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11.5 Red Rock Road, Douglas County, Oregon

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11.5.1 Site Description and Conceptual Site Model

Red Rock Road is a 17-mile former railbed used historically for timber operations. The road was built with tailings from the nearby Bonanza Mercury Mine in the early to mid-1900s. In the 1960s to 1970s the railroad was abandoned and the railbed is now located on approximately 140 tax lots of varied land uses including residential, occupational, and recreational. Mercury concentrations were generally below risk-based screening levels, and thus arsenic became the risk driver. Total arsenic concentrations in soil (65 samples) range from 19 to 241 mg/kg with a local background of 24 mg/kg.

Several soil assessments were conducted over a period of about 10 years. Historically, arsenic was assumed to have a relative bioavailability (RBA) of 60%. In 2009, site-specific RBA testing was conducted, with results ranging from 2% to 7%. The results suggested that arsenic bioavailability was much lower than the default value. The state regulatory agency and responsible party agreed on a conservative RBA of 10%.

11.5.1.1 Arsenic on the Site

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Of the 12 individual sites and 1 duplicate sampled, total concentrations ranged from 90 to 241 mg/kg. Background arsenic in soils for the site is 24 mg/kg.

11.5.1.2 Soil Type

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Soil is a well-graded gravel with some fines, red in color and high in iron oxides. The soil is generally consistent throughout the 17 miles of railbed. The base material for the former railbed is tailings from the former Bonanza mercury mine which is ore that was roasted at temperatures of greater than 500° C, potentially adding to the concentration of iron oxides. The original ore material is hydrothermally placed cinnabar within an Eocene-aged sandstone and siltstone of marine origin.

11.5.1.3 Source of Arsenic

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The source of arsenic at the site is historical mining of mercury ore.

11.5.1.4 Land Use/Exposure Scenarios

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Land use for the site is predominantly residential, but some commercial (timberlands and farming), and occasional recreational use occurs.

11.5.2 Methodology Used for Evaluating Bioavailability

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Three lines of evidence were employed for the Red Rock Road project:

- sequential extraction by Bloom et al. method, summed F1 and F2, conducted in 2001
- Relative Bioavailability Leaching Procedure (University of Colorado), conducted in 2009
- speciation and mineralogy by electron microprobe (University of Colorado), conducted in 2009

Consistent results were found among these methods. Of the three methods, the in vitro extraction (following the relative

bioavailability leaching procedure) was relied on as the most reliable method. The results were similar to the results of the earlier 2001 sequential extraction. The microprobe method provided a qualitative result indicating reduced bioavailability due to iron oxide phase arsenic, which supported the other results.

Contractor costs for sample collection, analysis, reporting was about $45,000. The cost to present results and to discuss with the regulatory agency including document review time was about $40,000. Total cost to incorporate bioavailability into the risk assessment was about $100,000.

11.5.3 Calculated Bioavailability of Arsenic in Soils

A bioavailability value of 2.4-7%, with an average 4% was calculated.

11.5.4 Application of Bioavailability to Risk Assessment

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A conservative bioavailability value of 10% was used in the risk assessment as a multiplier in the calculation of soil ingestion. The other parameters in the risk assessment calculation were default USEPA exposure factors. The conservative value was used because of the lack of in vivo data for correlation and because of the potential for variability of results from different in vitro methods. This value is 3% higher than the maximum RBA in the dataset.

11.5.5 How Did Bioavailability Results Affect Site Decisions?

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The estimated cost to excavate and dispose of 17 miles of rail bed was several million dollars (based on a road prism of about 12 ft wide at the top, 20 ft wide at the bottom, by 2 ft tall, for a total of 50,000 to 100,000 cubic yards). The total cost to conduct bioavailability assessment including sample collection, analysis, report preparation, and discussions with the regulatory agency was about $100,000. The outcome of the conducting bioavailability assessment was that most of the properties in the project required no remedial action. Approximately seven properties within the 140 properties still require some form of remediation or institutional controls because of unacceptable risk due to issues outside the scope of bioavailability. The remedial action costs, however, were significantly reduced by conducting the bioavailability assessment.

11.5.6 Regulatory and Community Considerations

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There are several notable regulatory and community issues related to estimating the site-specific bioavailability for the risk assessment for this project. The Oregon Health Authority (OHA) historically relied on USEPA/ATSDR's 60% bioavailability and did not immediately accept the reduced bioavailability for this project. OHA completed a Public Health Assessment prior to the bioavailability analysis and used 60% RBA for arsenic. After completing the site-specific bioavailability analyses, several discussions between ODEQ and OHA were needed in order for OHA to accept the lower bioavailability. In addition, OHA recommended that a third-party review be conducted.

A review was also conducted by Toxicology Excellence for Risk Assessment (TERA). TERA indicated that the methods employed in the RRR project were appropriate and current methods and that they concurred with the results. OHA accepted the conclusions of the review and agreed that 10% relative bioaccessibility was an appropriate site-specific value in the risk assessment. OHA has yet to revise the public health assessment, but they have updated their webpage for the site indicating that there is new information. Ultimately, it may be appropriate for OHA to update their Public Health Assessment, but that is not a common activity conducted using ATSDR funds, which many state health agencies use for public health assessments. This could be an outstanding issue because it pertains to public outreach.

Public outreach began in spring of 2016 and it appears that the community, including the property owners, have generally accepted the risk assessment results. Generally, there have been limited questions from the public about bioavailability.