RECORD OF DECISION

REMEDIAL ACTION ALTERNATIVE

For

KEN FOSTER FARM SITE
SHERWOOD, OREGON

Prepared By

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY
Northwest Region Office

January 2017
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1. INTRODUCTION

1.1 INTRODUCTION

This document presents the Oregon Department of Environmental Quality’s (DEQ’s) selected remedial action for a portion of the Ken Foster Farm (KFF) site (the “Site”). The Site is located at 23000-23500 SW Murdock Road in Sherwood, Oregon (Figures 1 and 2). The remedial action was developed in accordance with Oregon Revised Statutes (ORS) 465.200 et seq. and Oregon Administrative Rules (OAR) Chapter 340, Division 122, Sections 010 through 115. The remedial action was developed in consideration of public comments on the recommended remedial action that was described in DEQ’s Staff Report dated September 2016. The selected action is described in Section 7 and DEQ’s responses to public comments are summarized in Section 8.

The remedial action covers the upland site area and is based on the Administrative Record for this Site. The remedial action for the wetland area will be identified at a later date.

The Administrative Record Index is presented in Section 9. This report summarizes the more detailed information contained in the Remedial Investigation (RI) and Feasibility Study (FS) reports completed by Geosyntec on behalf of the Oregon Department of Environmental Quality (DEQ).

1.2 SCOPE AND ROLE OF THE RECOMMENDED REMEDIAL ACTION

The remedial action addresses the presence of hexavalent chromium, mercury and lead in soil at the Site. The remedial action consists of the following elements:

- Capping, excavation and/or consolidation and capping of upland soil.
- Public communication and notification.
- Operation and maintenance.
2. SITE HISTORY AND DESCRIPTION

2.1 SITE LOCATION AND LAND USE

The Site is a 40-acre tract of former pasture land at 23000 to 23500 SW Murdock Road in Sherwood, Washington County, Oregon (Figures 1 and 2). The Site is located in the northwest quarter of the southwest quarter of Section 33, Township 2 South, Range 1 West of the Willamette Meridian. Between 1962 and 1971, tannery wastes from the former Frontier Leather Tannery (ECSI #116 and #2638) were land applied at KFF as a soil amendment. The wastes reportedly were covered in lime to control odor and tilled into existing soil. The wastes included animal wastes from the tannery’s hide preparation operations (such as hide scrapings, tissue, fat, and hair), as well as liquid sludge from the tannery’s wastewater settling tanks. Evidence of waste disposal, such as bone fragments and stained soil, is still visible in some areas at the Site.

The Site was originally divided into ten tax lots for redevelopment as low-density residential properties. Tax Lot 900 was further subdivided into eight tax lots in 1995, with four lots zoned for residential use (Lots 2200, 2300, 2400 and 2500). The other four tax lots to the south (Tracts 2600, 2700, 2800, and 2900) comprise a lowland containing a wetland and surrounding riparian area covering about 2.5 acres. There is a small wetland of less than 0.5 acres along the north edge of Tax Lot 1300, adjacent to SW Ironwood Lane.

Lots 2200, 2300, 2400 and 2500 were remediated (removal and capping) by Ironwood Homes under DEQ oversight and received No Further Action (NFA) determinations from DEQ by 2009. Excavated soil from these lots was placed on Tax Lot 2900 and Tax Lot 300, covered with clean imported fill, and seeded to provide a vegetative cover. These two areas are referred to as engineered soil cells and do not present a risk to human health because the soil caps prevent exposure.

In 2007 DEQ issued a NFA determination for Tax Lot 1100 following an investigation by the United States Environmental Protection Agency (EPA). No additional work is anticipated on the five lots that have been issued NFAs by DEQ. The properties with NFA determinations comprise approximately 3.5 acres. Under terms of a Consent Judgment finalized in 2013, DEQ agreed to use settlement funds for remediation of the wetland and surrounding riparian area, with the exception of the engineered soil cell on Tax Lot 2900. The funds from the settlement also may be used for investigation and cleanup in other Site areas and/or the Frontier Leather Site, as available.
Site elevations range from about 250- to 360-feet above mean sea level (MSL). Two 40- to 90-foot high on-site knolls create a rolling topography. One knoll is located in the northeast quadrant of the Site; the other crests along the Site’s southern boundary.

2.2 PHYSICAL SETTING

2.2.1 Climate

The following climate information is based on station information for the Portland-Hillsboro Airport for the period of 1998 through 2008 (Western Regional Climate Center 2013). Average temperatures range from an average minimum of 33.3 degrees Fahrenheit (°F) in February to an average maximum of 81.4 °F in August. The average annual precipitation rate was reported as 34.4 inches per year, with a maximum daily precipitation rate of 2.32 inches per day. The majority of the precipitation events occur during the months of October through April.

2.2.2 Geology

The Site is located at the boundary between the southeast foothills of the Chehalem Mountains and broad lowlands of the Tualatin River Valley. It lies in an upland area on the east side of the Rock Creek drainage basin. Columbia River Basalt (CRB) underlies the entire Tualatin River Valley and is exposed at the Site, primarily along hillsides. The Sherwood Fault trends northeast-southwest near the northwest corner of Site.

During the Pleistocene Missoula Flood the Site area was largely stripped of existing soil cover, resulting in a scoured surface known as the Tonquin Scablands. The wetland occupies a broad channel adjacent to a hillside leading down to Rock Creek, and is likely a relic of the Missoula Flood event.

Soil thickness at the Site ranges from 0 (exposed bedrock) to 8 feet, but is typically less than 2 feet. CRB is exposed along hillsides in places. The soil profile is thickest in the wetland and lower elevation areas of the Site. The U.S. Department of Agriculture’s Soil Conservation Service mapped site soils as a xerochrepts-rock outcrop complex with smaller areas of Saum silt loam and Laurelwood silt loam. The upper horizons of Saum silt loam are typically dark reddish brown in color, while those of Laurelwood silt loam are dark brown. The xerochrepts-rock complex is about 50-percent xerochrepts and 30-percent rock outcrop, and has variable permeability. Saum soil is well-drained with moderately slow permeability. Laurelwood soil is well-drained with moderate permeability. Tannery waste has contributed to the soil column over much of the Site.

2.2.3 Hydrogeology

The CRB comprises the deep groundwater aquifer at the Site. Groundwater supply wells are typically installed at depths of 200 feet or more. A City of Sherwood backup water supply well is located across Murdock Road near the northwest corner of the Site. There are three water supply wells located at the Site. A well on Tax Lot 100 is used for domestic water supply and is installed to
a depth of 330 feet. Wells on Tax Lot 700 (210 feet) and Tax Lot 1300 (69 feet) are reportedly used for irrigation.

There is no seasonal or perched water at the Site, with the exception of the lowland area around the wetland. Temporary groundwater monitoring wells were installed to depths of approximately 2 feet in three of the wetland sampling locations (WET-2, WET-3, and WET-4). Upon installation of each of the temporary monitoring wells, groundwater stabilized at or near the ground surface.

2.2.4 Surface Water and Stormwater Features

An approximate 2.5-acre wetlands area lies between the two knolls at the KFF eastern boundary. The wetland is in the palustrine emergent Cowardin class and in the depressional hydrogeomorphic (HGM) classification. Reed canary grass (Phalaris arundinacea) is the dominant wetland vegetation.

The wetland is located in a depressional landform, and the adjacent uplands slope moderately steeply down to the wetland from the north, west, and south. Wetland hydrology is fed by precipitation and runoff from the adjacent hillsides. There is a stormwater in-flow pipe in the northwest corner of the wetland that conveys stormwater beneath Ironwood Lanes from a small seasonal drainage on Tax Lot 100.

An outlet at the southeast end of the wetland leads to the Rock Creek drainage basin. Rock Creek is approximately 1,000 feet to the east at an elevation of about 150 feet. DEQ staff observed drainage from the wetland in late February 2014, after sustained rainfall events the preceding weeks. At this time the wetland had reached capacity. Isolated surface water was observed approximately 200 feet downhill from the wetland outlet, beyond which it infiltrated into the soil horizon. There was no indication of surface flow beyond this point, however, a rectangular vegetated channel continues down the hillside. It appears this channel is man-made given its rectangular cross section, and is consistent with linear features on historic aerial photographs (DEQ 2005). There is no evidence of channelized flow or established drainage from the wetland to Rock Creek. Based on these observations flow from the wetland is of low volume and frequency, and it is unlikely that significant runoff volume from the on-site wetland reaches Rock Creek. This conclusion is consistent with results of soil sampling completed by DEQ on the hillside adjacent to the wetland to the east (see Section 3.1.3)
3. INVESTIGATION RESULTS

3.1 NATURE AND EXTENT OF CONTAMINATION

This section summarizes RI data collected by DEQ. A detailed summary of prior investigations is included in the RI report.

From August through November 2013, Geosyntec Consultants (Geosyntec) and Kennedy/Jenks Consultants (Kennedy/Jenks) completed RI field activities at the Site on behalf of DEQ (Kennedy Jenks/Geosyntec, 2014b). The RI focused on establishing the nature and extent of hexavalent chromium [Cr(VI)], total chromium (trivalent chromium Cr[III] + Cr[VI]), lead, and mercury in soil, groundwater, sediments, and surface water at uplands and wetlands areas of the Site. RI field activities were conducted using a phased approach. Phase I soil sampling was conducted at Tax Lot 100, including the collection of discrete surface and subsurface soil samples at 98 locations at decision units DU-1 through DU-3. Most samples were collected from surface soil (0-6 inches), and a limited number of subsurface samples were collected from deeper intervals. Several composite surface soil samples also were collected at DU-1. Phase II soil sampling was scoped based on the results of the Phase I soil sampling and consisted of surface and subsurface discrete soil sampling at 229 locations at Tax Lots 200, 300, 600, 700, 1000, 1200, and 1300. Sample locations and Cr(VI) results for upland soil are shown on Figures 3 through 10.

In September 2013, a wetland field investigation was conducted that included the collection of wetland sediment, groundwater, and surface water samples at seven locations (Figure 11). In September and November 2013, groundwater sampling was conducted at three on-site wells, the City of Sherwood well #6, and a background well located approximately 0.5 miles from the Site.

In February 2013, DEQ staff collected soil samples in nearby off-site areas to assess regional background concentrations of total chromium and Cr(VI) in soil. DEQ staff also completed sampling on residential properties immediately south of the Site and on the hillside and valley to the east of the wetland area in August 2014.
3.1.1 Upland Soil

Site

Cr(VI) was distributed similarly across most of the Site, with generally higher concentrations found on downslope areas, consistent with land application of tannery waste and subsequent downhill migration through overland runoff. Mercury and lead were commonly detected. None of the Phase 1 samples from Tax Lot 100 contained lead above the DEQ human health risk-based concentration (RBC) for residential use. Mercury was detected above the RBC in a number of samples in the southern portion of Tax Lot 100.

Sampling data did not show a significant correlation of Cr(VI) to total chromium concentrations, or a clear correlation with geochemical parameters such as pH. There is a high degree of heterogeneity in Cr(VI) concentrations at a small spatial scale. Therefore, a relationship of Cr(VI) concentrations to other parameters could not be established. The measured pH of upland soils (5.1 to 8.9) indicated an increase in pH above anticipated native soil conditions (5.4 to 6.0). The alkaline soil pH conditions are attributed to historical lime amendments used for odor control following tannery waste application.

Metal concentrations in soil were generally highest at the southern portion of Tax Lot 100, which drains to the wetland area at the southeastern portion of the Site, and at Tax Lots 600 and 1000. Cr(VI) commonly was detected above 1 mg/kg and at a maximum concentration of 9 mg/kg. In general, lower concentrations of Cr(VI) were detected on Tax Lots 300 and 1200.

There were no clear trends of Cr(VI) concentrations with respect to depth below ground surface. The Cr(VI) detections along the southern boundaries of Tax Lot 600, Tax Lot 700, and Tax Lot 1000 suggested that Cr(VI) concentrations above the DEQ RBC for residential use of 0.29 milligrams per kilogram (mg/kg) may extend to the south of the Site boundaries.

Off-Site Residences

DEQ sampled six off-site residential yards to the south. Sample location maps are included as Appendix A and Cr(VI) results are shown on Table 1. Cr(VI) was detected above the residential RBC at three of six properties sampled. Cr(VI) was detected above the residential RBC in one of two samples collected at two properties, and for the third property Cr(VI) was detected above the RBC in three of six samples at the third property. There is no indication that tannery waste was directly applied to these properties. It is plausible that the presence of Cr(VI) detected above background levels on these properties is a result of re-deposition of soil through human foot traffic, animals tracks (e.g., deer), and windblown soil erosion from the Site.

3.1.2 Groundwater

Groundwater well sampling detected low levels of Cr(VI) in two of the three on-site wells sampled, and did not detect Cr(VI) in groundwater collected from the off-site City of Sherwood well or the background well (Table 2). Detected levels were above DEQ’s RBC for drinking
water. However, sampling results for regional water supplies show similar levels suggesting a regional ambient source of Cr(VI) in surface water and groundwater (see Section 3.3.3). One of the wells (Tax Lot 100) was used for drinking water and, therefore, DEQ completed an interim remedial action in April 2015 that connected the residence to the City of Sherwood water system.

### 3.1.3 Wetland Soil and Sediment

Wetland sediment analytical results are summarized in Table 3 and shown on Figure 11. In general, the RI wetland sediment results for total chromium were consistent with historical results collected by EPA (E&E, 2007) and Martin S. Burke and Associates, Inc. (MSBA, 2011). Total chromium was detected at concentrations up to about 97,000 mg/kg. Lead, mercury, and Cr(VI) also were detected at elevated concentrations, with the highest detections associated with the drainage pathway from the outfall to the center of the wetland. At location WET-002 the highest concentrations of total chromium, lead, and mercury were detected in both the near-surface and subsurface samples.

Cr(VI) concentrations ranged from 0.247 mg/kg to 6.54 mg/kg in wetland samples collected in October 2013. There was no apparent trend of Cr(VI) concentrations with respect to the depth of the sample. Total chromium concentrations ranged from 18 mg/kg to 90,000 mg/kg. Lead concentrations ranged from 3 mg/kg to 580 mg/kg. Mercury concentrations ranged from 0.03 mg/kg to 90 mg/kg. Total chromium, lead, and mercury concentrations were higher at near-surface depths relative to deeper sediment depths. Total chromium was detected at an elevated concentration of 1,300 mg/kg at the furthest downgradient location (WET-007).

Analysis of wetland sediment samples using the simultaneously extracted metal/acid volatile sulfide (SEM/AVS) method showed non-detect concentrations, with the exception of the duplicate sample (4.92 mg/kg; KFF-WET-007-SED-0308-DUP). Typically in sediments where chromium is the primary metal of concern, if AVS > 0.0 (detected) it would be expected that chromium would be present in trivalent form Cr(III), as opposed to more toxic Cr(VI). The lack of AVS detections indicates reduction of Cr(VI) to less toxic Cr(III) is not favorable. The wetland is also only seasonally inundated and near-surface sediments are dry for portions of the year. Consequently, sediment redox conditions also do not favor the reduction of Cr(VI) to Cr(III).

DEQ staff collected additional soil sampling on Tax Lot 1100 adjacent to the wetland and further down the valley slope to Rock Creek to determine if significant contamination had migrated from the wetland area. Samples also were collected on the east side of Tax Lot 100 to determine the extent of contamination that may have migrated downslope with overland stormwater runoff. The sample location map is included in Appendix A. Sample results are shown on Table 4. Sixteen samples were analyzed for total chromium, lead, and mercury. Two samples were analyzed for Cr(VI).

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1 This is different from the Tax Lot 1100 that is located within the Site boundary, for which DEQ issued a No Further Action Determination in 2007.
Generally low level concentrations were detected, and DEQ concluded that contamination had been adequately defined to the east of the Site towards the Rock Creek drainage basin (DEQ, 2014b).

3.1.4 Wetland Shallow Groundwater and Surface Water

Low levels of metals were detected in shallow groundwater and surface water collected at the wetland, indicating low mobility of chromium at the Site (Table 5). This is consistent with historical leaching tests of soil, which show very low leachability of chromium and other metals.

3.2 Risk Assessment

The results of the risk assessment for human health and potential ecological receptors at the Site are summarized below. More detail is available in Appendix A of the RI Report (Geosyntec, 2014).

3.2.1 Conceptual Site Model

The Locality of Facility (LOF) includes Tax Lots 100, 200, 300, 600, 700, 1000, 1200, 1300, and several tax lots to the south as indicated on Table 1. Within the Site boundary there are existing residences on Tax Lots 100, 200, 300, 700, 1200, and 1300. Tax Lots 600 and 1000 are not developed. The owner of Tax Lot 1000 has plans to subdivide their approximately 3 acre property into three lots of approximately 1 acre each.

All of the off-site properties contain residences. The CSM for potential human exposures within the LOF are shown on Figure 12. Exposure pathways retained for the risk assessment include:

- Current and future residential direct contact exposure to soil in the Site upland
- Future construction/excavation worker exposure to soil in the Site upland
- Current trespasser in the wetland area
- Future wetland visitor/trespasser

For the purposes of risk evaluation, each developed lot was divided into decision units (DUs) that represent the individual exposure areas. The DUs are based on assumed current residential use of differing portions of each property. High use areas surrounding homes containing structures, lawns, garden areas, etc., were assigned a DU-1 designation. The remaining undeveloped portion of these lots was divided into DU-2 and DU-3. Due to varying lot sizes and shapes, decision unit size among properties varied. Tax Lot 600 is undeveloped and was treated as one DU. Tax Lot 1000 also is undeveloped. There are plans to develop Tax Lot 1000 into three residential lots, and these were each treated as separate DUs.
3.2.2 Human Health Risk Assessment

Chemicals of interest (COIs) for the Site are chromium as total chromium and Cr(VI), lead, and mercury. COIs were screened against RBCs to determine contaminants of potential concern (COPCs). COPCs are the chemicals that were quantitatively evaluated in the HHRA.

Soil concentrations for lead and mercury were also screened against DEQ background concentrations for metals (DEQ 2013) listed for the South Willamette Valley. DEQ has not established statewide background levels for Cr(VI). Based on statistical analysis of the background soil results for Cr(VI) collected during the RI, it was concluded that typical background concentrations of Cr(VI) are nearly equivalent to the DEQ human health risk-based concentration for direct contact with soil under a residential exposure scenario (0.29 mg/kg).

In addition to screening individual COIs against RBCs, COPCs were selected based on potential exposures to individual or multiple COIs within both soil and groundwater. To evaluate cumulative risk from different media, the ratios of maximum detected concentration to RBC in both soil and groundwater were also summed (Sij). If Sij was less than 1, the chemical was not selected as a COPC based on potential cumulative exposure to COIs within different media.

Soil COPCs for human health are Cr(VI), mercury, and lead. Cr(VI) is the only COPC in groundwater.

The HHRA evaluated risk under reasonable maximum exposure (RME) conditions. The HHRA indicated that for site residents there is the potential for cancer risk estimates above the DEQ acceptable level of one in a million (1x10^-6) lifetime cancer risk and noncancer hazard quotient above the DEQ acceptable level of one. Risk estimates for direct contact with soil for each Tax Lot DU are summarized on Table 6. Risk estimates for exposure under construction/excavation worker or wetland trespasser/visitor exposure scenarios do not indicate unacceptable risk. Based on results from previous sampling and RI sampling, there are no “highly concentrated” hot spots for human exposures. Potentially unacceptable risk for various media and exposure scenarios is described below.

**Upland Surface Soil:**

- Upland surface soil at tax lots 100, 200, 300, 600, 700, 1000, and 1200, based on potential current and future direct contact exposures to Cr(VI) by residents and cancer risk estimates exceeding one in a million lifetime cancer risk

- Upland surface soil at DU-2 in Tax Lot 100, based on potential current and future direct contact exposures by residents to mercury and noncancer hazards

Cr(VI) and mercury were identified as contaminants of concern (COC) for soil. Lead does not present unacceptable risk and is not a COC. Unacceptable risk from Cr(VI) was identified for high use DU-1 areas on Tax Lots 100, 200, 700 and 1200. The unacceptable risk on Tax Lot 300 was for DU-2, which is not a high use area. The risk assessment also identified potential
unacceptable human health risk from Cr(VI) in the wetland area on Tax Lot 1300. However, the wetland area is not a high use area, and will likely not be developed in the future. According to the site developer, several feet of soil fill was placed on the developed portion of Tax Lot 1300 prior to construction of the residence, which is consistent with the low Cr(VI) levels found on the developed part of the property.

Groundwater:

- Groundwater potentially posed unacceptable risk at Tax Lot 100, based on exposure to Cr(VI) through use as domestic water supply and cancer risk estimates exceeding one in a million excess lifetime cancer risk.

Thus Cr(VI) was identified as a COC for groundwater.

3.2.3 Ecological Risk Assessment

A majority of the Site’s upland open spaces are vegetated with native grasses and small native and invasive non-native vascular plants, with a few small stands of older trees, including pines and madrones. Portions of the Site are heavily vegetated with blackberry briars, and in some areas poison oak is prevalent. Portions of the Site that adjoin the Rock Creek drainage basin, including Tax Lot 100, have been mapped by Metro as high value wildlife habitat (DEQ 2005). By 2006, many of the large trees in the Tax Lot 100 that provided high value habit area had been cut in anticipation of subdividing the property. Deer, coyote, smaller mammals, and birds also are assumed to use upland areas.

Threatened and endangered (T&E) terrestrial receptors were not observed to be present at the Site during site visits. Exposure pathways are not complete for T&E terrestrial receptors to be exposed to contaminants in soils (surface and subsurface). The Site comprises former pasture land and portions are currently developed for residential dwellings. It is reasonable to assume that further subdivision of lots for additional residential development is likely.

There is potential for wildlife such as birds, voles, gophers, and deer, in addition to soil invertebrates such as worms, to be in direct contact with contaminated soil. Animals could be exposed to COCs in soils within the terrestrial upland habitat of the Site. Exposure pathways are not complete for ecologically important terrestrial receptors to contaminants in groundwater. Also, groundwater is not present within the root zone at which most terrestrial plants could come into contact with groundwater.

The wetlands area inside the southeast corner of the Site, the low-lying area trending east to west across the center of the Site, and the ephemeral pond and wetlands area south of the Site have been mapped by Metro as highest value riparian habitat (DEQ 2005). The wetlands are seasonally inundated and do not provide aquatic habitat for fish species, and provide limited benthic habitat. The wetlands do provide ecologically important habitat for wildlife such as birds, amphibians, and reptiles. The risk screening indicated these receptors potentially are at
risk through direct contact with impacted surface soils, surface sediments, shallow pore water, and/or surface water.

Almost every upland soil sample contains total chromium levels exceeding the DEQ site-specific screening level value (SLV) of 155 mg/kg based on direct contact by birds with soil. This indicates that there is a potential unacceptable risk to birds through direct contact. The DEQ SLV for chromium in soil for direct contact with mammals is quite high (340,000 mg/kg). None of the detected concentrations in soil or sediment were above this concentration. Thus chromium does not present a risk to mammals at the Site.

3.3 BENEFICIAL USE AND HOT SPOT DETERMINATION

The criteria used to evaluate remedial alternatives for groundwater and surface water include consideration of whether a “hot spot” is present or not, as determined by a loss of “current or reasonably likely future” beneficial use of the water resource.

3.3.1 Groundwater Beneficial Use Determination

A beneficial use determination for groundwater and surface water was completed in the RI (Geosyntec, 2014). Shallow groundwater is seasonal and localized in the wetland areas. Its primary use is recharge to surface waters and possibly deeper groundwater. Surface waters in the immediate vicinity of the Site are not used for drinking water. Surface water rights allocations for irrigation, livestock watering, and fish and wildlife support exist for Rock Creek east of the Site. Deeper groundwater is used for drinking water and irrigation. Public water supply is available to the area from the City of Sherwood. The City of Sherwood obtains its water from the Willamette River water supply program. A network of City wells provides a backup supply. The City well near the Site is not currently used. Three groundwater wells are present at the Site. Since completion of the DEQ interim remedial action these wells are used only for irrigation and no longer supply drinking water. Based on groundwater well use at and near the Site, the current use of deeper groundwater in the site area is for drinking and irrigation uses. Given the availability of City water in the area, it appears unlikely that drinking water supply wells will be installed at the Site in the future.

3.3.2 Surface Water Beneficial Use Determination

Surface water bodies affected or potentially affected by site contamination are limited to the on-site wetland. Other water bodies, including Rock Creek, have not been affected by site contamination. The wetland provides a beneficial use for aquatic organisms, a potential water supply for terrestrial animals such as birds and mammals. The wetlands are only seasonally inundated and do not provide aquatic habitat for fish species, and only limited benthic habitat. The RI showed minimal impacts to surface water in the wetland or underlying shallow groundwater. On this basis no unacceptable risk through direct contact with surface water or surface water hotspots were identified.

3.3.3 Hot Spots

Cr(VI) was detected above its RBC in a drinking water well and for this reason could be
considered a groundwater hotspot under OAR 340-122-115(32)a. In consideration of this preliminary hot spot determination, the potential risk from ongoing residential use of this well, and the expense and timeframe needed for a comprehensive water quality assessment, DEQ completed an interim remedial action in April 2014 and connected the residence to the City of Sherwood Water supply as discussed in Sections 3.1.2 and 3.4.

After DEQ completed the IRAM, additional information regarding Cr(VI) in regional groundwater was obtained and evaluated. Regional water supply testing results for Cr(VI) are summarized below, along with the results from the Tax Lot 100 well.

**Table 7: Summary of Cr(VI) Concentrations in Regional Drinking Water**

<table>
<thead>
<tr>
<th>Source and Sampling Date</th>
<th>Minimum Detected (µg/L)</th>
<th>Maximum Detected (µg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tualatin Valley Water District Distribution System (2011)</td>
<td>&lt;0.05</td>
<td>0.220</td>
</tr>
<tr>
<td>Portland Water Bureau Source Water (2014)</td>
<td>&lt;0.03</td>
<td>0.048</td>
</tr>
<tr>
<td>City of Hillsboro (2014-2015)</td>
<td>0.113</td>
<td>0.204</td>
</tr>
<tr>
<td>City of Milwaukie (2013)</td>
<td>0.97</td>
<td>1.7</td>
</tr>
<tr>
<td>Tax Lot 100</td>
<td>0.14</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Results for regional water supply samples from various sources are similar to those found in the Tax Lot 100 well, suggesting that Cr(VI) contamination in the Tax Lot 100 is within the range of regional ambient concentrations of Cr(VI) in groundwater and not related to surficial contamination at the Site. On this basis DEQ does not believe contamination in deep groundwater is related to releases from the Site and concludes there is no hotspot in groundwater.

Total chromium levels in wetland sediment and soil are above the sediment hotspot level of 370 mg/kg, based on 10 times the DEQ SLV for sediment. They are also above the soil hotspot level of 1,550 mg/kg based on 10 times the SLV developed by DEQ for direct contact by birds.

For upland soil, the majority of locations sampled containing chromium at concentrations exceeding the hot spot level of 1,550 mg/kg. A localized area of Tax Lot 100 also contained lead and mercury at concentrations exceeding ecological hot spot levels.
3.4 ESTIMATE OF UPLAND SOIL CONTAMINANT EXTENT

Soil remedial action areas have been revised from those presented in the FS. The remedial areas developed for this ROD are based on a point by point comparison of the sample concentration to the DEQ RBC for human health, rather than on decision units that were used for the FS. The resulting areas capture all Cr(VI) concentrations above 0.29 mg/kg, the DEQ RBC for residential use. The total upland remedial area identified on a point by point basis is approximately 8.6 acres, corresponding to 374,600 square feet. The total volume of contaminated soil in the remedial action areas above the DEQ RBC for residential use is estimated at approximately 25,000 cubic yards. The estimated areal extent and volumes for each tax lot area are summarized on Table 8. Soil areas and volumes for high use properties, defined by existing yard and landscape areas, are shown on Table 9.

An alternative to addressing only the remedial areas identified on a point by point basis, is capping the entire upland area, which has advantages if implemented during site development as discussed below. The entire upland area of 31.2 acres was used for estimating purposes for this alternative.

3.5 INTERIM REMEDIAL ACTIONS

Based on groundwater sampling results for the Tax Lot 100 well DEQ, with the homeowner’s concurrence, disconnected the water supply well from the home and connected the home to the City of Sherwood water supply system. The work was completed in March 2015.

After the installation of the water line and backflow assembly, the City inspector visited the Site and approved backfilling of the trench. Upon completion of the trench backfilling, the disturbed soils were graded to match the existing grade and covered with a straw mulch to minimize erosion. The utility trench crossing at Ironwood Lane and the driveway were backfilled with gravel, compacted and paved with an asphalt patch.
4. PROJECT TEAM REVIEW SUMMARY

Technical documents produced during the investigation of the Site have been reviewed by a technical team at DEQ. The team consists of the project manager, toxicologist, engineer and Cleanup Section manager, who provided technical support and peer review. The team unanimously supports the recommended remedial action.
5. DESCRIPTION OF REMEDIAL ACTION OPTIONS

5.1 REMEDIAL ACTION OBJECTIVES

Acceptable risk levels, as defined in OAR 340-122-115(1) through (6), and remedial action objectives were developed based on the identified beneficial uses, exposure pathways and the risk assessment.

5.1.1 Acceptable Risk Levels

The following acceptable risk levels (ARLs) were used for site media to protect the identified beneficial uses and potential receptors.

<table>
<thead>
<tr>
<th></th>
<th>Upland Soil-Human Health</th>
</tr>
</thead>
<tbody>
<tr>
<td>COC</td>
<td>Acceptable Risk Level (mg/kg)</td>
</tr>
<tr>
<td>Cr(VI)(^a)</td>
<td>0.29</td>
</tr>
<tr>
<td>Chromium (III)</td>
<td>120,000</td>
</tr>
<tr>
<td>Lead</td>
<td>400</td>
</tr>
<tr>
<td>Mercury</td>
<td>23</td>
</tr>
</tbody>
</table>

5.1.2 Remedial Action Objectives

Site-specific remedial action objectives (RAOs) were developed for upland soil for the purpose of achieving protection of human health and beneficial uses, in accordance with OAR 340-122-040. The RAOs for the Site upland are as follows:

**RAO 1.** Prevent current and future site residents from exposure to soils containing Cr(VI) that would result in greater than one in one million additional cancer risk.

**RAO 2.** Reduce transport of chromium, lead, and mercury in soil runoff to the wetlands.

Because the upland area has been partially developed, and is reasonably likely to be further
developed into high density subdivisions, thus eliminating most of the natural habitat, DEQ screened out the terrestrial ecological risk pathways from RAO development. A potential remedial action to address ecological risks from the wetland area is not addressed in this ROD. In the event that additional funding becomes available beyond those needed to address human health risk, DEQ will revisit the need for a wetland remedy.

5.2 REMEDIAL ACTION OPTIONS

General response actions and remedial technologies were screened in the FS. The general response actions included in-situ treatment, excavation, and institutional and engineering controls. Several remedial technologies were evaluated for each general response action. Treatment was not retained as a remedial technology because it was evident it would be eliminated during the comparative analysis based on effectiveness and reliability concerns.

Viable response actions and technologies that can meet the RAOs were assembled into remedial action options. The remedial alternatives evaluated in this ROD vary somewhat from those presented in the FS. The remedial areas are based on a point by point comparison of the sample concentration to the DEQ RBC, rather than on decision units that were used for the FS. As a result, all sampling points with Cr(VI) above the DEQ RBC would be targeted for remediation, thus assuring protective conditions for future residents regardless of tax lot size or configuration.

The FS included capping and removal alternatives. DEQ identified a modified capping remedy, in addition to a consolidation and capping remedy, to be considered in remedy evaluation and selection.

5.2.1 Upland Alternative 1 (UA-1): No Action

No action would be taken to mitigate risk. This alternative is included to represent baseline conditions.

5.2.2 UA-2: Limited Capping in Place

Alternative UA-2 is designed to reduce exposure by isolating contaminants above the DEQ RBC for Cr(VI) in upland area soils.

Under Alternative UA2, the remedial action areas would be capped to prevent direct contact. Acceptable caps will include both softscapes (topsoil, landscaping) and hardscapes (buildings, pavement, brick, tile, etc.). For costing purposes it is assumed that a nominal 1-foot soil cap will be installed. A demarcation barrier will be installed between the clean soil cover and underlying impacted soil. This alternative controls potential risks and hazards from exposure to contaminated soils by limiting direct contact with impacted soil. The cap also reduces the susceptibility of residual impacted soil to erosion by wind or storm runoff.

Hydro-seeding, sodding and other re-vegetation efforts would be completed to reintroduce
vegetation. The hydro-seeding would provide erosion control for the new soil cap and lessen maintenance needs to preserve cap performance objectives.

Operation and maintenance (O&M) costs are based on annual inspections for the first five years, and on a 5-year basis after that. Any repairs needed will be the responsibility of the owners. Notification to the public and property owners regarding the presence of contamination and cap maintenance requirements would be accomplished by the following:

- Maintaining up-to-date tax lot specific information on DEQ’s Environmental Cleanup Site Information (ECSI) database.

- Close coordination with the City of Sherwood, such that owners/developers must receive no further action determinations prior to occupancy approval from the City.

- Oregon Real Estate Law ORS.105.465(2), which requires a seller to provide a disclosure statement to potential residential buyer, substantially in the same form specified under ORS 105.464. In this case the seller would disclose to potential buyers the presence of contaminated soil and need to existing caps and/or other remedial components.

- Providing owners with a Soil Management Plan containing information on cap construction and restoration, management of impacted soil.

- Recording No Further Action determinations or Certificate of Completions on property deeds.

If this remedy was implemented in one mobilization, it is estimated it would take approximately 100 days to complete. The estimated cost for Alternative UA2 is $3,619,000, but would be substantially higher if implemented in phases. Assuming that developed properties would be covered with 33% hardscape as part of routine development, the actual remedial cost would decrease proportionately.

Due to concerns regarding sample density and representativeness and potential for contaminant disruption during development, DEQ may require soil testing after soil cleanup to demonstrate protective conditions for residential use.

5.2.3 UA-3: Comprehensive Capping in Place

Alternative UA-3 would contain the same remedial elements as UA-2, except that capping would be expanded to cover the entire upland area within practical limits. Conditions that may eliminate the need for capping include steep slopes with no appreciable soil layer, exposed bedrock, wetlands and drainages, and street right of ways. If this remedy was implemented in one mobilization, it is estimated it would take on the order of 250 days to complete. The
estimated cost for Alternative UA3 is approximately $11,000,000, which is considered conservatively high as discussed in section 6.4.5.

5.2.4 UA-4: On-Site Consolidation and Comprehensive Capping

Alternative UA-4 is similar to UA-3, as it provides a comprehensive property-wide remedy. UA-4 was developed to allow for grading/removal of soil, consolidating on other areas of the site, and capping. This may be preferable for some properties, particularly those with shallow depth to bedrock, or to facilitate installation of a cap near existing structures, and could reduce capping areas that would need to be maintained. Following grading the upland would be capped and have maintenance requirements and public notification as described for UA-2. Areas that have soil removed to the extent practical would be capped with a nominal 6 inches of soil or hardscape as would be installed for standard residential developments. For these areas, a demarcation barrier would not be required, and there would be no cap maintenance requirements.

UA-4 was identified because it is likely that some properties will be graded to optimize land use and/or facilitate soil capping during subsequent development.

Because there are many different development scenarios and property-specific conditions, a detailed cost estimate for UA-4 was not completed. It is assumed that costs for this alternative would be similar to UA-3, as the grading costs would be offset by lower capping costs for the graded areas. Thus $11,000,000 is the estimated cost for this remedial alternative. The estimated time for completion also has a high degree of uncertainty, but is assume to have a similar implementation period (250 days) if completed in one mobilization.

5.2.5 UA-5: Excavation with Off-Site Disposal

Alternative UA-5 is designed to reduce exposure by removal of soil containing levels above the DEQ human health RBC for Cr(VI) in upland area soils. Soil would be disposed off-site in a permitted landfill.

Under UA-5, remedial action areas would be excavated and transported off-site for disposal. This alternative controls potential risks and hazards from exposure to contaminated soils by removal. Soil would be removed to the depth of bedrock which ranges from less than 0.5 to over 3 feet in the upland, with an average depth of 2 feet used to calculate removal volumes. The excavated areas, assuming that all soil has been removed to the extent practical, would be capped with a nominal 6 inches of soil or hardscape as would be installed for standard residential developments. A demarcation barrier would not be required, and there would be no cap maintenance requirements.

If this remedy was implemented in one mobilization, it is estimated it would take approximately 130 days to complete. The estimated cost for Alternative UA5 is 5,805,000. As for UA-2, due to
concerns regarding sample density and representativeness and potential for contaminant
disruption during development, DEQ may require soil testing after soil cleanup to demonstrate
protective conditions for residential use.
6. EVALUATION OF REMEDIAL ACTION OPTIONS

6.1 EVALUATION CRITERIA

The criteria used to evaluate the remedial action alternatives described in Section 5 are defined in OAR 340-122-090, and establish a three-step approach to evaluate and select a remedial action. The first step evaluates whether a remedial action is protective; if not, the alternative is unacceptable and the second step evaluation is not required. The remedial alternatives considered protective are evaluated and compared with each other using five balancing factors. The five balancing factors are 1) effectiveness in achieving protection, 2) long-term reliability, 3) implementability, 4) implementation risk, and 5) reasonableness of cost. The third step applies if a hotspot is present. If so, DEQ rule mandates a preference for treatment or removal of hotspots, and allows a higher threshold for evaluating the reasonableness of additional costs. The third step was not necessary due to the absence of hotspots in the upland.

6.2 PROTECTIVENESS

The protectiveness of a given remedial action is evaluated by comparing estimated residual risk to the acceptable risk levels described in section 5.1.1 of this document. Direct contact with site soil is the primary pathway of concern.

OAR 340-122-090 states that protectiveness may be achieved by any of the following methods:

- Treatment
- Excavation and off-site disposal
- Engineering controls
- Institutional controls
- Any other method of protection
- A combination of the above

Where a hot spot has been identified, OAR 340-122-090(4) establishes a preference for treatment to the extent feasible, including a higher threshold for evaluating the reasonableness of costs for treatment. No human health hotspots were identified in the Site upland.
6.2.1 UA-1: No Action

Alternative 1 would not take any action to minimize potential human or environmental exposure, by reducing concentrations of COCs, migration of COCs, or using engineering or institutional controls. The potential for future exposure of residents to soil that exceeds the acceptable risk level would still exist. Therefore, Alternative 1 is not protective and will not be evaluated further.

6.2.2 UA-2: Limited Capping in Place

Capping remedial action areas will substantially reduce direct contact with the COCs and prevent their migration from those areas, and would be protective as long as properly maintained. The sampling density of approximately 10 samples per acre leads to concerns of uncertainty in Cr(VI) distribution and whether the limited cap would address all areas with Cr(VI) above the RBC.

6.2.3 UA-3: Comprehensive Capping in Place

An expanded cap, effectively covering all contaminated soil and preventing direct contact, is protective of human health provided the cap is maintained.

6.2.4 UA-4: On-Site Consolidation and Comprehensive Capping

Consolidation and comprehensive capping is similar to UA-3 and would be protective.

6.2.5 UA-5: Excavation with Off-Site Disposal

Excavation and removal is protective of human health. There would be similar concerns on the certainty of Cr(VI) distribution as indicated for UA-2 above.

6.3 BALANCING FACTORS

The four remedial action alternatives determined to be protective are evaluated against the following balancing factors defined in OAR 340-122-090(3):

- **Effectiveness in achieving protection.** The evaluation of this factor includes the following components:
  
  - Magnitude of the residual risk from untreated waste or treatment residuals, without considering risk reduction achieved through on-site management of exposure pathways (e.g., engineering and institutional controls). The characteristics of the residuals are considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, propensity to bio-accumulate, and propensity to degrade.
- Adequacy of any engineering and institutional controls necessary to manage residual risks.
- The extent to which the remedial action restores or protects existing or reasonably likely future beneficial uses of water.
- Adequacy of treatment technologies in meeting treatment objectives.
- The time until remedial action objectives are achieved.

- **Long-term reliability.** The following components are considered when evaluating this factor, as appropriate:
  - The reliability of treatment technologies in meeting treatment objectives.
  - The reliability of engineering and institutional controls needed to manage residual risks, taking into consideration the characteristics of the hazardous substances being managed, the ability to prevent migration and manage risk, and the effectiveness and enforceability over time of the controls.
  - The nature and degree of uncertainties associated with any necessary long-term management (e.g., operations, maintenance, monitoring).

- **Implementability.** This factor includes the following components:
  - Practical, technical, legal difficulties and unknowns associated with the construction and implementation of the technologies, engineering controls, and/or institutional controls, including the potential for scheduling delays.
  - The ability to monitor the effectiveness of the remedy.
  - Consistency with regulatory requirements, activities needed to coordinate with and obtain necessary approvals and permits from other governmental bodies.
  - Availability of necessary services, materials, equipment, and specialists, including the availability of adequate treatment and disposal services.

- **Implementation Risk.** This factor includes evaluation of the potential risks and the effectiveness and reliability of protective measures related to implementation of the remedial action, including the following receptors: the community, workers involved in implementing the remedial action, and the environment; and the time until the remedial action is complete.
• **Reasonableness of Cost.** This factor assesses the reasonableness of the capital, O&M, and periodic review costs for each remedial alternative; the net present value of the preceding; and if a hot spot has been identified at this site, the degree to which the cost is proportionate to the benefits to human health and the environment created through treatment of the hot spot.

In general, the least expensive remedial action is preferred unless the additional cost of a more expensive corrective action is justified by proportionately greater benefits to one or more of the other balancing factors. For sites with hot spots, the costs of remedial actions must be evaluated to determine the degree to which they are proportionate to the benefits created through restoration or protection of beneficial uses of water. A higher threshold will be used for evaluating the reasonableness of costs for treatment of hot spots than for remediation of areas other than hot spots. The sensitivity and uncertainty of the costs are also considered.

### 6.4 COMPARATIVE ANALYSIS OF BALANCING FACTORS

For the balancing factors, each alternative was ranked in relation to every other alternative for each of the evaluation criteria. For the sole purpose of evaluating overall relative ranking, the rankings within each balancing factor were given a score of 1, 0.75, 0.5, 0.25 or 0 respectively. A summary of DEQ’s comparative analysis is shown on Table 10.

This section evaluates each of the remedial action alternatives that met the protectiveness criteria against the balancing factors described in Section 6.3. The sections below summarize the major conclusions of this comparison and provide additional discussion for differentiating issues at this site.

#### 6.4.1 Effectiveness

UA-2 can be effective as long as the cap is maintained, which includes periodic inspections and repair as needed. It would not reduce contaminant toxicity or mass. There are concerns regarding uncertainty in Cr(VI) distribution and whether the limited cap would address all areas with Cr(VI) above the RBC, thus lowering its effectiveness rating. A limited cap installed prior to development could be subject to damage during development, potentially reducing its effectiveness. Site development could mobilize contamination, and lead to concerns on whether the cap was effectively remediating elevated concentrations. Testing may be needed to assess whether contamination was mobilized and to confirm effectiveness for UA-2 and UA-5. In addition, soil containing total chromium, lead and mercury would potentially be exposed and subject to transport to the wetland from surrounding properties that drain to the wetland.

As for UA-2, neither UA-3 nor UA-4 would reduce contaminant toxicity or mass. UA-3 and UA-4 would have a much higher degree of effectiveness than UA-2 in addressing RAOs. UA-4 would have similar effectiveness as UA-3, and depending on placement of the graded/excavated material, could be more effective than UA-3.
UA5 is effective in removal of human health COCs to the extent practical in remedial areas, thus reducing mass and associated toxicity, and direct contact with contaminated soil. As for UA-2, there are concerns regarding uncertainty in Cr(VI) distribution, including vertical extent, and whether limited excavation would address all areas with Cr(VI) above the RBC. However, because residual soil containing total chromium lead and mercury would remain in other areas (similar to UA-2), UA-5 may have limited effectiveness in addressing RAO2.

**6.4.2 Long-Term Reliability**

Capping remedies UA-2, UA-3, and UA-4 are reliable as long as the cap is maintained. These alternatives rely on property owners to disclose the need for cap maintenance to prospective purchasers, as there are no formal restrictions to be recorded on property deeds. This could affect long term reliability, especially for subsequent transactions. Capping remedies include periodic DEQ inspections to verify that caps remain effective.

Over time the cap could be disturbed to some extent by animals such as moles and gophers. The thickness of the cap and placement of demarcation barrier is expected to result in minimal residual contaminated soil reaching the surface.

Installation of underground sprinklers may require an installation depth greater than 1-foot, and thus the demarcation layer could be breached. A soil management plan will provide information on long term management of the cap, thus improving reliability that the cap will be restored.

UA-2 addresses a smaller remedial area and thus has lower long term reliability for reducing risk than UA-3 and UA-4. UA-3 and UA-4 are assumed to have similar long term reliability. The long-term reliability of UA-5 is higher than UA-2. It is considered similar to UA-3 and UA-4, because, although it addresses a smaller area, there is no long term inspection and maintenance needed.

**6.4.3 Implementability**

The installation of a cap on relatively flat, vacant properties is straightforward. However, capping around existing structures requires additional engineering for the transition between capping materials and existing grade. Much of the existing vegetation and shrubs in capped areas would be removed. If placement of a cap is required on slopes, retaining walls or enhanced erosion control methods may be needed. On developed properties there may be access limitations on heavy equipment. Portions of remedial areas already covered with concrete, asphalt, bricks or other hardscape, or otherwise have an existing cap deemed sufficient, will be left intact. Identifying and working around these areas may affect implementability. Testing may be needed to assess whether contamination was mobilized and to confirm effectiveness for UA-2 and UA-5, thus affecting implementation of these alternatives.

UA-3 and UA-4 could be incorporated into development, and testing would not be required under either of these alternatives, improving the implementability score.
UA-5 has a number of implementation issues. Loading of trucks for off-site soil transport and disposal adds difficulty to UA-5. Uneven bedrock surfaces may prevent complete removal of impacted soil using standard equipment. Excavating up to 2 feet or more around existing residences, driveways, structures, etc., presents implementation challenges and risk of property damage. On hillsides targeted for removal, it may not be possible to remove significant amounts of soil, and capping alone would be employed. Excavating around mature trees may not be possible due to root systems.

6.4.4 Implementation Risk

Human health and safety concerns for all remedial alternatives include increased truck traffic and associated risk from accidents or vehicle exhaust, worker safety, construction noise, and fugitive dust emissions. The implementation risk for these factors is directly related to the duration of the remedial action. The shorter duration remedy generally will have the least implementation risk. Excavation remedies could increase the potential for erosion of exposed soil through wind or rain, and potentially compromise existing structures. Excavation and off-site disposal present a risk for accidents and potential release of soil.

Remedial work will be conducted in accordance with a site-specific contaminated media management plan (CMMP) and health and safety plan, in addition to an erosion and sediment control plan (ESCP) which requires erosion prevention measures, and sediment and stormwater controls.

Capping alternatives will involve limited, if any, handling of contaminated soil, which limits contaminant mobilization and potential exposure to site workers or residents.

Mobilization of contamination is an implementation risk for UA-2 and UA-5, as contaminated soil would remain exposed to erosion and runoff under these alternatives. UA-5 has additional risk associated with off-site transport of soil and scores the lowest in implementation risk. Because UA-3 and UA-4 are comprehensive remedies the risk of contaminant mobilization is low, but this is offset by the scope and duration of a comprehensive capping remedy and physical hazards associated with heavy equipment. Thus implementation risk for UA-2, UA-3 and UA-4 are deemed equivalent.

6.4.5 Reasonableness of Cost

Cost estimates were developed for each of the upland remedial options based on net present worth of capital costs and long-term costs. The following list summarizes the cost estimates for the identified alternatives:

- Alternative UA-1, No Action ($0)
- Alternative UA2, Limited Capping ($3,619,000)
- Alternative UA3, Comprehensive Capping ($11,354,798)
- Alternative UA-4, Consolidation and Capping ($11,000,000)
- Alternative UA-5, Excavation and Off-site Disposal ($5,805,000)

Cost estimates assume that the remedial alternative would be conducted in one mobilization, which does not seem likely. Completion of cleanup in phases would likely be needed to accommodate varying plans among property owners, and would increase overall costs. It is assumed that UA-3 and UA-4 involve installation of a soil cap over the entire tax lot. Assuming that developed properties would be covered with a significant amount of hardscape as part of routine development, which would be eligible for apportionment, the actual remedial cost would decrease accordingly.

Because site development would have tasks and equipment common to capping remedies, the estimated costs for implementation of these remedies are conservatively high, since it includes costs that would be incurred during routine site development, regardless of contamination.
7. RECOMMENDED REMEDIAL ACTION ALTERNATIVE

The comparative analysis summarized on Table 12 shows that the active remedial alternatives scores ranged from 2.5 to 3.25. UA-3 and UA-4 score highest in effectiveness as they best satisfy the RAOs. UA-2 and UA-5 score higher for cost given that UA-3 and UA-4 are much more expensive, although estimated costs for UA-3 and UA-4 are somewhat artificially elevated as they include costs that would be borne during standard site development.

7.1 SELECTED REMEDIAL ACTION ALTERNATIVE

Based on the high level of effectiveness and reliability in addressing RAOs, UA-3 (Comprehensive Capping) is the selected remedy for undeveloped properties. To allow property owners to conduct additional work and/or implement other cleanup methods DEQ has identified a Contingency Remedy that allows for other alternatives to be implemented. Landscaped (yard) areas of currently developed properties will be remediated by DEQ through capping of remedial areas identified on a point by point basis, rather than through comprehensive capping. This is because the existing grasses, plants and landscaping in yard areas reduce direct contact with contaminated soil, cover waste remnants, and reduce erosion, and in this capacity are functioning adequately as a cap. Elements of the plan are discussed below.

7.1.1 Comprehensive Cap

Elements of the selected comprehensive capping remedy include the following:

- Cap over remedial areas within landscaped (yard) areas of currently developed properties.
- Cap over entire tax lot of undeveloped properties with imported soil or other materials installed over a demarcation barrier.
- DEQ will provide specifications for acceptable caps.
- Hardscape areas, such as buildings and driveways, would be eligible for apportionment.
- Long-term monitoring and maintenance.
- Work completed under terms of an appropriate agreement between DEQ and the property owner.
- Certificate of Completion recorded on property deed.
- DEQ will provide funding assistance through apportionment of KFF settlement account.
- DEQ would provide oversight of design and construction.
- DEQ would complete public notice and opportunity to comment.
• Contingency remedies such as removal or partial capping may be acceptable but would require site-specific approval by DEQ and public notice (see below).

### 7.1.2 Reasons for Selection of a Comprehensive Cap

A comprehensive cap was selected as a remedy for the following reasons:

- It is protective of human health and the environment, provides the best balance of remedy selection factors (effectiveness, long-term reliability, implementability, implementation risk and cost reasonableness).
- Excavation and off-site disposal and/or treatment is not necessary since contaminant concentrations are below hot spot levels.
- Caps have proven effectiveness if properly maintained.
- It addresses uncertainties with the surface and subsurface extent of Cr(VI) contamination and eliminates need for additional sampling during design and following construction.
- It addresses the potential for contaminated surface and subsurface soils to be redistributed within the tax lot during site grading and development.
- It is protective even in the event that the toxicity of hexavalent chromium changes when EPA completes its reassessment of Cr(VI), whereas removal or a partial cap may not be protective.
- All tannery waste disposal areas are capped including those with bone fragments, hide scraps and elevated Cr(III) (toxic to birds and other ecological receptors) and/or lead and mercury, which were identified as contaminant of potential concern for human health.
- It reduces the potential for stormwater runoff and potential impacts to the wetlands.

### 7.1.3 Funding Assistance

Criteria for apportionment of settlement funding include the following:

- Landscaped (yard) areas of currently developed properties will be cleaned up by DEQ using settlement funds by January 2018
- Undeveloped properties will be cleaned up by property owners or developers under site-specific funding and oversight agreements.
- The apportionment amount for undeveloped properties is set at approximately $57,000 per acre of capped area, DEQ arrived at this amount through an equitable division of settlement funds over all tax lots requiring cleanup. DEQ’s anticipated long-term oversight costs also will be funded by the settlement account.
- To ensure timely implementation of the ROD, the funds will be obligated for apportionment for a period of 10 years. Funds not used by 2026 may be used for wetland cleanup, and/or cleanup at the Frontier Leather site pursuant to terms of the settlement.
- Due to the potential for inflation and increased remediation costs, property owners or developers are encouraged to enter into site-specific funding agreements and cleanup their properties as quickly as possible.
7.1.4 **Contingency Remedy**

An owner may elect to complete additional investigation and propose alternate cleanup methods. The elements of a contingency remedy are as follows:

- DEQ will consider an alternative (contingency) remedy if an owner desires to implement a remedy other than comprehensive capping.
- Parties who wish to pursue a contingency remedy would need to enter into a site-specific participation agreement with DEQ, hire an environmental consultant, collect and test additional samples at a DEQ approved laboratory, complete a risk assessment, and prepare a cleanup plan. Testing would need to evaluate all Contaminants of Potential Concern for human health, which include hexavalent chromium, lead, and mercury.
- If an owner desires to implement UA-2, capping of remedial areas on a point by point basis, DEQ may require additional soil testing depending on development plan and lot sizes.
- Areas remediated would be eligible for apportionment; areas not requiring remediation would not be eligible for apportionment. Thus, owners may not receive the maximum funding amount based on tax lot size if a contingency remedy is implemented.
- DEQ would provide oversight of design and construction.
- Hardscape areas, such as buildings and driveways, would be eligible for apportionment.
- For remedies implemented prior to development, DEQ would reserve the right to require additional sampling to verify that construction activities do not re-contaminate previously cleaned up areas or otherwise mobilize contamination. Property owners would be responsible for repairing damaged caps or remediating re-contaminated areas.

7.1.5 **Institutional Controls**

For communicating the presence of contaminated soil and the need to maintain the cap DEQ has identified alternatives to traditional formal controls such as an EES or a Notice of Environmental Contamination. These include:

- Maintaining up-to-date tax lot specific information on DEQ’s Environmental Cleanup Site Information (ECSI) database
- Close coordination with the City of Sherwood, such that owners/developers must enter into an appropriate cleanup agreement with DEQ prior to approving development plans, and receive a Certificate of Completion or no further action determination prior to occupancy approval from the City.
- Oregon Real Estate Law ORS.105.465(2), which requires a seller to provide a disclosure statement to potential residential buyer, substantially in the same form specified under ORS 105.464. In this case the seller would disclose to potential buyers the presence of contaminated soil and need to existing caps and/or other remedial components.
• Recording the Certificate of Completion or no further action determination issued by DEQ after site cleanup on the property deed. In cases where property is purchased under a Prospective Purchaser Agreement, the agreement would be recorded on the property deed.

• Providing owners with a Soil Management Plan containing information on cap construction, repair and management of impacted soil.

7.2 PLAN FOR OFF-SITE PROPERTIES

There are three residential properties south of the Site where elevated Cr(VI) levels have been detected. Subject to approval by the property owners, DEQ would conduct additional sampling to verify the extent of contamination and determine whether these additional areas may warrant capping. Although potential capping of these offsite properties has not been included in the cost estimate, costs are not anticipated to be large.

7.3 RESIDUAL RISK ASSESSMENT

OAR 340-122-084(4)(c) requires a residual risk evaluation of the recommended alternative that demonstrates that the standards specified in OAR 340-122-040 will be met, namely:

• Assure protection of present and future public health, safety, and welfare, and the environment

• Achieve acceptable risk levels

• For designated hot spots of contamination, evaluate whether treatment is reasonably likely to restore or protect a beneficial use within a reasonable time

• Prevent or minimize future releases and migration of hazardous substances in the environment

The proposed remedial action for soil is protective of human health and the environment. The acceptable risk levels for human health prescribed by the Oregon Environmental Cleanup Statute and implementing rules are $1 \times 10^{-6}$ excess lifetime cancer risk for individual carcinogens, $1 \times 10^{-5}$ for cumulative carcinogens, and a hazard index of one for non-carcinogens. The selected remedy manages soil contamination which means that the residual risk is equivalent to the baseline risk. There currently is no unacceptable risk from non-carcinogens or cumulative risk from carcinogens. Soil that presents a potential risk to site residents in high use areas from direct contact will be capped. Currently undeveloped properties will be remediated before occupation. Maintenance needed to ensure protective conditions will be the responsibility of the owners. Notification to the public and property owners regarding the presence of contamination and cap
maintenance requirements would be accomplished through the controls listed in Section 16.1.5.
8. PUBLIC NOTICE AND COMMENTS

DEQ’s notice of the proposed remedial action was published in the Secretary of State’s Bulletin and in the Oregonian on September 1, 2016. Copies of the DEQ ROD, RI and FS Reports, and other documents in the Administrative Record were made available on DEQ’s website and in DEQ’s Northwest Region office. DEQ Staff gave an informational presentation on the proposed remedy at Sherwood City Hall on September 22, 2016. The public comment period ended on September 30, 2016. Comments were received from two property owners and/or their representatives, and from one citizen. The comments and DEQ responses are included as Appendix B.

A comment from one party was in opposition to long term storage of contaminated soil at the Site. This commenter asserted that capping material, if used, should be concrete and that warning signs should be place on each property.

Comments from owners concerned how DEQ was apportioning the settlement funds, and clarification on what alternative methods would be allowed to achieve site cleanup.

Based on public comments, DEQ included more details on the rationale for remedy selection, important elements of the remedy, criteria for apportionment of settlement funds in the ROD, and provided for a contingency remedy. No substantive changes were made to the recommended remedial alternative were necessary to address the comments.
9. ADMINISTRATIVE RECORD INDEX

The Administrative Record consists of the documents on which the recommended remedial action for the Site is based. The primary documents used in evaluating remedial action alternatives for the Ken Foster Farm site are listed below. Additional background and supporting information can be found in the project file located at DEQ Northwest Region Office, 700 NE Multnomah Street, Suite 600, Portland, Oregon.

SITE-SPECIFIC DOCUMENTS


Creekside Environmental Consulting, LLC. 2006b. Environmental Site Investigation Report - Pat & Tammy Huske Properties 23320 & 23000 SW Murdock Road, Sherwood, Oregon 97140.


GeoEngineers. 2009. Data Summary Report, Tax Lot 600, Former Ken Foster Farm, Sherwood, Oregon File No. 16283-001-01. Data Summary report,


Martin S. Burck Associates, Inc. (MSBA). 2011. Sampling and Analysis Plan, Former Ken Foster Farm, Ironwood Homes - Wetland, SW Murdock Road, Sherwood, Oregon ESCI No. 4750


Oregon Department of Environmental Quality. 2005. Preliminary Assessment (PA), Ken Foster Farm (former) 23000-23500 SW Murdock Road, Sherwood, Oregon 97410, EPA ID#ORN1002567.


Oregon Metro, 2013. Regional Land Information System (RLIS),
http://rlisdiscovery.oregonmetro.gov


STATE OF OREGON


GUIDANCE AND TECHNICAL INFORMATION

DEQ. Background Levels of Metals in Soils for Cleanups. March 20, 2013.

DEQ. Risk-Based Concentrations for Individual Chemicals. Last revised 7 June 2012.


