7.0 BASELINE RISK ASSESSMENT FOR SITE 39

The baseline human health risk assessment (BRA) for Site 39, the Inland Ranges, is presented in this section. This BRA was conducted following the methods described in Section 2.0. Any specific deviations from these methods are identified in the sections that follow.

7.1 Site Background

The following sections summarize background information for Site 39. A description of the physical setting of Site 39, including topography, geology, and hydrogeology, is presented, as is information on past and potential future land uses and nearby human populations.

7.1.1 Physical Setting

Site 39 is located in the southwest portion of Fort Ord. It is an area that encompasses the Inland Ranges (approximately 8,000 acres) and the 2.36-inch Rocket Range (approximately 50 acres). The Inland Ranges include several study areas which are evaluated separately in the Site 39 RI: Range 36A, Range 40A, Range 33, the explosive ordnance target areas, and the small arms ranges (Volume II, Section 2.0). The delineation of these study areas is based on previous investigations (including field work) at several individual ranges and research regarding potential ordnance-related training areas. For the purposes of this BRA, Site 39 was evaluated as one area; the study areas identified and discussed in the Site 39 RI (Volume II) are not considered separately.

The Inland Ranges are bounded by Eucalyptus Road to the north, Barloy Canyon Road to the east, Old South Boundary Road to the south, and North-South Road to the west (Plate 7.1). Most ordnance-related activities within the Inland Ranges were associated with the trainfire ranges situated just inside the perimeter; weapons were generally fired toward the center of the Inland Ranges. The High Impact Area (HIA), an area of approximately 1,100 acres in the center of the Inland Ranges, is defined as the area whose boundaries were based on maximum ordnance trajectory, overlapping range fans, and the extent of restricted air space for Monterey Airport. The main target areas for the high explosive ordnance used at some ranges are within the HIA; however, other high explosive target areas are within the Inland Ranges but outside of the HIA. The locations and limits of the individual trainfire ranges did not change appreciably over the years, although several have been decommissioned. Targets constructed in the ranges include fixed silhouettes, track-mounted moving targets, pneumatic and electric popups, automobiles, trucks, tanks, and armored personnel carriers. Remnants of some of these targets are present at some of the ranges. Information on the use of each of the inland ranges is presented in Section 1.1 of Volume II, Remedial Investigation, Site 39.

The 17 small arms ranges included in Site 39 were evaluated as one study area. These ranges are predominantly along the northern, southern, and western perimeter of the Inland Ranges. Pistols, rifles, machine guns, and subcaliber weapons were fired in these areas. As at Site 3, the small arms ranges at Site 39 were visually inspected and percent bullet cover was noted (i.e., less than 1 percent bullet cover, 1 to 10 percent bullet cover, and greater than 10 percent bullet cover). Chemical data were collected at Site 3 from representative areas of each specified percent bullet cover to characterize chemical concentrations in each of these areas. Because conditions at Site 3 and the small arms ranges are similar, the chemical data collected at Site 3 were considered representative of chemical concentrations in each area of specified percent bullet cover at the small arms ranges. Therefore, no additional chemical data were collected at the small arms ranges. The field investigation for the Site 39 small arms ranges is described in Volume II, Remedial Investigation, Site 39, Section 3.5.2.

The 2.36-inch Rocket Range is immediately north of Eucalyptus Road, outside of but near the north-central portion of the Inland Ranges. This range is relatively flat with low shrubs and is bounded on the east side by a manmade berm. No physical boundary defines the west site of the range. A low, broad ridge provides a natural backstop at the northern extent of the range. Two sections of narrow gauge track for moving targets and disturbed ground possibly from a third track extend across the range from east to west. No other evidence of target remnants is present.

7.1.1.1 General Topography

The western and central portions of Site 39 consist of low rolling hills and closed depressions; the ground surface generally slopes to the west and northwest throughout most of the area. In the eastern portions of the site, the terrain is more rugged and consists of ridges that rises up to 600 feet above the canyon bottoms. Elevations range from approximately 900 feet mean sea level (MSL) in the southeast to approximately 200 feet MSL in the southwest. Vegetation at Site 39 is primarily central maritime chaparral, with low sparsely distributed shrubs.

7.1.1.2 Hydrogeology

On the basis of limited available hydrogeologic information, Site 39 appears to be nearly entirely underlain by the Seaside Basin. Groundwater flow regimes beneath Site 39 are complex, with independent flow regimes present in different areas of the site. The Seaside Basin has three distinct water-bearing units which are, from surface to depth, the Uppermost, Paso Robles, and Santa Margarita aquifers. Depth to the Uppermost aquifer ranges from 60 to 180 feet. The general flow direction of groundwater at Site 39 is to the north and northwest.

Surface water hydrology at Site 39 is influenced by variations in topography in the western, central, and eastern portions of the site. In the western and central portions, seasonal runoff is minimal due to low rolling hills and a high rate of infiltration into the permeable dune sand that comprises much of the surface soil.

Well-developed natural drainages are absent through much of this area. The eastern portion of the site, which is characterized by rugged terrain formed in more resistant lithologies, has eastward-flowing ephemeral stream drainages within narrow canyons that have moderate to steep sloping walls. Runoff is toward the Salinas Valley.

The hydrogeology of the site is described in detail in Volume II, Remedial Investigation, Site 39, Sections 1.5 and 1.6.

7.1.2 Land Use

Most of Site 39 was previously used for target practice. The Inland Ranges were reportedly used since the early 1900s for ordnance training exercises, including naval gunfire from offshore. Over the years various types of ordnance have been used or found in the Inland Ranges, including hand grenades, mortars, rockets, mines, artillery rounds, flame throwers, and machine gun and small arms rounds. The 2.36-inch Rocket Range was used as an antitank rocket (bazooka) range, probably during and shortly after World War II.

Because of base closure activities at Fort Ord, Site 39 is currently inactive. Proposed future plans call for most of Site 39 to become part of a habitat reserve, managed by the Bureau of Land Management (BLM) (*COE, 1994*). The Fort Ord Environmental Impact Statement (*COE, 1993*) describes this area as a natural resource management area (NRMA). BLM will manage the NRMA for the benefit of natural resources, with priority given to conservation, enhancement, and restoration of habitat.

Several areas within the proposed NRMA but along the southwest border of the Inland Ranges have other proposed future land uses. These include recreational facilities, education and research facilities related to the area's natural resources, a fire and law enforcement training area, and relocation of Highway 68 *(COE, 1994)*. These areas comprise a very small portion of Site 39 and are outside the high impact areas. Available future land use plans indicate that the site is not expected to be developed for residential, industrial, or commercial use.

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In Volume III, Site 39, Section 7.1.3, change the second sentence of the second paragraph in the first column of page 82 to read:

Pedestrians may also visit the NRMA for recreational purposes.

7.1.3 Nearby Populations

Site 39 is bordered to the west, southwest, south, and southeast by residential areas of the city of Seaside. These residential areas are heaviest along the western border of Site 39. York School, a secondary day school, is located on the southern border of the site. Nearby residents, both children and adults, may currently be found in these offsite areas. No residential areas are present within Site 39.

In the future, people who may be found onsite at the NRMA include habitat management personnel and scientists and students from the universities planned to be constructed at other Fort Ord areas; such scientists and students would be expected to be engaged in biological studies. Trespassers may also visit the NRMA for recreational purposes, although access is expected to be restricted. Other people who may be found onsite include law enforcement trainees at the peace officer training area, construction workers associated with highway construction or engaged in building planned onsite facilities, workers at the proposed state and county parks, and visitors to these parks.

7.2 Data Evaluation

HLA sampled soil and groundwater at Site 39 in April and May 1994 as part of the RI chemical site characterization. In addition, HLA performed several investigations at individual ranges at Site 39 between 1992 and 1994. Soil samples were collected from areas expected to be highly impacted by ordnance (e.g., soil near targets). These areas include the high impact area and several ranges in the northern portion of the site (Plate 7.1). For the purpose of this BRA, it was conservatively assumed that the chemical data were representative of conditions throughout Site 39. Groundwater samples were collected from seven monitoring wells at Site 39: MW-05-02 at Range 36A in the eastern part of the site and six basewide wells in the western portion of the site. Soil and groundwater data from all investigations performed by HLA at Site 39 are included in this BRA. A detailed description of the sampling activities, including the complete analytical program for each study area evaluated is presented in Volume II, Remedial Investigation, Site 39, Sections 2.0 and 3.0.

In 1990, 24 soil samples from Range 36A were collected and analyzed for metals and explosives during an investigation performed by James M. Montgomery (JMM) Consulting Engineers. Detected concentrations of metals and explosives in these JMM samples are within the range of concentrations detected in soil samples collected by HLA during subsequent investigations (Volume II, Remedial Investigation Site 39, Tables 4 through 6). Data for these samples were reviewed but were not included in the BRA because complete validation of the data was not possible and exclusion of the data is unlikely to significantly impact the results of this BRA.

The methods used to evaluate chemical data and the data set considered for this BRA are discussed in Section 2.1.1.5 and summarized here. Soil data are segregated by the following depths: surface soil data (0 to 2 feet bgs), subsurface soil data (2 to 10 feet bgs), and deep soil data (greater than 10 feet bgs). Statistical data analyses for the chemicals detected in soil are presented on Tables 7.1a through 7.1c, and for chemicals detected in groundwater on Tables 7.2 and 7.3. The frequency of detection, minimum and maximum detected concentrations, arithmetic mean concentration, standard deviation on the arithmetic mean concentration, and 95 percent upper confidence limit on the arithmetic mean concentration are presented for each detected chemical. The analytical program and chemicals detected in soil and groundwater in each area are summarized below.

7.2.1 Soil

Soil samples were collected from 203 soil borings at Site 39. Of these 203 borings, 6 were boreholes for the 6 basewide monitoring wells at Site 39. Soil samples were collected from these borings at depths of 0 foot (i.e., surface samples) to 180 feet bgs. Soil samples collected from the remaining 197 borings were collected at depths of 0 to 21 feet bgs, with at least one surface sample from all but 1 boring. A total of 616 samples were collected and analyzed for the following:

- Priority pollutant metals (approximately 535 samples)
- Explosives (approximately 375 samples)
- Semivolatile organic compounds (30 samples)
- Chlorinated pesticides (18 samples)
- BTEX (138 samples).

As discussed in Section 2.1.1.1, results for screening analyses such as soil gas sampling and TPH analysis are not included in this BRA.

Analysis for Chromium VI (Cr VI) was not performed at Site 39. Detected concentrations of total chromium are assumed to represent Cr III. Chromium VI is not expected to occur in soils at Site 39 for the following reasons:

- No potential source of Cr VI was identified at Site 39
- A total of 262 soil samples from Sites 2 and 12, 16 and 17, 3, and 31 were analyzed for Cr VI; none was detected. Chromium VI has not been detected in soil at other locations at Fort Ord.

The following chemicals were detected in soil at Site 39:

- Surface soil (0 to 2 feet bgs): 2-amino-dinitrotoluene, 4-amino-dinitrotoluene, di-n-octyl phthalate, bis(2-ethylhexyl)phthalate, cyclotetramethylene tetranitramine (HMX), 2-methylnaphthalene, tetryl, 4-nitrophenol, pentachlorophenol, pentaerythritoltetranitrate (PETN), phenanthrene, pyrene, cyclotrimethylene trinitramine (RDX), 1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, nitroglycerin, antimony, arsenic, beryllium, cadmium, chromium (total), copper, lead, mercury, nickel, selenium, silver, and zinc (Table 7.1a)
- Subsurface soil (2 to 10 feet bgs): 2-amino-dinitrotoluene, bis(2-ethylhexyl)phthalate, HMX, 4-nitrophenol, pentachlorophenol, RDX, antimony, arsenic, beryllium, cadmium, chromium (total), copper, lead, mercury, nickel, selenium, silver, and zinc (Table 7.1b)
- Deep soil (greater than 10 feet bgs): arsenic, beryllium, cadmium, chromium (total), copper, lead, mercury, nickel, selenium, silver, thallium, and zinc (Table 7.1c)

Except for HMX, which was detected at a maximum concentration of 1,100 milligrams per kilogram (mg/kg), explosive compounds and SOCs are generally present at low concentrations (e.g., 1-10 mg/kg). Both explosives and SOCs were detected primarily in surface or near-surface soil samples (0 to approximately 2.5 feet bgs), and concentrations decrease significantly from the surface to 2.5 feet bgs. All metals were detected above the site-specific maximum background concentration for Fort Ord in at least one sample.

TIC data are available for samples analyzed using EPA Test Method 8270. Sixteen compounds were identified as TICs in the Site 39 dataset, in addition to several "unknown compounds." A review of data for this site indicates that the TICs identified are most likely either hydrocarbon-related or naturally occurring (i.e., biological compounds such as fatty acids). Petroleum hydrocarbons are considered to be fully characterized in the SOC and BTEX analysis (EPA Methods 8270 and 8240), and potential exposure to hydrocarbons is evaluated in this BRA using SOC data. TICs identified as naturally occurring were not evaluated in this BRA because they were detected at low concentrations, low frequency, and other chemicals with known toxicity were detected in this area. Therefore, TIC data are not evaluated further in this BRA.

7.2.2 Groundwater

A comprehensive groundwater study was not performed at Site 39. However, groundwater sampling was performed at existing monitoring wells at Site 39 in response to regulatory agency comments concerning groundwater quality, as discussed in Volume II, Remedial Investigation Site 39, Section 3.6. The purpose of the sampling was to evaluate the potential presence of explosive compounds, priority pollutant metals, and nitrates in groundwater beneath the site. As discussed in the Site 39 Remedial Investigation (Volume II), groundwater beneath Site 39 does not appear to have been impacted by site activities for the following reasons:

- No organic chemicals were detected in groundwater

- Metals detected in soil are unlikely to leach to groundwater (Volume II Remedial Investigation, Site 39, Section 5.0; Volume II Introduction, Section 3.0). In addition, detected concentrations of metals in groundwater are generally low and consistent between the Uppermost and Paso Robles Aquifers.

Results of the groundwater sampling conducted at the site are discussed in Volume II, Remedial Investigation, Site 39, Section 3.6.3.

Groundwater samples have been collected from both the Uppermost aquifer and the Paso Robles aquifer beneath Site 39. In this BRA, data for the Uppermost aquifer and Paso Robles aquifer were treated as separate datasets. Chemicals detected in the groundwater beneath Site 39 include:

- Uppermost aquifer: antimony, arsenic, beryllium, calcium, chloride, chromium (total), copper, iron, magnesium, lead, mercury, nitrate, potassium, sodium, sulfate, and zinc

- Paso Robles aquifer: antimony, arsenic, bromide, calcium, chloride, chromium (total), copper, iron, magnesium, mercury, nitrate, nitrite, potassium, sodium, sulfate, and zinc

The summaries of statistical data for the chemicals detected in groundwater are presented in Tables 7.2 and 7.3 for the Uppermost and Paso Robles aquifers, respectively.

7.3 Selection of Chemicals of Potential Concern (COPCs)

This section describes the selection of COPCs in soil and groundwater for quantitative risk assessment at Site 39. Chemicals detected in soil and groundwater were evaluated using the COPC selection criteria described in Section 2.1.2. For comparison of detected soil concentrations to site-specific background concentrations, Fort Ord NQTP shallow soil background concentrations were used, as described in Section 2.1.2.1. Results of the COPC selection for soil and groundwater are presented in the following sections.

7.3.1 Soil

COPC selection for soil at Site 39 is summarized in Table 7.4. The COPCs were selected only for chemicals detected in surface soil (0 to 2 feet bgs) on the basis of the exposure assessment described in Section 7.4. Seven SOCs, 9 explosives, and 12 metals were detected in surface soil. COPC selection was conducted in four steps, as discussed below.

The first step, background comparison, eliminated one metal, mercury, for which the maximum concentration detected in soil at Site 39 was less than the background concentration. The second step was elimination of chemicals considered to be essential human nutrients. An estimated daily dose (EDD) was calculated for zinc as described in Appendix B. Zinc was eliminated as a COPC because the EDD of 1.78 mg/day is lower than the recommended daily allowance of 5 to 10 mg/day.

In the third step, lead was retained as a COPC because the maximum concentration of 4,060 mg/kg is greater than the health-based screening level (HBSL) of 240 mg/kg.

In the fourth step, the detected chemicals not yet eliminated were evaluated using a toxicity screen, as described in Section 2.1.2.2. The details of the toxicity screen are presented in Appendix C. This step eliminated the following chemicals detected in soil because their screening HQs were less than the target HQ of 0.01: bis(2-ethylhexyl)phthalate [BEHP], chromium, di-n-octyl phthalate, 2-methylnaphthalene, pentachlorophenol, phenanthrene, pyrene, silver, tetryl, and 1,3,5-trinitrobenzene. Two of these chemicals, BEHP and pentachlorophenol, also had screening risks less than 1×10^{-8}.

The following chemicals were retained as COPCs because their screening HQs were greater than 0.01: antimony, beryllium, cadmium, copper, HMX, and nickel. In addition, 2-amino-dinitrotoluene, 4-amino-dinitrotoluene, arsenic, RDX, and 2,4,6-trinitrotoluene were retained as COPCs because their screening risks were greater than the target risk of 1 x 10^{-8}.

Nitroglycerin, 4-nitrophenol, and pentaerythitol (PETN) were not included as COPCs. The elimination of these chemicals as COPCs were based on the lack of EPA or Cal/EPA toxicity values, very low frequencies of detection (i.e., 0.6 to 4.8 percent), and an evaluation of chemical-specific fate and transport data.

Data indicate that these three chemicals are not stable nor are they likely to persistent in the environment. Published data indicate that when released into soil, 4-nitrophenol rapidly biodegrades, with half-lives ranging from approximately 1 to 10 days in agricultural topsoil and in flooded soil, respectively *(Gile and Gillet, 1981)*. In subsoil (undisclosed depth), its biodegradation half-life has been reported at 40 days under aerobic conditions *(Gile and Gillet, 1981)*. Howard et al *(1991)* report a half-life for nitroglycerin in soil ranging from 2 to 7 days. No quantitative information regarding soil-half lives for PETN was found, but laboratory studies indicate biodegradation in soil is should be an important fate process for PETN *(HSDB, 1994)*.

To summarize, the following 12 chemicals were retained as COPCs in soil at Site 39: 2-amino-dinitrotoluene, 4-amino-dinitrotoluene, antimony, arsenic, beryllium, cadmium, copper, HMX, lead, nickel, RDX, and 2,4,6-trinitrotoluene (Table 7.4).

7.3.2 Groundwater

The following section describes the selection of COPCs in groundwater. Although groundwater beneath Site 39 does not appear to be impacted by site activities, available groundwater data were reviewed for selection of COPCs. COPCs were selected separately for the Uppermost and Paso Robles Aquifers.

7.3.2.1 Uppermost Aquifer

Table 7.5 summarizes the selection of COPCs in the Uppermost aquifer. Eleven metals and 5 inorganic chemicals were detected in groundwater samples from this aquifer. COPCs were selected in two steps.

The first step, evaluation of essential nutrients, eliminated calcium, iron, magnesium, and zinc as COPCs because the EDDs calculated for these chemicals are less than their RDAs for 0- to 6-year-old children (Table 7.5 and Appendix B). Of these chemicals, zinc was detected both in soil and in groundwater in the Uppermost aquifer. Assuming that receptors may be exposed to zinc via ingestion in both soil and groundwater, the EDD for zinc in soil (i.e., 1.8 mg/day; Table 7.4) was added to the EDD for zinc in the Uppermost aquifer (i.e., 0.01 mg/day; Table 7.5). The sum EDD of 1.8 for both these sources is still significantly lower than the RDA of 5 to 10 mg/day for zinc.

The second step, the toxicity screen, eliminated the following chemicals whose screening HQs were less than the target HQ of 0.01: chromium and copper. The following chemicals were retained as COPCs because their screening HQs exceeded 0.01: antimony, mercury, and nitrate. In addition, arsenic and beryllium were retained as COPCs because their screening risk exceeded 1 x 10^{-8}.

Several detected chemicals (i.e., chloride, potassium, sodium, and sulfate) could not be evaluated because they lack toxicity values. These inorganics are ubiquitous in the environment, are generally of low toxicity, and include essential nutrients. They were not, therefore, further evaluated in this BRA. Because lead was detected but lacks toxicity values, it could also not be evaluated in the toxicity screen. Exposure to lead in groundwater is evaluated as described in Section 7.4.6.

To summarize, the following five chemicals were retained as COPCs in groundwater in the Uppermost aquifer: antimony, arsenic, beryllium, mercury, and nitrate (Table 7.5).

7.3.2.2 Paso Robles Aquifer

Table 7.6 summarizes the selection of COPCs in groundwater in the Paso Robles aquifer. Nine metals and seven inorganic chemicals were detected in samples collected from this aquifer.

The first step in COPC selection, evaluation of essential nutrients, eliminated calcium, iron, magnesium, and zinc, because the EDDs calculated for these chemicals are lower than their RDAs for 0- to 6-year-old children (Table 7.6 and Appendix B). Of these chemicals, zinc was detected in both soil and groundwater of the Paso Robles aquifer. As was done for the Uppermost aquifer, the EDD for zinc in soil (i.e., 1.8 mg/day, Table 7.4) was added to the EDD for zinc in the Paso Robles aquifer (i.e., 0.018 mg/day, Table 7.6). The summed EDD of 1.8 for zinc from these combined sources is still significantly lower than the RDA for zinc of 5 to 10 mg/day.

The second step, the toxicity screen, eliminated chromium and copper because the screening HQs calculated for these chemicals were less than 0.01. The following chemicals were retained as COPCs because their screening HQs exceeded 0.01: antimony, mercury, nitrate, and nitrite. In addition, arsenic was retained as a COPC because its screening risk exceeded 1×10^{-8}. The toxicity screen could not be conducted for several chemicals (i.e., bromide, chloride, potassium, sodium, and sulfate) because they lack toxicity values, as discussed above in Section 7.3.2.1. These chemicals are, therefore, not considered further in this BRA.

To summarize, the following five chemicals were retained as COPCs in groundwater in the Paso Robles aquifer: antimony, arsenic, mercury, nitrate, and nitrite (Table 7.6).

7.4 Exposure Assessment

The following section provides a discussion of the nature and degree of potential exposure to the COPCs that may occur at Site 39. Section 7.4.1 presents an assessment of the potential chemical sources and potential chemical migration pathways for the COPCs. Section 7.4.2 discusses potential hypothetical receptors and identifies the receptors selected for quantitative evaluation. Section 7.4.3 discusses potential exposure pathways for the receptors identified in Section 7.4.2, and identifies the pathways selected for quantitative evaluation. Section 7.4.4 describes the exposure scenarios used in this BRA for estimating potential exposures. Section 7.4.5 presents the exposure point concentrations used to estimate exposures. Section 7.4.6 addresses the methods used to estimate exposure (dose) for all receptors assumed to be exposed to COPCs at Site 39.

7.4.1 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 39 RI presents a site-specific discussion of chemical fate and transport, and identifies potential chemical migration pathways at Site 39. The potential migration pathways identified in Section 5.0 of the Site 39 RI are discussed in the following sections.

The source of chemical contamination in soil at Site 39 is assumed to be the historical use of ordnance and hydrocarbon fuels during target/training practices. Groundwater at Site 39 does not appear to have been impacted by site activities. However, it was considered a potential source because COPCs were identified in both aquifers and because maximum detected concentrations of antimony and nitrate exceed MCLs, as discussed in Volume II Remedial Investigation, Site 39, Section 3.6.3. Release of chemicals from soil can occur through volatilization, wind erosion, stormwater runoff, and downward migration into groundwater. Migration of chemicals in groundwater can occur through volatilization, solubilization, and recharge to surface water. For the COPCs detected in surface soil and groundwater, these potential release mechanisms are discussed below in relation to the characteristics of Site 39.

7.4.1.1 Volatilization

Through volatilization, certain chemicals can be released from soil in a vapor phase. As indicated in Section 7.3, the COPCs detected in soil at Site 39 include SOCs, explosives, and metals. SOCs and explosives generally have either high molecular weights 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.

Volatilization of chemicals from groundwater can result in the release of chemicals in groundwater to soil gas, with subsequent migration of chemical vapors through soil gas to ambient air. As indicated in Section 7.3.2, only metals and inorganic chemicals were selected as COPCs in groundwater. Potential volatilization of chemicals in groundwater to soil gas and migration to ambient air is therefore not a likely migration pathway, and was not evaluated in this BRA.

7.4.1.2 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. This chemical migration route was, therefore, quantitatively evaluated.

7.4.1.3 Stormwater Runoff

The extent to which chemicals in soil 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 expected to sorb moderately strongly to site soil, and might therefore be prone to runoff. However, the soil at Site 39 is largely sandy. Rainwater will likely either be absorbed by the soil or volatilize by evapotranspiration. The runoff potential is therefore expected to be low, and stormwater runoff was not evaluated.

7.4.1.4 Leaching

The potential for chemicals to leach from soil to groundwater depends on the physical and chemical properties of the chemicals, the chemical concentrations, soil type, pH (for metals), and other site-specific conditions. For example, metals in soil with a low pH (i.e., acid) have a tendency to leach downward through the soil column. The soil pH measured at Site 39 ranges from 4.7 to 7, which is not highly acidic. This range indicates that the potential for metals to leach to groundwater is low. The SOCs and metals detected at the site are expected to sorb strongly to soil particles. These factors, in addition to the relatively low concentrations of chemicals detected in soil and the depth to groundwater (60 to 180 feet) indicate that leaching is unlikely to occur.

As shown in Table 7.1c, no organic chemicals were detected at depths greater than 10 feet. Moreover, as discussed in Section 7.2.2, no organic chemicals were detected in groundwater samples (Tables 7.2 and 7.3). These results indicate that there is no current evidence of migration of organic chemicals detected in soil at Site 39 to groundwater beneath the site. In addition, the concentrations of metals at depths greater than 10 feet bgs are generally below background values in contrast to the concentrations in surface soil, which generally

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In Volume III, Site 39, Section 7.4.2, change the third sentence of the paragraph starting at the bottom of the first column and ending at the top of the second column of page 88 to read:

The presence of potential future onsite receptors is limited due to the proposed land uses.

In Volume III, Site 39, Section 7.4.2, change the fifth bullet in the second column of page 88 to read:

Onsite or nearby recreational visitors who may be present at recreational and nonrecreational areas of the NRMA

In Volume III, Site 39, Section 7.4.2, change the first sentence in the first full paragraph in the second column of page 88 to read:

Because of the proposed future land uses, it was assumed that no construction or other intrusive activities that might expose subsurface soil are likely to occur.

In Volume III, Site 39, Section 7.4.2, change the second sentence in the second full paragraph in the second column of page 88 to read:

Additionally, they are not expected to frequently visit the more isolated north and central parts of the site where the highest concentrations of COPCs are present.

exceed background values. These factors also indicate that leaching of metals is unlikely to have occurred.

7.4.1.5 Migration in Groundwater

Chemicals in groundwater may move through groundwater by solubilization and recharge to surface water. Only metals and inorganic chemicals were detected in groundwater. Chemicals that are dissolved in groundwater are likely to remain dissolved (e.g., metals and inorganics that are present as salts). Dissolved compounds may move offsite in groundwater; however, the detected concentrations are low and further dilution is likely to occur. The movement of undissolved metals through groundwater is limited by the tendency of metals to sorb tightly to soil particles in the aquifer. This sorption slows their migration and decreases the concentration of metals as the groundwater concentration equilibrates with the concentration of metals in the surrounding soil. The transport of chemicals via recharge to surface water from groundwater at Site 39 is unlikely to occur because no permanent surface water bodies exist onsite; intermittent drainages are present only following heavy rains.

7.4.1.6 Summary of Chemical Source and Migration Analysis

To summarize, the emission of fugitive dust was considered the most likely chemical migration mechanism to occur for chemicals detected in soil and was therefore quantitatively evaluated in the risk assessment for Site 39.

7.4.2 Potential Receptors

This section identifies the hypothetical receptors evaluated at Site 39. Methods used to identify receptors are discussed in Section 2.2. Receptor identification is based on the background information presented in Section 7.1, describing the general site topography, current and possible future land uses, and current and possible future demographics.

Onsite human receptors are not currently present at Site 39 because the site is inactive. Current offsite receptors at Site 39 are limited to nearby offsite residents. The presence of potential future onsite receptors is limited due to the proposed land uses, the presence of unexploded ordnance, and possible restricted access to parts of the NRMA. However, receptors who may be present on the basis of proposed future land uses include:

- Onsite habitat management workers associated with the NRMA
- Onsite scientists and students from the education and research facilities that may be constructed at the site or from universities expected to be built at other locations on Fort Ord
- Onsite trainees from the proposed fire and law enforcement training area
- Onsite and offsite workers associated with proposed recreational facilities that may be located onsite
- Onsite or nearby recreational visitors who may be present at the nonrestricted recreation areas of the NRMA
- Offsite residents.

Because unexploded ordnance is present at Site 39, it was assumed that no construction or other intrusive activities that might expose subsurface soil are likely to occur. Therefore, potential receptors associated with these activities are unlikely.

Onsite scientist/student, fire and law enforcement trainee, city and state park worker, and recreational visitor receptors are not evaluated in this BRA because they are expected to be present onsite less frequently than habitat management workers and, therefore, to have significantly less potential exposure to site-related chemicals. Additionally, they are not expected to have access to the more isolated northern and central parts of the site where the highest concentrations of COPCs are present. Nearby offsite workers or onsite visitors are not evaluated in this BRA because they are expected to be present less frequently than the offsite residents or onsite habitat management worker, and therefore to have significantly less potential exposure to site-related chemicals.

Trespassers may occasionally be present along the perimeter of Site 39. Contaminated areas at Site 39 are located within the interior of the site (Volume II, Remedial Investigation, Site 39). Due to the presence of unexploded ordnance at the site, the probability of a trespasser successfully reaching the inner portions of the site on a repeated basis (i.e. exposure of a significant frequency and duration) is low. Therefore, potential trespassers are not evaluated in this BRA.

Habitat management personnel at the NRMA are expected to be onsite on a regular and frequent basis and are therefore evaluated in this BRA. Residents (both children and adults) currently live in offsite areas adjacent to the site, as described in Section 7.1.3, and are therefore also evaluated in this BRA.

7.4.3 Potential Exposure Pathways

This section identifies potential exposure pathways for the future onsite habitat management worker and current offsite resident receptors, and identifies the pathways selected for quantitative evaluation. Because of the presence of unexploded ordnance and the proposed protection of habitat at Site 39, intrusive activities that might expose subsurface soil are not expected to occur. Therefore, only exposures to surface soil (0 to 2 feet bgs) are evaluated further in this BRA.

The future habitat management worker might be exposed to chemicals in soil at Site 39 via incidental ingestion of soil, dermal contact with soil, and inhalation of dusts entrained in air. Exposure to chemicals in groundwater might occur via ingestion of groundwater. These exposure routes are quantitatively evaluated in this BRA. Because dust emissions are likely to be reduced by the vegetative cover over much of the site, thus reducing the potential for receptors to inhale dusts, the inclusion of this pathway for quantitative evaluation is considered conservative. Similarly, because it is considered unlikely that groundwater in either the Uppermost or Paso Robles aquifers will be used to provide water supplies for the future facilities proposed for the site, evaluation of this exposure pathway is conservative.

Exposure to COPCs in both the Uppermost and Paso Robles aquifers was quantitatively evaluated. However, potential exposure was considered be limited to either the Uppermost or the Paso Robles aquifer. Exposure to groundwater from each of these aquifers is separately evaluated.

The offsite resident receptor may be exposed to COPCs in soil via inhalation of airborne dust. Offsite resident receptors have no direct access to the site and are, therefore, not expected to directly contact onsite soil via ingestion or dermal contact. Because nearby offsite residents currently receive their domestic water supply from municipal wells, exposure to groundwater beneath Site 39 is not expected for the offsite resident receptor. Inhalation of airborne dust was, therefore, the sole exposure pathway quantitatively evaluated for the offsite resident receptor. Evaluation of this pathway is considered highly conservative for the following reasons:

- The prevailing winds for most of the year are westerly and tend to blow dust toward the east, away from the residential areas south, southwest, and southeast of the site. Moreover, most of the contamination at Site 39 is in the northern portion of the site, making it unlikely for residents to the southeast to be exposed to contaminated dust

- The vegetative cover at the site tends to reduce dust emissions to ambient air, making it less likely that people at these offsite locations would be exposed to dust.

To summarize, the following hypothetical receptors and potential exposure pathways were quantitatively evaluated for soil and groundwater at Site 39:

- Future onsite habitat management worker exposed to COPCs in surface soil (0 to 2 feet bgs) via dermal contact, ingestion, and

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In Volume III, Site 39, Section 7.4.2, delete the first full paragraph in the first column of page 89.

inhalation of dust, and to COPCs in the Uppermost aquifer via ingestion of groundwater

- Offsite resident exposed to chemicals in surface soil (0 to 2 feet bgs) via inhalation of dust.

7.4.4 Exposure Scenarios

This section discusses the site-specific conditions that are used to quantitatively evaluate exposures of the potential receptors defined in Section 7.4.2: a hypothetical future onsite habitat management worker and an offsite resident. Both average and reasonable maximum exposure (RME) 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. In addition, general definitions of exposure duration (ED), exposure frequency (EF), exposure time (ET) and fraction of intake (FI) are presented in Section 2.2.5. The following sections present the assumed values for these terms for each of the potential future receptors evaluated at Site 39. The assumed exposures of the hypothetical habitat management worker and offsite resident are described below in Sections 7.4.4.1 and 7.4.4.2, respectively.

7.4.4.1 Habitat Management Worker

For the conversion of Site 39 to a NRMA, as discussed in Section 7.1.2, it was assumed that a habitat management worker would be present onsite. For both the average and RME scenarios, it was assumed that the habitat management worker would be present onsite 8 hours per day (ET), 250 days per year (EF). Based on EPA *(1990b)* data, the habitat management worker was assumed to work at the NRMA for 10 years and 25 years (ED) for the average and RME scenarios, respectively.

To estimate the RME FI, the habitat management worker receptor was conservatively assumed to receive 100 percent of his or her daily exposure to soil via ingestion or dermal contact while working at the site (i.e., RME FI of 1.0). For the average scenario, the receptor was assumed to receive 50 percent of his or her daily exposure to soil via ingestion or dermal contact while working onsite (i.e., average FI of 0.5).

The site-specific exposure assumptions used in the risk assessment for the habitat management worker receptor are summarized in Table 7.7.

7.4.4.2 Offsite Resident

As discussed in Section 7.4.3, the offsite resident receptor is assumed to be exposed to COPCs in soil via inhalation of airborne dust. For the purposes of this BRA, it was conservatively assumed that exposure to airborne dust would occur indoors and outdoors and that indoor dust concentrations would be the same as outdoor dust concentrations. The offsite resident was conservatively assumed to be present 20 hours per day and 24 hours per day, for the average and RME scenarios, respectively. For both the average and RME scenarios, it was assumed that the offsite resident would be present 350 days per year (EF). Based on EPA *(1990b)* data, the offsite resident was assumed to live near the future NRMA for 9 years and 30 years (ED) for the average and RME scenarios, respectively.

The FI term does not apply to exposure via inhalation and was therefore not estimated for the offsite resident receptor.

7.4.5 Exposure Point Concentrations (EPCs)

Section 2.2.7 presents the methods used for developing EPCs. As discussed in Section 7.4.3, the pathways quantitatively evaluated for the hypothetical receptors at Site 39 include exposure to surface soil via ingestion, dermal contact, and inhalation of airborne dust, and exposure to groundwater via ingestion. The EPCs used to evaluate ingestion of soil, ingestion of groundwater, and dermal contact with soil are represented by the measured soil or groundwater concentrations of the COPCs, as defined in Section 2.2.7. As discussed in Section 7.4.3, the habitat management receptor is assumed to be exposed only to chemicals detected in surface soil. The soil EPCs used are therefore the COPC concentrations detected in surface soil, i.e., 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. Inhalation of dust by the offsite resident receptor was evaluated using the same EPCs; offsite chemical concentrations in dust were conservatively assumed to equal onsite concentrations, and indoor chemical concentrations in dust were also conservatively assumed to equal concentrations in outdoor ambient air.

The EPCs for soil and airborne dust in air are presented in Table 7.8. The EPCs for groundwater are presented in Table 7.9.

7.4.6 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 39 are presented in Section 7.4.5 and Tables 7.8 and 7.9. 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 39 are presented in Section 7.4.4. The calculations for the estimated exposure dose are presented in Appendix E.

Because of its unique toxicological properties, exposure to lead in soil was evaluated for Site 39 using site-specific concentrations of lead detected in soil through modeling (i.e., the UBK and LEADSPREAD models), as described in Section 2.2.9. These models also evaluate ingestion exposure to groundwater. The concentration of lead used for water in these models is not site-specific, but a default value of 15 μg/l, which is the background concentration of lead in drinking water in the state of California (Section 2.2.9.2). This background concentration is far higher than either the average or RME concentrations of lead detected in groundwater sampled from the Uppermost aquifer (i.e., 1.08 and 1.80 μg/l, respectively; Table 7.5). Lead was not detected in groundwater from the Paso Robles aquifer. The results of the lead evaluation are discussed below in Section 7.6.3 and presented in Appendix F.

7.5 Toxicity Assessment

The toxicity assessment presents the chemical-specific cancer slope factors (SFs) and noncancer reference doses (RfDs) used in the BRA. Where EPA and DTSC have derived different slope factors for a chemical, the more conservative value was used. The EPA, RfD, or an appropriate surrogate RfD, was used for all noncarcinogenic endpoints other than lead toxicity. The chemical-specific SFs and RfDs used in the BRA are provided in Table 2.9.

7.6 Risk Characterization

Section 2.4 discusses methods used to estimate potential adverse noncancer health effects and potential, upper-bound cancer risks. The following sections present the results of the risk characterization of Site 39. Possible noncancer health effects are presented first, followed by discussion of potential cancer risks and results of the lead exposure evaluation.

7.6.1 Possible Noncancer Health Effects

This section provides a discussion of possible noncancer effects associated with potential exposure of the habitat management worker and offsite resident receptors to COPCs in soil and groundwater at Site 39.

7.6.1.1 Habitat Management Worker Receptor

Possible noncancer health effects estimated for the habitat management worker receptor are presented in Tables E53 through E58 in Appendix E, and are summarized in Table 7.10. The multipathway noncarcinogenic hazard indexes (HIs) for exposure to COPCs in soil from Site 39 and groundwater from the Uppermost aquifer are estimated to be 0.1 and 1 for the average and RME scenarios, respectively, indicating that no adverse noncarcinogenic adverse health effects are anticipated for this receptor at Site 39.

As discussed in Section 7.4.3, potential noncancer effects associated with exposure to the Paso Robles aquifer were evaluated separately. Because the HIs for groundwater are essentially the same for both aquifers (Tables E55 through E58), only potential risks associated with the Uppermost aquifer are presented in Table 7.10.

7.6.1.2 Offsite Resident Receptor

Possible noncancer health effects estimated for the offsite resident receptor are presented in Tables E59 through E63 in Appendix E, and are summarized in Table 7.11. The noncarcinogenic HIs range from 0.0003 to 0.004, indicating that no noncarcinogenic adverse health effects are anticipated for the offsite resident receptor at Site 39.

7.6.2 Possible Cancer Risks

This section provides a discussion of the possible cancer risks associated with potential exposure of the habitat management worker and offsite resident receptors to COPCs in soil and groundwater at Site 39.

7.6.2.1 Habitat Management Worker Receptor

Possible cancer risks estimated for the habitat management worker receptor for exposure to soil and groundwater in the Uppermost aquifer at Site 39 are presented in Tables E53 through E58 in Appendix E and are summarized in Table 7.12. Possible cancer risks associated with exposure to groundwater in the Paso Robles aquifer (Tables E55 through E58) are essentially equivalent to those estimated for the Uppermost aquifer. Therefore, only potential risks associated with the Uppermost aquifer are presented in Table 7.12. The estimated multipathway lifetime cancer risk for the average scenario is 2×10^{-6}. This value is at the lower end of the EPA target risk range of 1×10^{-6} to 1×10^{-4}. The estimated lifetime cancer risk for the RME scenario is 8×10^{-5}, which is within the EPA target risk range.

Approximately 95 percent of the total RME risk is due to exposure to arsenic, beryllium, and RDX in soil, and ingestion of arsenic and beryllium in groundwater. The contribution of each of these exposures to the total RME risk is summarized below:

- Beryllium in soil: 42 percent (RME risk of 3.4×10^{-5})
- Arsenic in groundwater: 23.5 percent (RME risk of 1.9×10^{-5})
- Beryllium in groundwater: 15 percent (RME risk of 1.2×10^{-5})
- RDX in soil: 8.9 percent (RME risk of 7.1×10^{-6})
- Arsenic in soil: 6.8 percent (RME risk of 5.4×10^{-6})

Much of the RME risk may be considered to be due to background levels of arsenic and beryllium in groundwater and arsenic in soil for the following reasons:

- As discussed in Section 7.4.1, leaching of metals to groundwater is considered unlikely due to low soil concentrations, soil pH, and depth to groundwater at Site 39. In addition, the concentrations of arsenic in the Uppermost and Paso Robles aquifers are similar (Tables 7.3 and 7.4), suggesting a naturally occurring source of arsenic. Therefore, risks associated with beryllium and arsenic in groundwater are likely to be background-related.

- The RME concentration of arsenic in soil (3.68 mg/kg) barely exceeds the background concentration (3.4 mg/kg). The incremental risk associated with the arsenic concentration above background is 4×10^{-7}.

The RME concentration of beryllium in soil (9.34 mg/kg) is above the background concentration (0.35 mg/kg). However, beryllium was detected above background in only 11 of 218 soil samples collected at Site 39 (Volume II, Site 39). Of these 11 samples, 9 had detected concentrations of beryllium below 1 mg/kg. Concentrations of beryllium below 1 mg/kg are likely to be naturally-occurring (i.e. background-related), as discussed in the Site 39 RI

(Volume II). The highest beryllium concentrations (66.6 and 2.7 mg/kg) appear to be site-related. Site-related concentrations of beryllium appear to be limited to a small area within the Range 44 (Volume II Remedial Investigation, Site 39).

7.6.2.2 Offsite Resident Receptor

Possible cancer risks estimated for the offsite resident receptor are presented in Tables E39 through E43 in Appendix E and summarized in Table 7.13. The estimated lifetime cancer risks are 2×10^{-7} and 3×10^{-6} for the average and RME scenarios, respectively. The average risk is below the EPA target risk range of 1×10^{-6} to 1×10^{-4}, and the RME risk is at the low end of this range. The RME scenario likely overestimates risks for several reasons, including: (1) conservative exposure times (ETs) of 20 and 24 hours were assumed for the average and RME scenarios, respectively; (2) outdoor dust concentrations were conservatively used as EPCs for both indoor and outdoor exposure to dust; and (3) the offsite concentration of COPCs sorbed to dust were conservatively assumed to equal onsite concentrations. The RME risk for these receptors is considered unlikely to reflect actual offsite exposure conditions.

7.6.3 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 habitat management worker and the offsite resident receptors at Site 39 are presented in Tables F19 through F24 (Appendix F), and the results are summarized in Table 7.14. The ninety-ninth percentile average and RME blood-lead levels estimated for both receptors are well below the target ninety-ninth percentile blood-lead level of 10.0 μg/dl (Section 2.4.9), as shown in Table 7.14.

7.7 Uncertainty Analysis

Section 8.1 discusses the uncertainties and limitations that may impact the BRAs conducted for the five RI sites. This section discusses the potential site-specific uncertainties related to offsite resident receptors, onsite habitat management receptors, and EPCs of chemicals adsorbed to dust particulates. These uncertainties all contribute to the conservatism of the Site 39 BRA. Another uncertainty relates to toxicity values for three chemicals detected in soils. Assumptions about these chemicals decrease the conservatism of the BRAs at Site 39. Details of the uncertainties and limitations are presented in the following sections.

7.7.1 Offsite Resident Receptors

The evaluation of offsite resident receptors is considered highly conservative because these receptors are evaluated solely for exposure to onsite soil via dust inhalation. The prevailing westerly winds, the vegetative cover at the site, and the fact that the preponderance of onsite contamination is north of offsite residential areas, are all likely to reduce onsite dust emissions and decrease the potential for offsite resident receptor exposure to these emissions.

The offsite resident receptor was conservatively assumed to have an exposure time (ET) of 20 hours per day for the average scenario and 24 hours per day for the RME scenario. Most adult receptors are, in fact, likely to spend a significant percent of each day away from home; these intake assumptions, therefore, are more likely to apply to the most sensitive receptors (i.e., young children and elderly and ill residents).

7.7.2 Onsite Habitat Management Receptors

Onsite habitat management receptors are assumed to be exposed to groundwater in either the Uppermost or Paso Robles aquifer via ingestion. It is unlikely that either of these aquifers will be pumped for onsite water supplies in the future, particularly the deeper Paso Robles aquifer. Furthermore, leaching of chemicals detected in onsite soil is considered unlikely to have occurred, as discussed in Sections 7.2.2 and 7.4.1; the chemicals detected in the Uppermost and Paso Robles aquifers are considered to reflect naturally occurring background conditions. These factors suggest that quantitatively evaluating exposure to groundwater is highly conservative.

The onsite habitat management receptor is conservatively assumed to work full time onsite (i.e., 8 hours per day for 250 days per year for 10 or 25 years [for the average and RME scenarios, respectively]). No information is currently available about possible working conditions for these hypothetical receptors, who are likely to move over the entire site, including uncontaminated areas, and unlikely to spend their entire working days at the onsite areas of greatest contamination. These receptors are also unlikely to spend their entire time at work outdoors, or to receive 100 percent of their exposure to soil via ingestion or dermal contact at work, as was assumed for the RME scenario.

7.7.3 Chemicals Adsorbed to Dust Particulates

The EPCs of chemicals adsorbed to dust particulates are conservatively assumed to be the same for the offsite resident receptors and onsite habitat management workers; there is, in fact, likely to be significant attenuation of chemical concentrations as dust is transported offsite, and further attenuation as dust is transported to indoor air in offsite residences.

7.7.4 Toxicity Values

Three of the chemicals detected in soil (i.e., nitroglycerin, 4-nitrophenol, and PETN) lack Cal/EPA and EPA-developed toxicity values. Therefore, these chemicals could not be quantitatively evaluated in this BRA. Although exposure to these chemicals is unlikely to significantly contribute to chemical risks and hazards at Site 39, as discussed in Section 7.3.1, the exclusion of these chemicals from the quantitative evaluation has the potential to slightly decrease the conservatism of the BRA of Site 39.

7.8 Summary of Baseline Risk Assessment for Site 39

This BRA was conducted as part of the Basewide RI/FS for Fort Ord, California. Five SOCs (i.e., explosive compounds) and seven metals in soil were selected as COPCs. For groundwater in the Uppermost aquifer, four metals and one inorganic chemical were selected as COPCs. Two hypothetical receptors were selected for quantitative evaluation: a future onsite habitat management worker and a current offsite resident receptor. This BRA evaluates potential exposure of the habitat management worker receptor to soil via ingestion, dermal contact, and inhalation of dusts, and to groundwater in the Uppermost aquifer via ingestion. The offsite resident receptor was evaluated for exposure to soil via inhalation of dusts.

The results of the BRA indicate that potential exposures to COPCs at Site 39 will result in multipathway HIs below or equal to EPA's threshold level of concern for both receptors evaluated.

The multipathway cancer risks for the habitat management worker receptor are at the low end of or within EPA's threshold levels of concern (i.e., 1×10^{-6} for the average scenario, and 8×10^{-5} for the RME scenario). The multipathway risk estimated for the RME scenario for this worker receptor is predominantly due to exposure to beryllium in soil (42 percent of total RME risk). Although exposure to arsenic and beryllium in groundwater accounts for approximately 39 percent of the total RME risk, these metals are considered to be naturally occurring in groundwater. Moreover, direct exposure of the worker receptor to groundwater at Site 39 is unlikely. Approximately 6.8 percent of the RME risk is due to exposure to arsenic in soil; adjusting this risk for exposure to background levels of arsenic in soil reduces this component of the multipathway risk to a risk that is below EPA's threshold levels of concern. The remaining chemical contributing to the RME risk is RDX in soil. The risk for RDX (i.e., 7×10^{-6}) is at the low end of EPA's range of concern and was calculated on the basis of RME conditions, which generally overestimate exposures that are likely to actually occur at the site.

The multipathway cancer risks estimated for the offsite resident receptor are below or at the low end of EPA's threshold levels of concern. The evaluation of these receptors is considered to be highly conservative because of the low likelihood that they will be significantly exposed to dusts transported from onsite soil. Moreover, the RME risk (i.e., 3×10^{-6}) is considered to overestimate risks because chemical concentrations in offsite dust were assumed to equal concentrations in onsite dust, and concentrations in indoor air were assumed to equal concentrations in outdoor ambient air. These receptors were also conservatively assumed to spend 20 or 24 hours per day at home, for the average and RME scenarios, respectively. These assumptions increase the conservatism this evaluation.

The results of the lead exposure evaluation indicate that all exposures to lead evaluated in this BRA result in blood-lead level estimates well below EPA's *(1990z)* 10 μg/dl threshold level of concern.