

6.0 BASELINE RISK ASSESSMENT FOR SITE 31

The baseline human health risk assessment (BRA) for Site 31, the Former Dump Site, is presented in this section. This BRA follows the methods presented in Section 2.0. Any specific deviations from these methods are identified in the sections that follow.

6.1 Site Background

The following sections summarize the background information for Site 31, including a discussion of its history and features such as geology, hydrogeology, land use, and a review of nearby populations.

6.1.1 Physical Setting

Site 31 is in the southern part of the East Garrison on elevated land overlooking the Salinas Valley to the north. The site is approximately 0.2 mile southeast of the intersection of Watkins Gate and Barloy Canyon roads. Site 31 is located within and adjacent to a ravine that is oriented from west to east (Plate 6.1). Site 31 is subdivided topographically into three areas for the purposes of risk assessment: the North Slope, the South Slope, and the Leadership Reaction Training Compound (LRTC) Area. The North Slope encompasses the northern slope of the ravine; the South Slope encompasses the ravine floor and lower part of the southern ravine slope; and the LRTC Area includes the relatively level area above the North Slope (Plate 6.1). The LRTC Area is partially occupied by the Leadership Reaction Training Structure, an obstacle course previously used by the military as part of the training activities at Fort Ord. Unused structures from this training area remain onsite.

The ravine at Site 31 is approximately 70 feet deep. The North Slope is very steep, with a gradient of about 50 percent. Surface soil on this slope is loose, and visible debris can be found over an approximately 500-foot-long section. The North Slope is vegetated mostly with grasses, with several small patches of coast live oak trees. An ephemeral stream is located on the ravine

floor; this stream contains water only during heavy rains. The South Slope is heavily vegetated with coast live oak woodland. The LRTC Area is vegetated mostly with grasses, with some small patches of oaks.

Site 31 is underlain by dense to very dense silty sand of the Aromas Sand. In the relatively flat LRTC Area, up to 1 foot of disturbed sandy material overlies undisturbed native silty sands. Generally, 13 or more feet of loose sand overlies undisturbed native silty sand along the North Slope. Past cut-and-fill practices may have resulted in the deposition of clean sandy material on this slope. Native surface sandy soil is found at the relatively undisturbed South Slope. The depth to groundwater is assumed to be approximately 12 feet below MSL, which is approximately 135 feet below the floor of the ravine. A detailed description of the site is provided in Volume II Remedial Investigation, Site 31, Section 3.0.

6.1.2 Land Use

Site 31 was used as a dump site in the 1940s, when the East Garrison had its largest population. Items of refuse found on the North Slope appear to be from the 1940s and 1950s, indicating that Site 31 was used as a dump site into the 1950s. Site 31 may also have been used as a general refuse landfill from the 1930s. Ash and melted glass within the debris indicate that a significant amount of the refuse was incinerated prior to dumping. The incinerator most likely used to burn the refuse was at the top of the ravine, within the area now called the LRTC Area. A detailed description of historical land use is provided in Volume II Remedial Investigation, Site 31, Section 1.2.

For future land use planning, Site 31 has been designated as part of Polygon 11B, comprising 734 acres that include the East Garrison. Sites 29, 30, and 32 of the basewide investigation are part of the East Garrison and are included in Polygon 11B. Two hundred acres of this parcel are slated to become the Monterey Agricultural

Center, which will include facilities for agricultural production, storage, cooling, packaging, and distribution, and approximately 250 housing units for families and farm workers. Development of the Agricultural Center is expected to take place predominantly in areas that are already developed in the parcel, particularly the East Garrison and the Ammo Supply Point (which is southeast of Site 3). The remainder of Polygon 11B is to be set aside as open space/habitat, with a priority on preserving areas that are natural habitats (*FORG, 1994; COE, 1994*). Precise future plans for Site 31 are unknown. The steep nature of Site 31 and its natural habitats suggest that part will be set aside as open space and not developed as part of the Agricultural Center.

6.1.3 Nearby Population

Two onbase areas near Site 31, Site 29 and the Ammo Supply Point, are still in use by the Army. Site 29 includes a DRMO facility, and the Ammo Supply Point stores explosives used by UXO clearance personnel; workers may be found at both sites at least part of the time. Site 29 is approximately 0.3 mile to the north of Site 31, and the Ammo Supply Point is approximately 0.25 mile to the south. Site 31 and the remaining nearby areas are not currently used. The nearest offbase residential buildings are in the Salinas River Valley, approximately 0.5 mile to the northwest of Site 31 and approximately 0.75 mile to the southeast. Workers and residents may be located in these onbase and offbase areas in the future.

In the future, people associated with the Monterey Agricultural Center may be on base property near Site 31. Construction workers, farm and other Agricultural Center workers, and residents (children and adults) may be in the area on a temporary or permanent basis. In addition, park rangers are expected to frequent the open space areas, and students and scientists from the adjacent university campuses slated to be built at Fort Ord may also visit the wild habitat reserves. Visitors may also use the open space areas on or adjacent to Site 31 for recreation.

6.2 Data Evaluation

Soil sampling conducted by HLA at Site 31 as part of the RI site characterization activities took place in two phases. No sampling activities were conducted by any company other than HLA. Phase 1 included carrying out geophysical surveys; installing and sampling 18 soil gas survey probes as a screening method to detect the presence of VOCs in soil, consistent with methods outlined in the RI/FS Work Plan (*HLA, 1991c*); and installing and sampling 18 soil borings. Phase 2 field activities included collection of 57 surface soil samples (i.e., at a depth of 0.0 feet bgs) and installing and sampling 21 soil borings. A detailed description of site sampling activities is provided in Volume II, Remedial Investigation, Site 31, Section 2.0. No groundwater sampling was conducted at Site 31.

In all, 61 samples were collected from Phase 1 and 2 soil borings, with 1 to 3 samples collected from each boring at depths of 0.0 to 16.0 feet bgs. Samples were analyzed for VOCs, SOCs, pesticides/PCBs, CDDs and CDFs, TPH as diesel, and priority pollutant metals (including hexavalent chromium). Two VOCs, 11 SOCs, 7 pesticides, CDDs and CDFs, TPH as diesel, and 13 metals were detected at Site 31 overall. These data are provided in Appendix C, Volume II Remedial Investigation, Site 31.

Data from soil samples collected at Site 31 for the Baseline Ecological Risk Assessment (ERA) were not evaluated in the BRA because all data points except one were from composite samples. The one non-composite data point for soil obtained from the LRTC Area was not evaluated because concentrations did not differ substantially from the data previously obtained. In addition, sufficient data were available to assess Site 31 without the inclusion of the ERA data.

The methods used to evaluate chemical data for use in this BRA are discussed in detail in Section 2.1. The suspected source of chemicals detected at Site 31 is onsite dumping of general refuse and incinerator ash. No offsite sources of chemicals were identified in the RI report.

As described in Section 2.1.1.5, data were segregated by depth for the North Slope, South Slope, and LRTC Area. North Slope data were divided into surface soil data (0 to 2 feet bgs), subsurface data (greater than 2 to 10 feet bgs) and deep soil data (greater than 10 feet bgs). The South Slope and the LRTC Area data were divided into surface data (0 feet bgs); subsurface data (greater than 0 to 10 feet bgs), and deep data (greater than 10 feet bgs). Chemicals detected at each area are summarized in the sections that follow.

6.2.1 North Slope

Chemicals detected in North Slope soils are summarized as follows:

- Surface Soil (0 to 2 feet bgs): SOCs (carcinogenic PAH expressed as B[a]P-TE and total cPAH, dibenzofuran, fluoranthene, 2-methylnaphthalene, naphthalene, phenanthrene, and pyrene), pesticides (4,4'-DDE and 4,4'-DDT), CDDs and CDFs expressed as TCDD-TE, and metals (antimony, arsenic, beryllium, cadmium, total chromium, copper, lead, mercury, nickel, silver, and zinc) (Table 6.1a)
- Subsurface Soil (greater than 2 to 10 feet bgs): VOCs (acetone and methylene chloride), pesticides (4,4'-DDE and 4,4'-DDT), CDDs and CDFs expressed as TCDD-TE, TPH as diesel, and metals (antimony, arsenic, beryllium, cadmium, total chromium, copper, lead, mercury, nickel, silver, thallium, and zinc) (Table 6.1b)
- Deep Soil (greater than 10 feet bgs): Pesticides (aldrin, gamma-BHC [lindane], 4,4'-DDE, 4,4'-DDT, dieldrin, endrin, and heptachlor) and metals (antimony, arsenic, beryllium, total chromium, copper, lead, nickel, and zinc) (Table 6.1c).

6.2.2 South Slope

Chemicals detected in South Slope soils are summarized as follows:

- Surface Soil (0 feet bgs): TCDD-TE and metals (antimony, arsenic, beryllium,

cadmium, total chromium, copper, lead, mercury, nickel, and zinc) (Table 6.2a)

- Subsurface Soil (greater than 0 to 10 feet bgs): VOCs (acetone), TCDD-TE, and metals (antimony, arsenic, beryllium, cadmium, total chromium, copper, lead, mercury, nickel, and zinc) (Table 6.2b)
- Deep Soil (greater than 10 feet bgs): Samples were not collected.

6.2.3 LRTC Area

Chemicals detected in LRTC Area soils are summarized as follows:

- Surface Soil (0 feet bgs): TCDD-TE and metals (antimony, arsenic, beryllium, total chromium, copper, lead, mercury, nickel, and zinc) (Table 6.3a)
- Subsurface Soil (greater than 0 to 10 feet bgs): TCDD-TE and metals (antimony, arsenic, beryllium, total chromium, copper, lead, mercury, nickel, and zinc) (Table 6.3b)
- Deep Soil (greater than 10 feet bgs): Metals (arsenic, beryllium, total chromium, lead, nickel, and zinc) (Table 6.3c).

6.2.4 All Areas

Statistical data analyses for chemicals detected in soil at these three areas are presented in Tables 6.1a to 6.3c. CDDs and CDFs are reported as TCDD-TE, and carcinogenic PAH are reported as B(a)P-TE and Total cPAH in these tables, as described in detail in Section 2.2.7. Also presented for each detected chemical are the frequency of detection, minimum and maximum detected concentrations, arithmetic mean concentration, standard deviation of the arithmetic mean, and 95 percent upper confidence limit of the arithmetic mean concentration.

Carcinogenic PAH was detected in only one out of 8 analyses in surface soil at the North Slope. At a site where a chemical is detected at some sampling stations and nondetected at others, EPA (1989b) recommends that the arithmetic mean be

calculated by adding one-half the method detection limit for each nondetect sample to the detected concentrations and dividing this sum by the number of analyses. For all samples with nondetected concentrations of PAH at the North Slope, one-half the detection limit was greater than the maximum (i.e., only detected) concentration; these values were therefore excluded from statistical calculations on the basis of EPA guidance (1989b). There is, therefore, only one data point for B(a)P-TE and total cPAH at the North Slope.

Hexavalent chromium was not detected in soil at Site 31. A total of 88 samples were analyzed for hexavalent chromium, including 56 at the North Slope, 12 at the South Slope, and 20 at the LRTC Area. Detection limits for these samples ranged from 0.10 to 20 mg/kg. Detected concentrations of total chromium are therefore assumed to represent trivalent chromium.

TIC data were available for all areas at Site 31 in EPA Test Method 8240 and 8270 datasets. Fourteen compounds were identified as TICs, in addition to several unknown TICs. Of the TICs reported, 2,4'-DDD, 4,4'-DDE (detected by EPA Test Method 8270), and 1,2,3-trichlorobenzene (detected by EPA Test Method 8240) are of potential interest with respect to the BRA.

EPA Test Method 8270 (SOCs) is not designed to specifically analyze for semivolatile pesticides such as DDE and DDT. The identity of these compounds in the TIC results for EPA Test Method 8270 is questionable because mass spectrographic analytical methods are unable to distinguish between the 2,4'- and 4,4'- isomers of DDD, DDE, and DDT. Because 4,4'-DDE and 4,4'-DDT were detected by EPA Test Method 8080 at Site 31 (at the North Slope), it was assumed that the fully validated dataset for this site provided data that are representative of the pesticides onsite.

1,2,3-Trichlorobenzene was detected only once in the TIC analysis, at depth (9.0 feet bgs) and at a low concentration (22 ppb). Exposure to this chemical is unlikely given the predicted future use of the site; additionally, adverse health effects are unlikely at this concentration. These

TICs were not, therefore, further evaluated in the BRA for Site 31.

6.3 Selection of Chemicals of Potential Concern (COPCs)

This section describes the selection of COPCs in soil for quantitative risk assessment at Site 31. COPCs were selected separately for each of the three areas evaluated (i.e., the North Slope, South Slope, and LRTC Area). The COPC selection was conducted only for chemicals detected in surface soil (defined in Section 6.2) on the basis of the exposure assessment of Site 31, as will be described in Section 6.4.4. The methods used are described in detail in Section 2.1.2.

6.3.1 North Slope

COPC selection for the North Slope is summarized in Table 6.4. Seven SOCs (including potentially carcinogenic PAH), two pesticides, TCDD-TE, and 11 metals were detected in surface soil (0 to 2 feet bgs) at the North Slope. The first step of the COPC selection process, background comparison, eliminated one metal, nickel, because its maximum detected concentration is less than background.

The second step was elimination of chemicals considered to be essential human nutrients. As shown in Appendix B, the Estimated Daily Dose (EDD) for zinc at the North Slope is 0.618 mg/day, which is less than 5 to 10 mg/day, the RDA for a 0- to 6-year-old child. Zinc was therefore eliminated as a COPC at the North Slope.

The third step, comparison of the maximum detected lead concentration to the Health-Based Screening Level (HBSL), retained lead as a COPC. The maximum concentration of 22,100 mg/kg is significantly greater than the HBSL of 240 mg/kg.

In the fourth step, the detected chemicals still remaining were evaluated using a toxicity screen (Section 2.1.2.2). The details of this screening step are presented in Table C13 in Appendix C. This step eliminated the following chemicals detected in North Slope soil whose screening HQs were less than the target screening HQ of

0.01: chromium, dibenzofuran, fluoranthene, mercury, 2-methylnaphthalene, naphthalene, phenanthrene, pyrene, and silver. The following chemicals were retained as COPCs because their screening HQs exceed 0.01: antimony, arsenic, cadmium, and copper. For chemicals detected at the North Slope that have available slope factors, all screening cancer risks exceed 1×10^{-8} , including those calculated for arsenic, B(a)P-TE, beryllium, 4,4'-DDE, 4,4'-DDT, and TCDD-TE. These chemicals were therefore retained as COPCs.

As described in Section 2.2.7, carcinogenic PAH (cPAH) were evaluated using B(a)P-TE concentrations to assess carcinogenic effects and Total cPAH concentrations to assess noncarcinogenic effects. If concentrations of either B(a)P-TE or Total cPAH were selected by the screening steps, both were evaluated in the quantitative risk assessment.

Two Group A carcinogens were detected at the North Slope, nickel and arsenic. Nickel was eliminated as a COPC because the maximum concentration was less than background, as discussed above. Arsenic was retained on the basis of the toxicity screen. Lead, mercury, and 2,3,7,8-TCDD are identified as California Proposition 65 chemicals; lead and TCDD-TE were retained as COPCs as described above. Mercury, however, was eliminated because the screening HQ is less than 0.01.

To summarize, the following chemicals were retained as COPCs for the North Slope at Site 31 (Table 6.4): antimony, arsenic, B(a)P-TE (and therefore Total cPAH), beryllium, cadmium, copper, 4,4'-DDE, 4,4'-DDT, lead, and TCDD-TE.

6.3.2 South Slope

The selection of COPCs at the South Slope is summarized in Table 6.5. TCDD-TE and 10 metals were detected in South Slope surface soil (0 feet bgs). The first step, comparison to background concentrations, eliminated arsenic, beryllium, chromium, mercury, and nickel. The second step, evaluation of essential nutrients, eliminated zinc. An EDD of 0.038 mg/day was calculated for zinc for the South Slope, as

described in Appendix B. This value is below the RDA of 5 to 10 mg/day.

The third step, evaluation of lead, eliminated lead as a COPC because the maximum concentration, 166 mg/kg, is below the HBSL of 240 mg/kg. The fourth step, the toxicity screen, eliminated antimony and copper because the screening HQs are less than 0.01. Screening cancer risks were calculated for cadmium and TCDD-TE at this area; both screening risks exceed 1×10^{-8} . The details of the toxicity screen are presented in Table C14 in Appendix C. Cadmium and TCDD-TE were, therefore, retained as COPCs for this area.

Two Group A carcinogenic chemicals, arsenic and nickel, were detected at the South Slope. Both metals were eliminated as COPCs in the background comparison. Mercury, lead, and 2,3,7,8-TCDD are California Proposition 65 chemicals; mercury was eliminated in the background comparison, and lead was eliminated by comparison to the HBSL. TCDD-TE was retained as a COPC for this area, as described above.

To summarize, two chemicals, cadmium and TCDD-TE, were retained as COPCs for the South Slope (Table 6.5).

6.3.3 LRTC Area

Table 6.6 summarizes the selection of COPCs for the LRTC Area at Site 31. TCDD-TE and nine metals were detected in surface soil (0 feet bgs) at the LRTC Area. The following chemicals were eliminated in the first step, the background comparison: arsenic, beryllium, chromium, mercury, nickel, and zinc. Because the background comparison eliminated zinc, the evaluation of essential nutrients was not conducted for the LRTC Area. The next step, evaluation of lead, eliminated lead as a COPC because the maximum concentration of 79.90 mg/kg is below the HBSL of 240 mg/kg. The final step, the toxicity screen, eliminated antimony but retained copper because the screening HQ of copper exceeds 0.01. A screening cancer risk was calculated only for TCDD-TE, the other known or suspected carcinogenic chemicals having been eliminated

in previous steps. The details of the toxicity screen are presented in Table C15 in Appendix C. The screening risk exceeds 1×10^{-6} ; TCDD-TE was, therefore, retained as a COPC.

Two Group A chemicals, arsenic and nickel, were detected at the LRTC Area. Both metals were eliminated in the background comparison. Mercury, lead, and 2,3,7,8-TCDD are California Proposition 65 chemicals; mercury was eliminated in the background comparison and lead was eliminated by comparison to the HBSL. TCDD-TE was retained as a COPC, as described above.

To summarize, two chemicals, copper and TCDD-TE, were selected as COPCs at the LRTC Area at Site 31 (Table 6.6).

6.4 Exposure Assessment

The following section discusses the nature and degree of potential exposure to the COPCs that may occur at Site 31.

6.4.1 Chemical Source and Migration Analysis

Section 3.0 of the introduction to the RI (Volume II) presents a general discussion of chemical fate and transport. Section 3.0 of the Introduction to the RI also includes a table of physical and chemical properties pertaining to environmental fate and transport of chemicals detected at the Fort Ord RI sites, and a discussion of potential chemical migration pathways. Section 5.0 of the Site 31 RI presents a site-specific discussion of chemical fate and transport, and identifies potential chemical migration pathways at Site 31. The potential migration pathways identified in Section 5.0 of the Site 31 RI are discussed in the following sections.

The only potential source (i.e., retention medium) at Site 31 is soil, resulting from the historical dumping of refuse and incinerator ash.

Release of chemicals from soil can occur through volatilization of chemicals, wind erosion, stormwater runoff, or downward migration of chemicals into groundwater. These potential

release mechanisms are discussed below for the COPCs detected in surface soil at the North Slope, South Slope, and LRTC Area, in relation to the characteristics of Site 31.

6.4.1.1 Chemical Vapors

Through volatilization, certain chemicals can be released from soil in a vapor phase. As indicated in Section 6.3, the COPCs detected in soil at Site 31 included SOCs, pesticides, CDDs and CDFs, and metals. SOCs, pesticides, and CDDs and CDFs generally have either high molecular weights (i.e., greater than 200) or low to moderate vapor pressures and Henry's Law constants; chemicals having either of these properties are generally unlikely to volatilize to air. In addition, these chemicals have moderate to high organic carbon partition coefficients (K_{oc}), indicating that they tend to sorb readily to soil, further reducing the potential for chemical volatilization. Metals are generally present in the environment either in their pure elemental form or as inorganic salts, both of which are essentially nonvolatile. For these reasons, volatilization was not considered a viable migration pathway for the COPCs; therefore, vapor emissions from soil to air were not evaluated.

6.4.1.2 Fugitive Dust

Wind or mechanical erosion can lead to the release of chemicals from soil. The same physicochemical properties that limit the migration of the COPCs from soil by volatilization result in the tendency of these chemicals to sorb to soil particles; the particles may become entrained in the air as fugitive dust as a result of wind erosion. This potential migration pathway can result in human exposures to the COPCs through the inhalation of dust. Although dust generation is expected to be minimal due to substantial vegetation at the site, as discussed in Volume II Remedial Investigation, Site 31, Section 5.0, this pathway was evaluated in the BRA to avoid underestimation of exposures. This chemical migration route was therefore quantitatively evaluated.

6.4.1.3 Stormwater Runoff

The extent to which chemicals are transported in stormwater runoff depends on the physical and chemical characteristics of the chemicals, soil type, and amount of rainfall. The organic COPCs present in onsite soil have limited water solubilities and high soil sorption tendencies and may therefore be prone to runoff by sorption to soil particles that are transported to onsite or offsite soil or surface water bodies. The metal COPCs detected are also expected to sorb moderately strongly to site soil, and might therefore be prone to runoff. Due to the friable surface soil conditions and sparse vegetation found at some parts of the North Slope, some transport of chemicals via stormwater runoff to the ravine floor may occur. Data from surface soil collected at the bottom of the ravine were evaluated as part of the South Slope data set.

6.4.1.5 Leaching

The potential for chemicals to leach from soil to groundwater depends on the physical and chemical properties of the chemicals, the chemical concentration, soil type, pH (for metals), and other site-specific conditions. For example, metals in soil in a low pH (i.e., acid) environment generally have a tendency to leach downward through the soil column. The soil pH measured at Site 31 ranged from 5.1 to 8, indicating that there is little potential for metals to leach to groundwater. The SOCs, pesticides, CDDs and CDFs, and metals detected at the site are expected to sorb strongly to soil particles. In addition, the depth to groundwater from the floor of the ravine is over 130 feet. Soil leachate modeling conducted for Site 31, as described in Appendix D of Volume II RI, Site 31, indicated that the COPCs are not expected to leach from soil to groundwater. This potential chemical migration route was not, therefore, quantitatively evaluated in this BRA.

To summarize, the emission of fugitive dust was considered the most likely chemical migration mechanism to occur and was therefore quantitatively evaluated in the risk assessment for Site 31.

6.4.2 Potential Receptors and Exposure Pathways

This section identifies the hypothetical receptors that could be exposed to COPCs at Site 31. The general methods used to identify receptors are discussed in Section 2.2. The information presented in Section 6.1, describing the general site topography, current and possible future land uses, and current and possible future demographics, form the basis of the exposure assessment of Site 31. Because the site is inactive, there are no receptors currently onsite. This discussion therefore considers only possible future receptors (i.e., on- or offsite).

Possible future on- and offsite receptors who may be exposed to chemicals at Site 31 include child and adult residents, construction workers, farm and other Agricultural Center workers (e.g., office or distribution facility workers), recreational visitors/trespassers, and park rangers. Scientists and students from the proposed future universities who are interested in the local habitat may also be receptors. Each of these receptors is discussed in more detail below.

As discussed in Section 6.1.2, the proposed Monterey County Agricultural Center is expected to be located in areas of Polygon 11B that are already developed and relatively level. This information indicates that the developed part of the East Garrison and the Ammo Supply Point, which are northwest and southeast of the site, respectively, are likely to be considered as sites for the Agricultural Center. The ravine at Site 31 (i.e., the North Slope and South Slope), having a 50 percent gradient, is too steep for construction.

Onsite residents, construction workers, and other workers are, therefore, considered unlikely to be located in these areas. Residences could possibly be built at the LRTC Area which, while small, is generally level. However, possible resident receptors at this area would be unlikely to spend more time at the steep and inaccessible North Slope (where the highest onsite chemical concentrations were detected) than a visitor from offsite. Moreover, concentrations of chemicals detected in soil at the LRTC Area are the lowest of the three onsite areas (Tables 6.3a - 6.3c), and are unlikely to substantially contribute to risks and hazards possibly associated with exposure to

chemicals at Site 31. The LRTC Area was not, therefore, evaluated for a residential scenario and was evaluated as described below.

Although these receptors are not likely to experience onsite exposures, the potential exists for future offsite exposures through inhalation of dust from Site 31. The distances of the developed East Garrison areas and the Ammo Supply Point from the site are approximately 0.3 and 0.25 mile, respectively. Although the areas where offsite residents or workers may be located is relatively near Site 31, the prevailing winds for most of the year are westerly and tend to blow dust toward the east, away from these areas. In addition, the vegetative cover at the site tends to reduce dust emissions to air, making it unlikely that people at these offsite locations would be exposed to dust from soil at Site 31. Offsite residents, construction workers, and farm and other Agricultural Center workers were not, therefore, identified as receptors for this site.

Park rangers, scientists, students, and recreational visitors are the remaining possible future receptors for this site. Recreational visitors/trespassers from the housing proposed to be located near Site 31 (i.e., residences associated with the Agricultural Center, as described in Section 6.1.2) are likely to visit the site more frequently and be younger than the other possible intermittent visitor receptors. Recreational visitors are likely to be children or teenagers attracted by the isolation, woods, and ravine at Site 31. For these reasons, and because children are considered to be more sensitive to the potential toxic effects of chemicals than adult receptors, child visitors were identified as hypothetical future receptors for this site. These receptors are henceforth referred to as "nearby resident trespasser receptors." Other potential visitor receptors were considered to have substantially less exposure to this site; therefore, no other receptors were quantitatively evaluated in the risk assessment for Site 31.

Possible routes, or pathways, of exposure of the nearby resident trespasser receptor to onsite chemicals in soil at Site 31 include incidental ingestion of soil, dermal contact with soil, and inhalation of dusts entrained in air. These exposure routes were considered likely and were

therefore quantitatively evaluated. Because dust emissions are likely to be reduced by the vegetative cover over much of the North Slope, South Slope, and LRTC Area, thus reducing the potential for receptors to inhale dusts, the inclusion of this pathway for quantitative evaluation is considered to be highly conservative.

Nearby resident trespasser receptors will not come into contact with groundwater at this site, but are likely to contact surface water and sediment when the ephemeral stream at the base of the ravine contains water. However, this stream contains water only after heavy storms, and the water readily infiltrates the sandy soil, as discussed in Section 6.4.1. Exposure to surface water is considered, therefore, to be an insignificant route of potential exposure. Therefore, exposure to surface water was not quantitatively evaluated.

To summarize, the following hypothetical future receptor and potential exposure pathways were quantitatively evaluated for the North Slope, South Slope, and LRTC Area at Site 31:

- Incidental ingestion of soil by nearby resident trespasser receptors
- Dermal contact with soil by nearby resident trespasser receptors
- Inhalation of dusts by nearby resident trespasser receptors.

These exposure pathways are discussed in the following section.

6.4.3 Exposure Scenarios

This section discusses the site-specific conditions (i.e., exposure assumptions) that are used to quantitatively evaluate the nearby resident trespasser receptors at Site 31. Both average and Reasonable Maximum Exposure (RME) exposure scenarios are presented, as discussed in Section 2.2.3. Section 2.2.5 presents the exposure assumptions (e.g., soil contact rates) common to receptors considered for this and the other sites evaluated in this BRA. Section 2.2.5 also presents general definitions for exposure

duration (ED), exposure frequency (EF), exposure time (ET), and fraction of intake (FI). Because the topography, access, and other physical conditions are different for the North Slope, South Slope, and LRTC Area, some exposure assumptions for these areas also differ and are addressed separately.

Children from the proposed residences associated with the Agricultural Center were assumed to possibly play at the site. Despite the relatively inaccessible nature of much of the site (i.e., the steep and heavily wooded ravine), ingress is gained relatively easily. These hypothetical nearby resident trespassers would be expected to enter Site 31 by Barloy Canyon Road to the west or Watkins Gate Road to the east.

For the average scenario, a child receptor aged 6 through 9 years was evaluated, giving an ED of 3 years. The receptor was assumed to be aged 6 through 18 years for the RME scenario, giving an RME ED of 12 years. It was considered unlikely that children younger than 6 years of age would visit the site because of the steep ravine and heavily wooded areas.

For the average scenario, the nearby resident trespasser receptor was assumed to play at the site each day of the weekend, for every week for 6 months of the year, giving an average EF of 48 days per year (i.e., 2 days times 4 weeks times 6 months). The receptor was assumed not to visit the site for the remaining 6 months of the year due to inclement weather. Once the nearby resident trespasser receptor enters Site 31, he or she may visit all three areas (i.e., the North Slope, South Slope, and LRTC Area). The EF for all three areas was therefore assumed to be equal, i.e., 48 days per year. The RME EF was assumed to be twice the average EF, or 96 days per year for all areas. This RME EF is very conservative because it assumes that the receptor plays at Site 31 every weekend day every week of the year, whatever the weather, and does this for all of the 12 years from 6 to 18 years of age.

An analysis of children's activities conducted by the EPA (1990b) found that children are likely to spend approximately 2 hours per day playing outdoors while at home. The nearby resident trespasser receptor was, therefore, assumed to

spend 2 hours at the site on any visit. Moreover, this receptor was assumed to spend an equal amount of time at each of the three onsite areas, giving an ET of 0.66 hour (i.e., 2 hours divided by 3) for the North Slope, South Slope, and LRTC Area. This ET of 0.66 hour was used to evaluate exposure to soil through inhalation of dust for both the average and RME exposure scenarios.

In risk assessments, FI is used to evaluate exposure to soil by ingestion and dermal contact; this term accounts for the fact that the time the receptor spends at Site 31 was divided between three areas. The receptor was conservatively assumed to receive 100 percent of his or her daily exposure to soil by ingestion or dermal contact while at Site 31, equally divided among the three areas. The North Slope is less accessible because of the approximately 1:1 gradient. However, it was assumed to have the same FI as the South Slope and LRTC Area because the steep side and loose surface soil were considered to potentially increase the receptor's contact with the soil, compared to the degree of direct contact with soil that is possible at the other two areas. The nearby resident trespasser receptor was, therefore, assumed to spend one third of his or her total time at the site at each of the three areas, giving an RME FI of 0.33 each for the North Slope, South Slope, and LRTC Area. The FI for the average scenario was assumed to be 0.16, or half the RME FI, for each of the three areas.

The very conservative RME scenario likely overestimates actual exposure conditions that may occur at the site in the future, and, therefore, may lead to an overestimation of potential RME risks and hazards. The site-specific exposure assumptions used in the risk assessment for Site 31 are summarized in Table 6.7.

6.4.4 Exposure Point Concentrations (EPCs)

Section 2.2.7 presents the methods used for developing EPCs. As discussed in Section 6.4.2, the exposure pathways quantitatively evaluated for the nearby resident trespasser at Site 31 are exposure to soil by ingestion, dermal contact,

and inhalation of dusts. The EPCs used for the first two pathways are represented by the soil concentrations of the COPCs, as defined in Section 2.2.7.

The nearby resident trespasser receptor was assumed to be exposed only to chemicals detected at the soil surface at the South Slope and LRTC area. This receptor was assumed not to engage in activities (e.g., digging) that would expose him or her to soil at a greater depth. The EPCs used for these two areas were, therefore, the COPC concentrations detected in soil at 0.0 feet bgs. Surface soil at the North Slope, where the historical dumping of refuse and incinerator ash predominantly occurred, is looser than at the other two areas due to the presence of sandy fill and surface and near-surface debris. Moreover, the vegetative cover (predominantly grasses) is less dense at the North Slope than at the South Slope and LRTC Area. For these reasons, the soil is more friable at the North Slope. When climbing on this steep slope, the receptor could possibly sink down to 2 feet bgs. The EPCs used for the North Slope, therefore, were the COPC concentrations detected from 0 to 2 feet bgs.

The EPCs used to evaluate the inhalation of dusts were calculated by multiplying the soil concentrations of the COPCs by the site-specific PM_{10} value, as discussed in Section 2.2.7. The EPCs are presented in Tables 6.8 to 6.10 for each area.

As discussed in Section 6.2, cPAH was detected at only one location at Site 31, at the North Slope. On the basis EPA (1989b) guidance, an arithmetic mean was not calculated. The one detected concentration was, therefore, used to evaluate both the average and RME scenarios (Table 6.8).

6.4.5 Estimation of Exposure (Dose)

The methods for estimating the dose from presumed exposure to all COPCs (except lead) are described in Section 2.2.4. The EPCs for Site 31 are presented in Section 6.4.4. Section 2.2.5 presents the receptor- and pathway-specific exposure assumptions used for all the sites

evaluated in this risk assessment; assumptions specific to Site 31 are presented in Section 6.4.3. The calculations for the estimated exposure dose are presented in Appendix E.

Because of its unique toxicological properties, exposure to lead was evaluated for Site 31 through modeling (i.e., the LEADSPREAD model), as described in Section 2.2.9. The results of the lead evaluation are discussed below in Section 6.6 and presented in Appendix F.

6.5 Toxicity Assessment

The methods used to evaluate potential toxic effects of the COPCs at Site 31 are described in Section 2.3. The toxicity values (RfDs and SFs) used to quantitatively evaluate the exposure pathways for Site 31 are presented in Table 2.9.

6.6 Risk Characterization

The methods used to estimate potential adverse noncancer health effects and potential, upper-bound cancer risks associated with exposure of the nearby resident trespasser to the COPCs detected at Site 31 are discussed in Section 2.4. The following sections present the results of the risk characterization for the North Slope, South Slope, and LRTC Area at Site 31. Possible noncancer health effects are presented, followed by potential cancer risks and results of the lead exposure evaluation.

6.6.1 Possible Noncancer Health Effects

This section discusses possible noncancer effects associated with potential exposure of the nearby resident trespasser receptor to COPCs in soil at all three areas of Site 31.

6.6.1.1 North Slope

Possible noncancer health effects estimated for the receptor for the North Slope are presented in Tables E47 and E48 in Appendix E. The multipathway noncarcinogenic hazard indexes (HIs) are estimated to be 0.0008 and 0.02 for the average and RME scenarios, respectively. This indicates that no noncarcinogenic adverse health

effects are anticipated for the nearby resident trespasser receptor at the North Slope.

6.6.1.2 South Slope

Possible noncancer health effects estimated for the receptor for the South Slope are presented in Tables E49 and E50 in Appendix E. The multipathway noncarcinogenic HIs are estimated to be 0.00004 and 0.0004 for the average and RME scenarios, respectively. This indicates that no noncarcinogenic adverse health effects are anticipated for the nearby resident trespasser receptor at the South Slope.

6.6.1.3 LRTC Area

Possible noncancer health effects estimated for the receptor at the LRTC Area are presented in Tables E51 and E52 in Appendix E. The multipathway noncarcinogenic HIs are estimated to be 0.00007 and 0.003 for the average and RME scenarios, respectively. This indicates that no noncarcinogenic adverse health effects are anticipated for the nearby resident trespasser receptor at the LRTC Area.

6.6.1.4 Summary of Possible Noncancer Health Effects

Table 6.11 presents the estimated total HIs for Site 31, which are the sums of the multipathway noncarcinogenic HIs for the North Slope, South Slope, and LRTC Area. The average and RME total HIs are 0.0009 and 0.02, respectively. This indicates that no noncarcinogenic adverse health effects are anticipated for the nearby resident trespasser receptor for Site 31.

6.6.2 Possible Cancer Risks

This section discusses the possible cancer risks associated with potential exposure of the nearby resident trespasser receptor to COPCs in soil at all three areas of Site 31.

6.6.2.1 North Slope

Possible cancer risks estimated for the receptor for the North Slope are presented in Tables E47 and E48 in Appendix E. The estimated lifetime cancer risk for the average scenario is 1×10^{-8} ,

and the estimated lifetime cancer risk for the RME scenario is 8×10^{-7} . These values are both below the EPA target risk range of 1×10^{-6} to 1×10^{-4} .

6.6.2.2 South Slope

Possible cancer risks estimated for the receptor for the South Slope are presented in Tables E49 and E50 in Appendix E. The estimated lifetime cancer risks are 8×10^{-11} and 6×10^{-9} for the average and RME scenarios, respectively. These are both below the EPA target risk range of 1×10^{-6} to 1×10^{-4} .

6.6.2.3 LRTC Area

Possible cancer risks estimated for the receptor for the LRTC Area are presented in Tables E51 and E52 in Appendix E. The estimated lifetime cancer risks are 9×10^{-10} and 6×10^{-8} for the average and RME scenarios, respectively. These are both below the EPA target risk range of 1×10^{-6} to 1×10^{-4} .

6.6.2.4 Summary of Possible Cancer Risks

Table 6.12 presents the estimated total cancer risks for Site 31, which are the sum of the multipathway cancer risks estimated for the North Slope, South Slope, and LRTC Area. The average and RME total cancer risks are 2×10^{-8} and 8×10^{-7} , respectively. These risks are below the EPA target risk range of 1×10^{-6} to 1×10^{-4} .

6.6.3 Results of Lead Exposure Evaluation

The methods for evaluating lead exposure are discussed in Section 2.2.9. The output of the LEADSPREAD model performed to evaluate possible lead exposure for the nearby resident trespasser receptor at Site 31 is presented in Tables F29 and F30 (Appendix F), and the results are summarized in Table 6.13. Possible lead exposure was evaluated for only one area at Site 31, the North Slope, because it is the only area where lead is a COPC.

The ninety-ninth percentile blood-lead level estimated for the receptor for the average

exposure scenario is 5.24 $\mu\text{g}/\text{dl}$, which is less than the target ninety-ninth percentile blood-lead level of 10.0 $\mu\text{g}/\text{dl}$ (Section 2.4.3). The ninety-ninth percentile blood-lead level estimated for the RME scenario is 16.1 $\mu\text{g}/\text{dl}$, which is above the target ninety-ninth percentile blood-lead level of 10.0 $\mu\text{g}/\text{dl}$. This result suggests that adverse health risks may result from exposure to RME concentrations of lead in surface soil at the North Slope.

The results of the background lead exposure evaluation are presented in Appendix A. The ninety-ninth percentile blood-lead concentration estimated for exposure to background levels of lead at Site 31 is 3.87 $\mu\text{g}/\text{dl}$ for both the average exposure and RME scenarios. This result indicates that approximately 74 percent of the average exposure blood-lead level estimated for the receptor for the North Slope is due to background concentrations of lead, and approximately 1.38 $\mu\text{g}/\text{dl}$ is attributable to site-related lead concentrations. Similarly, 24 percent of the RME blood-lead level is due to background concentrations, and 12.23 $\mu\text{g}/\text{dl}$ is attributable to site-related lead concentrations.

6.7 Uncertainty Analysis

Section 7.0 presents an analysis of the uncertainties and limitations that may impact the BRAs conducted for five RI sites at Fort Ord. These uncertainties are considered to generally include those pertinent to Site 31. A potential site-specific uncertainty is the assumption that the nearby resident trespasser receptor spends an equal amount of time at the North Slope, South Slope, and LRTC Area, giving an equal exposure time (ET) and fraction of intake (FI) for each of the three areas. This assumption could overestimate the amount of time the receptor spends at the North Slope, and could, therefore, overestimate cancer risks and noncancer health effects for this area. The reasons for this assumption are discussed in Section 6.4.3 and represent best professional judgment with respect to conditions at the site.

6.8 Summary of Baseline Risk Assessment for Site 31

The BRA for Site 31 described the methods for estimating potential cancer risks and adverse noncancer health effects associated with possible exposure to COPCs at this site. For the risk assessment, the site was divided into three areas: the North Slope, South Slope, and LRTC Area.

One receptor and three exposure pathways were selected for quantitative evaluation. The nearby resident trespasser receptor was assumed to be exposed to soil by incidental ingestion, dermal contact, and inhalation of dust at each of the three areas.

The potential cancer risks and noncancer health effects estimated for the nearby resident trespasser receptors at Site 31 are summarized in Tables 6.11 and 6.12; results of the lead exposure evaluation are summarized in Table 6.13. As discussed in Section 6.6.1, adverse noncancer health effects associated with exposure to the COPCs other than lead are not anticipated for the nearby resident trespasser receptors at Site 31. Moreover, estimated cancer risks are all below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (Section 6.6.2).

Section 6.6.3 presents the results of the lead exposure evaluation for the North Slope, the single area at Site 31 where lead was selected as a COPC. The average estimated blood-lead level is below the EPA threshold blood-lead level. The RME estimated blood-lead level of 16.1 $\mu\text{g}/\text{dl}$ (Table 6.13), however, exceeds the EPA threshold blood-lead level of 10 $\mu\text{g}/\text{dl}$, indicating that adverse health effects from lead exposure may be associated with the RME but not with the average exposure scenario. Approximately 24 percent of the estimated RME blood lead concentration, may, however, result from background exposure to lead. The results of the lead exposure evaluation indicate that remediation based on possible human health effects is required for Site 31.