

concurrence was obtained from the LEA prior to import. Letters of concurrence are presented in Appendix B.

5.2.4. GROUNDWATER QUALITY

Results for 24 groundwater monitoring events conducted from April 1991 to October 2006 (Ninyo & Moore 2002a, 2002b, 2005d, 2005g, 2006c, and 2006g) are summarized in Tables A-8 through A-12 in Appendix A. Analytical data generally indicate groundwater appears to be minimally impacted. To date, evaluation of the groundwater data has involved applying statistical analysis to 94 data sets for metals and 10 data sets for VOCs. The reported groundwater concentrations, groundwater elevations, and results of the statistical analysis are presented in the October 2006 groundwater monitoring report (Ninyo & Moore 2006g).

The October 2006 groundwater data are summarized on Figures 7 through 10. The analytical results, in general, indicate that VOCs, and SVOCs, were not detected at concentrations that exceed Enclosed Bay and Estuaries Criteria (Water Quality Criteria) (Marschack, 2003). Of the seven metals analyzed, nickel and zinc concentrations exceeded the water quality criteria during the October 2006 sampling event. The reported dissolved metal concentrations above the Water Quality Criteria are not at concentrations that would constitute a significant threat to groundwater quality in the area.

5.2.5. LANDFILL GAS MONITORING

Landfill gas monitoring results for eight events, from September 2004 to November 2006 (Ninyo & Moore 2004b, 2005c, 2005e, 2005f, 2006a, 2006d, 2006e, and 2006h), indicate that landfill gases do not appear to be migrating off-site at the locations evaluated (Figure 5). Landfill gas monitoring data is summarized in Table A-13.

6. CLEANUP LEVELS

The cleanup levels presented in this plan represent concentrations of COCs that distinguish clean from contaminated (impacted) materials. Clean materials contain concentrations of COCs below

the cleanup levels proposed in this plan, whereas contaminated materials contain concentrations of COCs at or above the cleanup levels. Documenting concentrations of COCs below the cleanup levels in confirmation soil samples will verify the removal of the buried wastes and associated impacted soil and allow for a determination of successful clean closure in accordance with applicable Title 27 CCR requirements.

6.1. EVALUATION OF COCS

For the purpose of the NTC landfill closure project, and in accordance with Title 27 CCR, the COCs are those hazardous substances, pollutants, and contaminants that represent buried wastes and impacted soils at the landfill.

The following the COCs were selected because they have either been detected, in the case of organics, or appear to be elevated above site ambient levels in the case of metals, based on data from previous site investigations (Appendix A).

- PAHs:
 - anthracene
 - benzo(a)anthracene
 - benzo(a)pyrene
 - benzo(b)fluoranthene
 - benzo(g,h,i)perylene
 - benzo(k)fluoranthene
 - chrysene
 - dibenz(a,h)anthracene
 - fluoranthene
 - indeno(1,2,3-cd)pyrene
 - naphthalene
 - phenanthrene
 - pyrene

- phthalates:
 - bis(2-ethylhexyl)phthalate
 - butylbenzyl phthalate
 - diethyl-phthalate
 - di-n-butyl phthalate
- chlorophenols:
 - pentachlorophenol
 - 2,4,5-trichlorophenol
- organochlorine pesticides:
 - chlordane
 - 4,4'-dichlorodiphenyldichloroethane (DDD)
 - 4,4'-dichlorodiphenyldichloroethene (DDE)
 - 4,4'-dichlorodiphenyltrichloroethane (DDT)
- PCBs
- total petroleum hydrocarbons
- dioxins/furans
- metals:
 - arsenic
 - chromium (total)
 - copper
 - lead
 - nickel
 - zinc

Based on occurrence, site concentrations, and background concentrations, some of the above-listed chemicals are selected as COCs for this closure project. The COCs and the reasons for their selection are discussed in the following sections.

6.2. BACKGROUND SOIL CONCENTRATIONS

Background chemical concentrations are defined as either naturally occurring (non-anthropogenic) or ambient (anthropogenic), and are not associated with the buried wastes or historical waste disposal practices at the landfill, and therefore, are not considered chemical releases. According to Title 27 CCR Section 20164, background refers to the concentrations or measures of constituents or indicator parameters in soil or water that has not been affected by waste constituents or leachate from the waste management unit.

The EPA defines background chemicals into two categories (EPA 1989):

- **Naturally Occurring or Non-anthropogenic Chemicals:** Minerals or inorganic elements that represent underlying geochemical conditions that have not been influenced by human activity.
- **Anthropogenic Chemicals:** Natural and man-made substances ubiquitously present in the environment as a result of human activities, but not related to site activities.

Anthropogenic activities that may have contributed to regional (site and vicinity) background concentrations of COCs include emissions from automobile exhaust, aircraft exhaust, past urban and industrial activities, and the presence of hydraulically dredged fill material from San Diego Bay.

Generally, under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), cleanup levels are not set at concentrations below natural background levels. Similarly, for anthropogenic contaminant concentrations, the CERCLA program normally does not set cleanup levels below anthropogenic background concentrations (EPA, 1996b, 1997, 2000). The reasons for this approach include cost-effectiveness, technical practicability, and the potential for recontamination of remediated areas by surrounding areas with elevated background concentrations.

Failing to distinguish between impacts attributable to the buried wastes and background conditions can lead to establishing cleanup levels below background levels, resulting in a costly, impractical, and protracted closure project. The proposed background concentrations are considered cost-effective and reasonable for this project. The cleanup levels will be used to

demonstrate compliance with the clean closure requirements of Title 27 CCR 20950(a)(2)(B) to “confirm the removal of waste and contaminated materials from the Unit and from its underlying and surrounding environs, such that the waste in the Unit no longer poses a threat to water quality.”

The background concentrations proposed herein are based on data derived from literature, generally accepted background concentrations, and on distinguishing impacts attributed to the buried wastes from other sources. Accordingly, these concentrations will only be applicable to this closure project and will be referred to as “site ambient concentrations.”

The following sections briefly describe the various groups of chemicals at the site, the range of background concentrations obtained from literature, and whether they constitute a COC for this project.

6.2.1. POLYCYCLIC AROMATIC HYDROCARBONS

PAHs are a complex class of organic compounds consisting of multiple aromatic rings. The simplest member of the PAH family is naphthalene, a two-ring compound. A widely recognized five-ring PAH compound is benzo(a)pyrene. PAHs come from a variety of sources; the majority of these sources are from the combustion or burning of fuels. Aircraft, automobiles, and past urban/industrial activities have likely contributed to ambient concentrations of PAHs at the site.

Data compiled by the Agency for Toxic Substances and Disease Registry (ATSDR, a federal public health agency of the US Department of Health and Human Services) from various studies listed background soil concentrations of PAHs in rural, agricultural, and urban soils across the nation. The background soil concentrations of PAHs in rural soils ranged from 0.3 to 1,300 µg/kg, and the background soil concentrations of PAHs in urban soils ranged from 200 to 166,000 µg/kg. The document reported global distribution of PAHs as evidenced by PAHs at concentrations above 150 µg/kg (benzo[g,h,i]perylene and fluoranthene) in arctic soils. Soil samples collected from remote wooded areas of Wyoming contained total PAH concentrations of up to 210 µg/kg

(ATSDR 1995). Although the PAH levels presented above are for areas that are geologically removed from the San Diego area, they are provided to make the point that PAHs are present in soils even in remote areas, considered to be minimally impacted by humans.

The State of Illinois Environmental Protection Agency conducted two studies jointly with the Electric Power Research Institute to determine the background concentrations of common PAHs in urban areas. The studies evaluated background concentrations of PAHs the Chicago area, both from within Metropolitan Statistical Areas (MSA - urban areas) and outside MSA (rural areas). The PAH compounds ranged from 0.2 to 1.5 mg/kg in the Chicago area, and from 0.42 to 2.7 mg/kg within the MSAs.

Background PAH data provided in the Procedural Guidance for Statistically Analyzing Environmental Background Data by the Naval Facilities Engineering Command (NAVFAC 1998) indicate PAH background concentrations ranging from 0.4 to 1.3 mg/kg in rural soils and from 0.4 to 650 mg/kg in urban soils.

Concentrations of PAHs at the project site ranged from non-detect to 7.9 mg/kg in 5 burned waste and 78 soil samples. The proposed cleanup level for PAHs at the site is 3 mg/kg, which approximates the upper bound background concentration of PAHs in the Chicago study. The PAH concentration in confirmation soil samples will be calculated as the sum of the detected concentrations of anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene, when analyzed by EPA method 8270C.

6.2.2. POLYCHLORINATED BIPHENYLS

PCBs are a group of man-made chemicals that contain 209 individual compounds (known as congeners); occurring either as oily liquids or solids and are colorless to light yellow with no known smell or taste. Eight types of PCB mixtures include 35% of all the different PCBs commercially produced and 98% of PCBs sold in the United States

since 1970, and are known by their industrial trade name, Aroclor (e.g., Aroclor-1254, Aroclor-1260). The mean background concentration of PCBs in US urban soils was evaluated by the EPA as 2.3 nanograms per kilogram (ng/kg) (EPA 2001).

PCBs were detected at a concentration of 320 µg/kg in one of five samples of burned waste analyzed for PCBs at the project site. The other four samples were non-detect for PCBs. PCB concentrations in soil at the project site ranged from non-detect to 96 µg/kg in 72 soil samples analyzed at the project site. EPA method 8082 will be used to analyze confirmation soil samples for PCBs. This method typically reports eight Aroclor mixtures with a reporting limit of 50 µg/kg for each Aroclor mixture. Accordingly, the proposed cleanup level for total PCBs is 400 µg/kg, which is the sum of the reporting limit for each Aroclor mixture. The sum of the eight Aroclor mixtures in the confirmation samples will be compared to the PCB cleanup level of 400 µg/kg.

6.2.3. DIOXINS/FURANS

Polychlorinated dibenzodioxins (CDDs), as a group, represent 75 different positional isomers, while polychlorinated dibenzofurans (CDFs) comprise over 135 compounds (EPA 2001). These two chemical classes are generally referred to as dioxins. Tetrachloro-dibenzodioxins (TCDD) and tetrachloro-dibenzofurans (TCDF) are a subset of CDD and CDF compounds, respectively. Dioxins have never been purposely manufactured. They are anthropogenically produced as trace impurities or incidental byproducts in chlorophenols, chlorinated herbicides, and commercial Aroclor (PCB) mixtures, bleached paper production or combustion.

The most widely studied of these compounds is 2,3,7,8-TCDD. This compound is considered the most toxic of the group and represents the reference compound for this class of compounds. The total concentrations of CDD and CDF are expressed as TEQ of 2,3,7,8-TCDD.

Studies conducted by the EPA have indicated that part-per-trillion levels of CDDs/CDFs have been found in everyday materials that are contaminated with dust - clothes dryer

lint (2.4 to 6.0 nanograms per kilogram [ng/kg]); vacuum cleaner dust (8.3 to 12 ng/kg); room air filters (27 to 29 ng/kg); and house furnace filter dust (170 ng/kg) (EPA 2001, 2004a). Background concentrations of CDDs and CDFs in urban soil, expressed as TEQ of 2,3,7,8-TCDD, ranged from 2 to 21 ng/kg with a mean of 9.3 ng/kg (9.3 picograms/gram [pg/g]).

Concentrations of CDDs and CDFs were detected in three burned waste samples analyzed at the project site. The concentrations, expressed in TEQs of 2,3,7,8-TCDD, ranged from 9.06 to 75.7 ng/kg (Appendix A). The proposed cleanup level for the site is 21 pg/g, which corresponds to the upper bound background concentration discussed above.

6.2.4. ORGANOCHLORINE PESTICIDES

DDT was used as an insecticide in the United States until banned for use in 1973 because of toxicity to wildlife. DDT, and its principal metabolites (DDD and DDE), are organochlorine pesticides (OCPs) that are very persistent in the environment due to low vapor pressure, high fat solubility, and resistance to degradation and photo-oxidation. DDT is degraded to DDE under aerobic conditions and to DDD in anoxic systems (EPA 2000).

Concentrations of organochlorine pesticides at the project site ranged from non-detect to 300 µg/kg of DDT, 130 µg/kg of DDE, 32 µg/kg of DDD, and 16 µg/kg of chlordane in 72 soil samples analyzed (Appendix A). The proposed cleanup levels at the project site are 2500 µg/kg for chlordane, 500 µg/kg for DDD and DDT, and 400 µg/kg for DDE. These values correspond to ten times the general reporting limits for analysis by EPA method 8081A.

6.2.5. PENTACHLOROPHENOL AND 2,4,5-TRICHLOROPHENOL

Pentachlorophenol and 2,4,5-trichlorophenol have been widely used as pesticides and herbicides in the United States. The compounds are found in all environmental media (air, soil, and water) as a result of their past widespread use.

Pentachlorophenol and 2,4,5-trichlorophenol concentrations were not detected in the five burned waste samples analyzed at the project site; concentrations ranged from non-detect to 250 µg/kg of pentachlorophenol and from non-detect to 4,600 µg/kg of 2,4,5-trichlorophenol in 78 soil samples analyzed (Appendix A). Pentachlorophenol was detected in eight of the 78 samples analyzed and 2,4,5-trichlorophenol was detected in nine of the 78 samples analyzed.

The proposed cleanup levels for pentachlorophenol and 2,4,5-trichlorophenol are 5 mg/kg and 1 mg/kg, which correspond to twice the general reporting limits when analyzed by EPA method 8270C.

6.2.6. TOTAL PETROLEUM HYDROCARBONS

Petroleum hydrocarbons are commonly found environmental contaminants. Many petroleum products are used in modern society, including those that are fundamental to our lives (i.e., transportation fuels, heating and power-generating fuels). The volume of crude oil or petroleum products that is used today dwarfs all other chemicals of environmental and health concern. Due to the numbers of facilities, individuals, and processes and the various ways the products are stored and handled, environmental contamination is potentially widespread.

Total petroleum hydrocarbons (TPH) is defined as the measurable amount of petroleum-based hydrocarbon in an environmental media. Since it is a measured, gross quantity without identification of its constituents, the TPH "value" still represents a mixture, and therefore, cannot be represented with a background or ambient concentration.

Concentrations of TPH at the project site ranged from non-detect to 3,300 mg/kg in 50 soil samples analyzed. TPH was detected in 31 of the 50 samples analyzed. Since there are no known petroleum hydrocarbon releases at the landfill, it is considered a low-risk site relative to criteria in the Interim Guidance on Required Cleanup at Low-Risk Fuel Contaminated Sites (RWQCB 1996). Accordingly, the proposed cleanup level for TPH in soil (carbon chain C₇-C₄₄) is 1,000 mg/kg.

6.2.7. PHTHALATES

Phthalates, the most common of which is di(2-ethylhexyl phthalate) (DEHP), are manufactured chemicals that are commonly added to plastics to make them flexible. DEHP is present in many plastics, especially vinyl materials, which may contain up to 40% DEHP, although lower levels are common. Over long periods of time, DEHP can move out of plastic materials into the environment. DEHP is often found near industrial settings, landfills, and waste disposal sites, like the NTC landfill.

When DEHP is present in the environment it is usually at very low levels. It should be noted that it is very difficult to determine these low levels accurately since DEHP is a ubiquitous laboratory contaminant. Laboratory contamination might cause false positives to be reported, and therefore, concentrations of DEHP in environmental samples must be carefully reviewed. Based on the widespread occurrence of phthalates and the potential for detecting false positives, DEHP is not considered a COC for clean closure of the NTC landfill and accordingly, a cleanup level for DEHP has not been established for this project.

DEHP concentrations at the project site ranged from non-detect to 2,200 µg/kg in 78 soil samples analyzed and were non-detect in the five burned waste samples analyzed (Appendix A).

6.2.8. METALS

This section discusses metal impacts, background concentrations, and proposes cleanup levels.

6.2.8.1. ARSENIC

Arsenic is widely distributed in the Earth's crust, and is mostly found in naturally occurring minerals. Typical arsenic concentrations in uncontaminated soils range from 1 to 40 mg/kg, with the lowest concentrations in sandy soils and soils derived

from granites. Higher arsenic concentrations are found in alluvial soils and soils with high organic content (ATSDR 2003).

A study of the background concentrations of trace and major elements in California soils by the Kearney Foundation of Soil Science, Division of Agriculture and Natural Resources, University of California Riverside, and staff of the Department of Toxic Substances Control (DTSC) analyzed metals in 50 benchmark soils. The arsenic concentrations ranged from 0.6 to 11 mg/kg, with a mean background concentration of 3.5 mg/kg (Kearney 1996).

Arsenic concentrations at the project site ranged from non-detect to 39 mg/kg in 79 soil samples analyzed (Appendix A). To account for the possibility of elevated naturally occurring arsenic concentrations, the proposed cleanup level for arsenic at the site is 11 mg/kg, which represents the upper bound background arsenic concentration in the Kearney study.

6.2.8.2. CHROMIUM

The chromium levels in soil vary greatly and depend on the composition of the parent rock from which the soils were formed. Soils derived from basalt and serpentine-bearing soils, ultramafic rocks, and phosphorites may contain chromium as high as a few thousand mg/kg, whereas soils derived from granite or sandstone will have lower concentrations of chromium. The concentration range of chromium in 1,319 samples of soils and other surficial materials collected in the conterminous United States ranged from 1 to 2,000 mg/kg, with a geometric mean of 37 mg/kg (ATSDR 2000). Although these soil types are not typical of the site geology, the information has been presented to indicate the wide range of naturally occurring chromium concentrations

The Kearney study indicated a range of background chromium concentration in California soils from 23 to 1,579 mg/kg, with a mean background concentration of 122 mg/kg (Kearney 1996).

Chromium concentrations at the project site ranged from 4.5 mg/kg to 363 mg/kg in 79 soil samples analyzed and from 10.5 to 189 mg/kg in 30 burned waste samples analyzed. The mean background concentration of 122 mg/kg is proposed as the cleanup level for chromium in soil at the site.

6.2.8.3. COPPER

Copper occurs naturally in the earth's crust and in parent rock at concentrations of approximately 50 mg/kg. In the United States, copper concentrations in differing soil types can vary over a large range (1 to 300 mg/kg) as a function of soil type and land resource region; but the mean values are relatively similar (14 to 41 mg/kg). Investigators reported geometric means of 24.0 mg/kg in California soils and 17 mg/kg in U.S. soils (ATSDR 2004). The Kearney Study indicated a range of 9.1 to 96.4 mg/kg, with a mean background concentration of 28.7 mg/kg (Kearney 1996).

Concentrations of copper in soil at the project site ranged from 2.7 to 220 mg/kg in 79 soil samples analyzed. To account for the possibility of elevated copper concentrations in the hydraulically dredged fill from San Diego Bay, the proposed cleanup level for copper at the site is 96 mg/kg, which represents the upper bound background copper concentration in the Kearney study.

6.2.8.4. LEAD

The natural lead content of soil derived from crystal rock typically ranges from <10 to 30 mg/kg in soil. However, the concentration of lead in the top layers of soil varies widely due to deposition and accumulation of atmospheric particulates from anthropogenic sources (ATSDR 2005c). An action level of 40 mg/kg has been used

to represent ambient levels of lead in soil in the downtown San Diego area associated with the Ballpark and associated redevelopment projects (DEH 2003).

The Kearney Study indicated background concentrations of lead in California soils ranged from 14.3 to 107.9 mg/kg, with a mean background concentration of 48.5 mg/kg (Kearney 1996).

Lead concentrations at the project site ranged from non-detect to 253 mg/kg in 79 soil samples and from 24.0 to 2,580 mg/kg in 30 burned waste samples analyzed for lead (Appendix A). The proposed cleanup level for lead at the site is 40 mg/kg, which is consistent with the downtown ambient level, and approximates the mean background concentration of lead in soil from the Kearney Study (48.5 mg/kg).

6.2.8.5. NICKEL

Nickel occurs naturally in the Earth's crust with an average concentration of 86 mg/kg. The nickel content of soil varies depending on local geology. Typical nickel levels reported in soil ranged from 4 to 80 mg/kg (ATSDR 2005a).

The Kearney Study indicated background concentrations of nickel in California soils ranged from 9 to 509 mg/kg, with a mean background concentration of 57 mg/kg (Kearney 1996).

Nickel concentrations at the project site ranged from non-detect to 461 mg/kg in 79 soil samples analyzed and from 4.62 to 3,170 mg/kg in the 30 burned waste samples analyzed (Appendix A). A cleanup level of 57 mg/kg of nickel is proposed for the site, corresponding to the mean background concentration of nickel in soil from the Kearney study.

6.2.8.6. ZINC

Zinc is found in soils and surficial materials of the conterminous United States at concentrations between <5 to 2,900 mg/kg, with a mean of 60 mg/kg. Zinc concen-

trations measured across the United States ranged from <5 to 400 mg/kg and from <10 to 2,000 mg/kg, with corresponding means of 36 and 51 mg/kg in cultivated and uncultivated subsurface soils, respectively; however, these differences in zinc concentration may be attributed to differences in the soils prior to use (and not to cultivation) (ATSDR 2005b).

The Kearney Study indicated background concentrations of zinc in California soils ranged from 88 to 236 mg/kg, with a mean background concentration of 149 mg/kg (Kearney 1996).

Zinc concentrations at the project site ranged from 13.1 to 675 mg/kg in 79 soil samples and from 44.8 to 16,100 mg/kg in 30 burned waste samples (Appendix A). The proposed cleanup level for zinc at the site is 149 mg/kg, which is the mean background concentration of zinc in soil from the Kearney Study.

6.3. CONTAMINANTS OF CONCERN AND CLEANUP LEVELS

The COCs are classified into two categories for expedient and cost-effective verification of the removal of buried wastes and associated impacted soils. PAHs, arsenic, chromium, copper, lead, nickel, zinc, and TPH, are considered to be the primary COCs because of their frequency of detection at levels above background at the site and because they are commonly found at burned waste sites and landfills. Therefore, confirmation samples will be analyzed for these primary COCs. It is proposed to analyze confirmation soil samples by EPA method 8270C for the entire SVOC list, which includes PAHs, pentachlorophenol, and 2,4,5-trichlorophenol; for total arsenic, chromium, copper, lead, nickel, and zinc, concentrations by EPA method 6010B; and for TPH (carbon chain identification range C₇ to C₄₄) by EPA method 8015.

For documentation purposes and to confirm that the other COCs are at levels less than the cleanup criteria, twenty-five percent of confirmation samples with primary COC concentrations that meet the cleanup criteria will be additionally analyzed for the secondary COCs. The secondary COCs, including organochlorine pesticides and PCBs, will be analyzed by EPA method 8081A/8082, and dibenzodioxins and dibenzofurans will be analyzed by EPA