NA	NA	NA	0.015	NA	NA		
		0.5-1	>30	2	2	NA	NA	0.0006	0.0006	NA	NA	NA	NA	0.015	NA	NA		
		1-1.5	0-15	5	5	NA	NA	0.00060	0.0120	NA	NA	NA	NA	0.015	NA	NA		
		1-1.5	15-30	2	2	NA	NA	0.00060	0.0060	NA	NA	NA	NA	0.015	NA	NA		
		1-1.5	>30	2	2	NA	NA	0.00060	0.0006	NA	NA	NA	NA	0.015	NA	NA		
		Other[6]		5	5	NA	NA	0.013	0.074	NA	NA	NA	NA	0.015	NA	NA		

Refer to notes at end of table.

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Table 2

Beneficial Use Categories by Physiographic Province, Depth, and Distance [1.]

Physiographic Province	Depth (feet)	Distance from Pavement (feet)	Beneficial Use Category
Basin and Range	All	All	No special management required, clean fill
Blue Mountains	All	All	No special management required, clean fill
Owyhee Uplands	All	All	No special management required, clean fill
Deschutes Columbia	All	>30 feet	No special management required, clean fill
	>0.5 feet	>15 feet	No special management required, clean fill
	<0.5 feet	>15 feet	Non-residential
	All	<15 feet	Non-residential
Klamath Mountains	All	All	Non-residential
High Lava Plains	All	All	Non-residential
Coast Range	All	All	Non-residential
Cascade Range	All	All	Non-residential
Portland Basin	All	All	Mine/quarry [2.]
South Willamette Valley	All	All	Non-residential

Notes:

1. These beneficial use categories do not apply to shoulder soil exhibiting indications of contamination (e.g., staining, odor) or soil in close proximity to known potential contaminant source areas (e.g., industrial facilities or gas service stations). Soil fitting this description will be subject to testing prior to export.

2. If project-specific data demonstrate that concentrations of constituents in shoulder soil are below Oregon Department of Environmental Quality Risk Based Concentrations for occupational exposure, then soil from that project may be managed as non-residential fill.

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Table 3
Beneficial Use Examples by Category

Beneficial Use Category	Applications	Examples
Clean Fill	Unrestricted Use	- No special management required; unrestricted use
Non-Residential	Commercial	- Fill for non-residential construction projects - Utility trench fill - Landscaping material - Livestock rangeland - Safety and sound berms along highways - Highway shoulder work and patching - Stockpiling of soil for later use
	Agricultural (non-food crop only)	
	Industrial	
	Transportation	
	Soil Banking [1.]	
Mine/Quarry	Industrial	- Mine reclamation fill - Quarry reclamation fill

Notes:
1. Soil banking will only be conducted on ODOT-controlled property.

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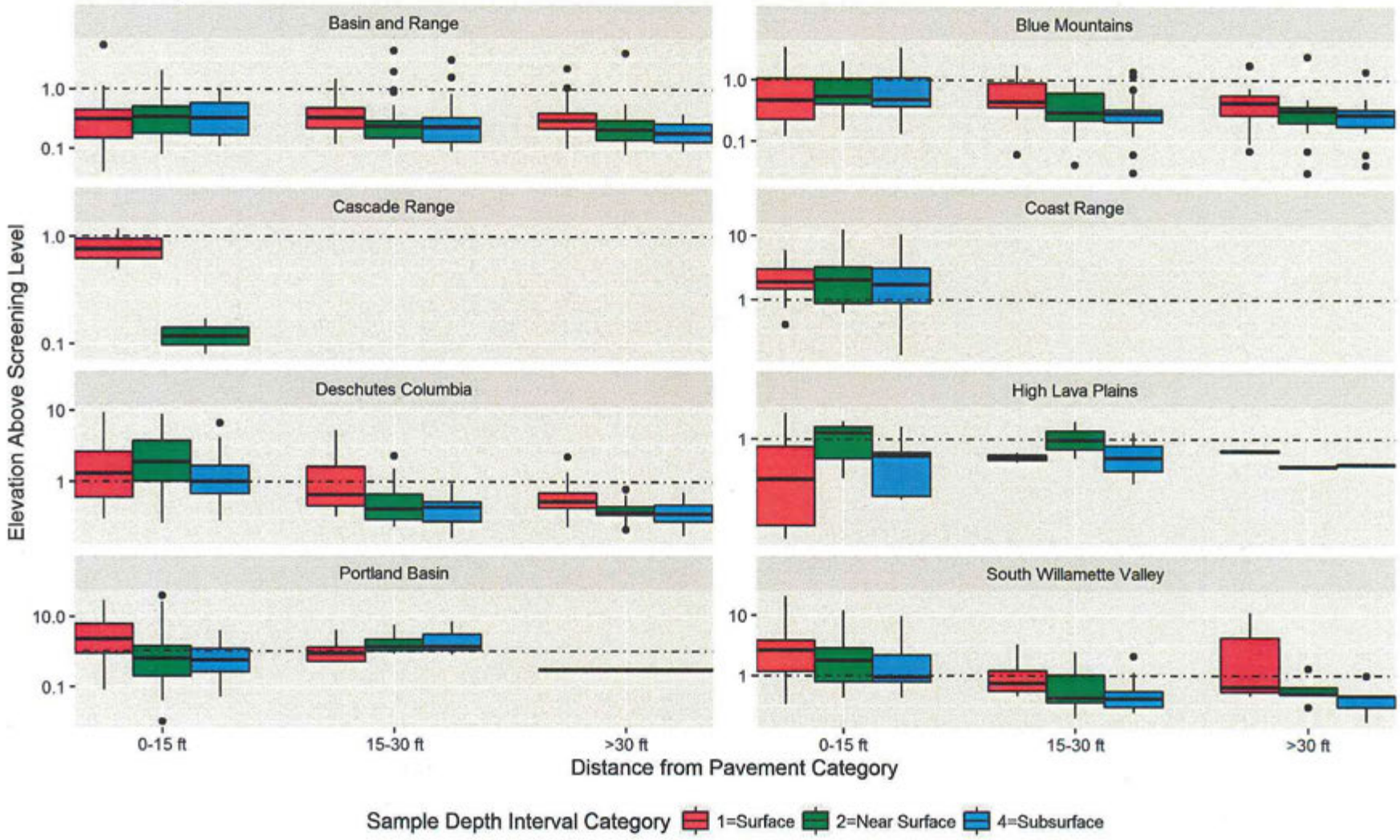
FIGURES



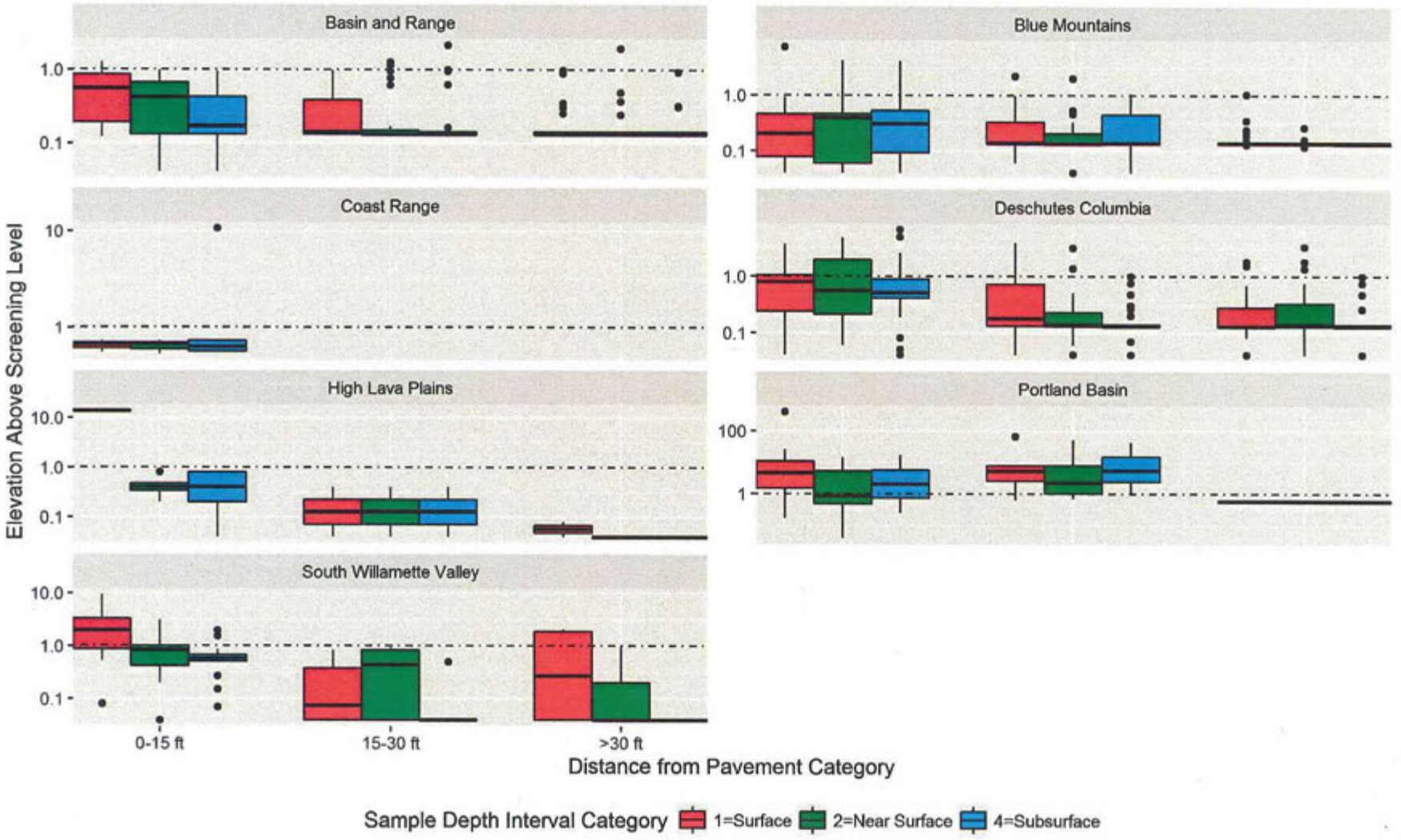
NOTE: Soil concentrations are shown relative to each physiographic province-specific lead clean fill criteria. A value of 1.0 on the Y-axis corresponds to the clean fill criterion. Concentrations are shown on a logarithmic scale.

Shoulder Soil Data Lead Box Plots

Oregon Department of Transportation

Cascadia Associates, LLC

Project Number	0028-001-001-07	Figure
October 2018		2

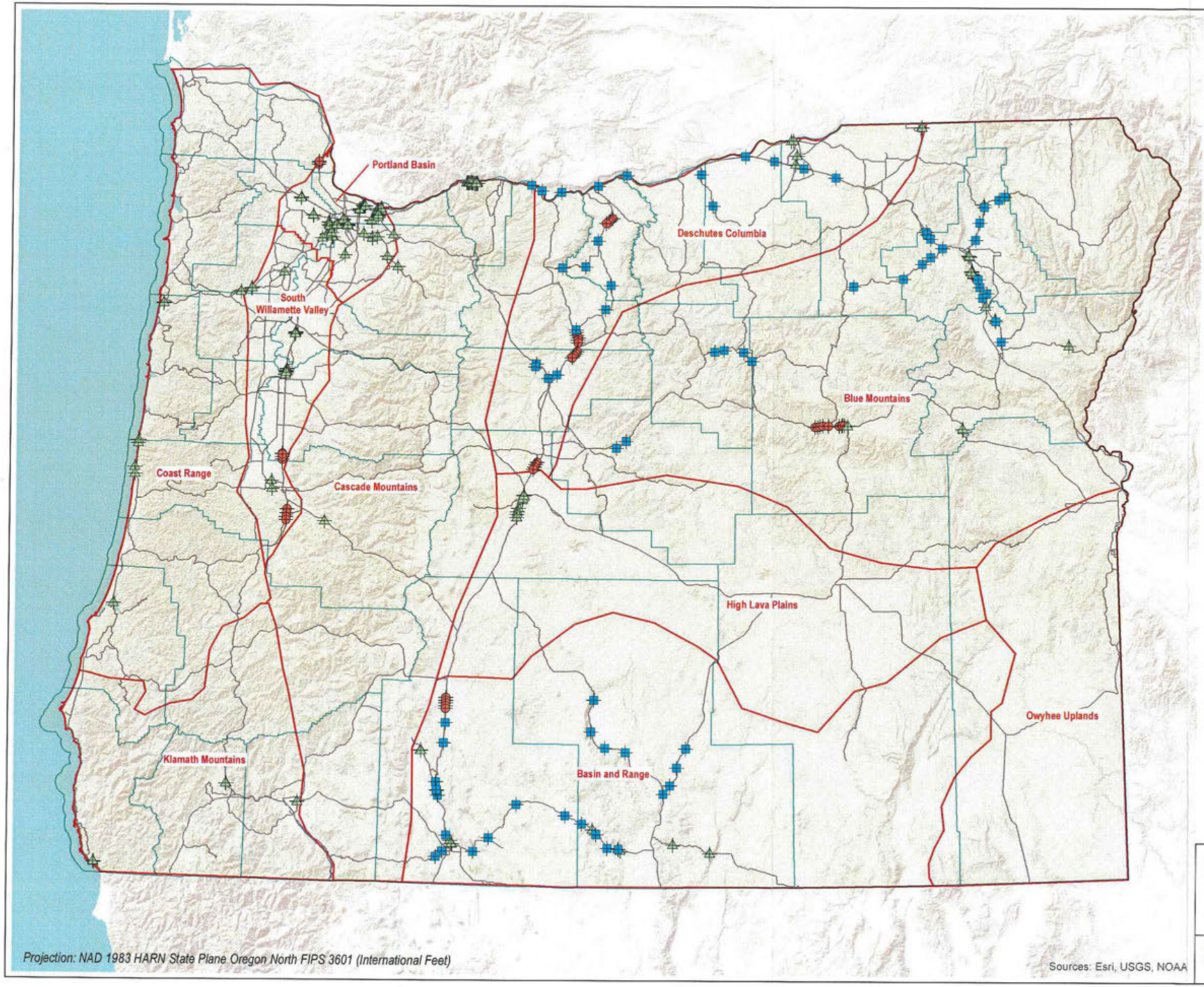


NOTE: Soil concentrations are shown relative to the benzo(a)pyrene clean fill criteria. A value of 1.0 on the Y-axis corresponds to a concentration of 0.015 mg/kg (i.e., the clean fill criterion). Concentrations are shown on a logarithmic scale.

Shoulder Soil Data Benzo(a)pyrene Box Plots

Oregon Department of Transportation

Cascadia Associates, LLC	Project Number	0028-001-001-07	Figure 3
	October 2018		



N

Legend:

- 2016 Cascadia Soil Sample Locations
- ODOT Projects Soil Sample Locations
- 2015 Apex Soil Sample Locations
- Oregon County Boundaries
- Major Roads
- Oregon Physiographic Provinces

Notes:
1. Multiple soil samples were collected in each of the locations shown.

Projection: NAD 1983 HARN State Plane Oregon North FIPS 3601 (International Feet)

Sources: Esri, USGS, NOAA

0 125,000 250,000 500,000

Approximate Scale in Feet

Highway Shoulder Soil Sampling Locations - Complete Dataset

Oregon Department of Transportation

Cascadia Associates, LLC

Project Number	0028-001-001-04	Figure
October 2018		1

Table 1

Summary Statistics[1] of Lead and Benzo(a)pyrene by Physiographic Province

Physiographic Province[2]	Analyte	Depth (feet bgs)	Distance from Pavement (feet)	Number of Samples[3]	Number of Non-Detect Samples	Min Detected Value	Max Detected Value	Min Detection Limit	Max Detection Limit	Median	Mean	Third Quartile	Standard Error	Clean Fill Criteria	90UCL for the mean[4]		Non-Normality Suggested?[5]	Chebyshev 90UCL > Clean Fill Criteria
						Concentration in milligrams per kilogram (mg/kg, DW)									Student's-t	Chebyshev		
South Willamette Valley	Lead	0-0.5	0-15	26	0	9.2	575	NA	NA	71.0	113.8	110	27.44	28	150	196	Yes	Yes
		0-0.5	15-30	7	0	13	92.7	NA	NA	21.0	32.7	47.0	10.90	28	48	65	Yes	Yes
		0-0.5	>30	7	0	13	308	NA	NA	18.0	89.8	184	43.35	28	150	220		Yes
		0.5-1	0-15	19	0	12	338	NA	NA	50.0	77.4	89.0	19.70	28	100	136	Yes	Yes
		0.5-1	15-30	8	0	5.7	70.5	NA	NA	11.0	25.1	23.0	8.74	28	37	51		Yes
		0.5-1	>30	5	0	8.4	36.5	NA	NA	14.0	18.2	18.0	4.83	28	26	33	Yes	Yes
		1-1.5	0-15	20	0	12	275	NA	NA	26.0	57.3	61.0	14.56	28	77	101	Yes	Yes
		1-1.5	15-30	8	0	6.7	59.1	NA	NA	11.0	18.6	12.0	6.42	28	28	38	Yes	Yes
		1-1.5	>30	5	0	4.7	27.8	NA	NA	13.0	13.4	13.0	3.93	28	19	25		
		Other[6]		31	0	7.31	288	NA	NA	20.9	36.8	34.0	9.67	28	50	66	Yes	Yes
	Benzo(a)pyrene	0-0.5	0-15	26	10	0.0012	0.14	0.008	2.7	0.029	0.0316	0.035	0.00703	0.015	0.041	0.05	Yes	Yes
		0-0.5	15-30	8	7	0.0021	0.0021	0.0006	0.0166	NA	NA	NA	NA	0.015	NA	NA		
		0-0.5	>30	5	3	0.0273	0.0311	0.0006	0.0164	NA	NA	NA	NA	0.015	NA	NA		
		0.5-1	0-15	19	8	0.003	0.046	0.0006	0.216	0.011	0.0116	0.015	0.00275	0.015	0.015	0.02	Yes	Yes
		0.5-1	15-30	8	7	0.0058	0.0058	0.0006	0.0141	NA	NA	NA	NA	0.015	NA	NA		
		0.5-1	>30	3	3	NA	NA	0.0006	0.0148	NA	NA	NA	NA	0.015	NA	NA		
		1-1.5	0-15	17	5	0.0011	0.029	0.0077	0.038	0.0085	0.00896	0.01	0.00199	0.015	0.012	0.02		Yes
		1-1.5	15-30	5	5	NA	NA	0.0006	0.0073	NA	NA	NA	NA	0.015	NA	NA		
		1-1.5	>30	2	2	NA	NA	0.0006	0.0006	NA	NA	NA	NA	0.015	NA	NA		
		Other[6]		23	22	0.013	0.013	0.0075	0.132	NA	NA	NA	NA	0.015	NA	NA		

Notes:

1. Summary Stats (mean, median, and se) use the Kaplan-Meier for data groups with censored values (non-detects). Summary statistics are only calculated when there are at least 3 detected values, otherwise only the range is reported.
2. The Owyhee Uplands physiographic province is not included in this table because there is no shoulder soil sampling data available for the province.
3. This summary includes all samples, even those non-detects with DLs that exceeded the clean fill criteria which were excluded from the sample sizes shown in Table 3.
4. Note: very few of the qqplots within each group actually look normal - some have outliers; some are just skewed; others look like a mixture of multiple sub-populations. BAP data in particular do not follow a normal distribution because of so many non-detects. Consequently, for a UCL estimate, Student's-t interval is inappropriate for most groups; Chebyshev's is highly conservative, but coverage is assured.
5. Non-normality of the data in this group, including the possiblity of outliers, is suggested when the absolute value of skewness > 2, or kurtosis > 3.
6. Samples categorized as "Other" are either missing sampling details or could not be classified within the depth and distance from pavement categories used in this evaluation.
7. NA = No data are available or could not be calculated with the existing dataset (see note 1).

Table 1

Summary Statistics[1] of Lead and Benzo(a)pyrene by Physiographic Province

Physiographic Province[2]	Analyte	Depth (feet bgs)	Distance from Pavement (feet)	Number of Samples[3]	Number of Non-Detect Samples	Min Detected Value	Max Detected Value	Min Detection Limit	Max Detection Limit	Median	Mean	Third Quartile	Standard Error	Clean Fill Criteria	90UCL for the mean[4]		Non-Normality Suggested?[5]	Chebyshev 90UCL > Clean Fill Criteria
						Concentration in milligrams per kilogram (mg/kg, DW)									Student's-t	Chebyshev		
Klamath Mountains	Lead	0-0.5	0-15	0	0	NA	NA	NA	NA	NA	NA	NA	NA	36	NA	NA		
		0-0.5	15-30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	36	NA	NA		
		0-0.5	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	36	NA	NA		
		0.5-1	0-15	0	0	NA	NA	NA	NA	NA	NA	NA	NA	36	NA	NA		
		0.5-1	15-30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	36	NA	NA		
		0.5-1	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	36	NA	NA		
		1-1.5	0-15	0	0	NA	NA	NA	NA	NA	NA	NA	NA	36	NA	NA		
		1-1.5	15-30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	36	NA	NA		
		1-1.5	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	36	NA	NA		
		Other[6]		11	0	3.4	76	NA	NA	14.0	21.0	24.0	6.56	36	30	41	Yes	Yes
	Benzo(a)pyrene	0-0.5	0-15	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		0-0.5	15-30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		0-0.5	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		0.5-1	0-15	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		0.5-1	15-30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		0.5-1	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		1-1.5	0-15	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		1-1.5	15-30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		1-1.5	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		Other[6]		11	11	NA	NA	0.0064	0.069	NA	NA	NA	NA	0.015	NA	NA		
Portland Basin	Lead	0-0.5	0-15	83	1	2.2	821	2.8	2.8	64.0	125.2	180	17.06	28	150	176	Yes	Yes
		0-0.5	15-30	9	0	13.4	120	NA	NA	25.0	37.1	37.4	11.48	28	53	72	Yes	Yes
		0-0.5	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	28	NA	NA		
		0.5-1	0-15	43	3	1.1	1100	0.29	5.6	18.0	67.6	41.0	30.01	28	110	158	Yes	Yes
		0.5-1	15-30	4	0	24	160	NA	NA	31.0	65.2	NA	31.94	28	120	161	Yes	Yes
		0.5-1	>30	1	0	8.3	8.3	NA	NA	NA	NA	NA	NA	28	NA	NA		
		1-1.5	0-15	46	0	1.3	116	NA	NA	16.0	26.1	34.0	4.30	28	32	39	Yes	Yes
		1-1.5	15-30	3	0	23	200	NA	NA	38.0	87.0	NA	56.67	28	190	257	Yes	Yes
		1-1.5	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	28	NA	NA		
		Other[6]		117	0	0.44	710	NA	NA	20.0	67.6	59.5	12.20	28	83	104	Yes	Yes
	Benzo(a)pyrene	0-0.5	0-15	57	15	0.0026	6.11	0.007	0.079	0.0605	0.196	0.119	0.107	0.015	0.34	0.52	Yes	Yes
		0-0.5	15-30	6	1	0.033	1.00	0.0095	0.0095	0.0657	0.226	0.13	0.159	0.015	0.46	0.70	Yes	Yes
		0-0.5	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		0.5-1	0-15	16	10	0.021	0.22	0.00066	0.07	NA	0.0493	0.024	0.0152	0.015	0.07	0.10		Yes
		0.5-1	15-30	4	1	0.018	0.78	0.0102	0.0102	0.018	0.22	NA	0.198	0.015	0.54	0.81	Yes	Yes
		0.5-1	>30	1	0	0.0088	0.0088	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		1-1.5	0-15	20	4	0.0037	0.265	0.0072	0.15	0.031	0.062	0.086	0.0177	0.015	0.086	0.12		Yes
		1-1.5	15-30	3	0	0.016	0.66	NA	NA	0.082	0.253	NA	0.205	0.015	0.64	0.87	Yes	Yes
		1-1.5	>30	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0.015	NA	NA		
		Other[6]		38	26	0.0088	13.7	0.0072	0.14	NA	0.405	0.0172	0.371	0.015	0.89	1.50	Yes	Yes

Refer to notes at end of table.

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