APPENDIX A – BACKGROUND SOIL

FINAL REMEDIAL INVESTIGATION REPORT
CASMALIA RESOURCES SUPERFUND SITE
CASMALIA, CALIFORNIA

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ATTACHMENT A-1 STATISTICAL EVALUATION OF BACKGROUND DATA

LIST OF ACRONYMS

CalEPA	California Environmental Protection Agency
CSC	Casmalia Steering Committee
DDE	dichlorodiphenyldichloroethylene
DQOs	Data Quality Objectives
EPA	Environmental Protection Agency
HSIR	Hydrogeologic Site Investigation Report
MDD	Minimum detectable difference
ND	Not Detected
NDMA	N-Nitrosodimethylamine
OCDD	octachlorodibenzo-p-dioxin
OCDF	octachlorodibenzofuran
PAH	polycyclic aromatic hydrocarbon
PCB	polycarbonate biphenyl
PRG	Preliminary Remediation Goal
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RWQCB	Regional Water Quality Control Board
SAP	Sampling Analysis Plan
SOP	Standard Operating Procedures
SVOC	semi-volatile organic compound
TCDD	tetrachlorodibenzo-p-dioxin
TEQ	toxic equivalent
UCL	upper confidence limit
UTL	upper tolerance limit
USEPA	United States Environmental Protection Agency

1.0 INTRODUCTION

The CSC completed the background soil investigation in accordance with the June 2004 Remedial Investigation/Feasibility Study (RI/FS) Work Plan which was prepared by the CSC and submitted to and approved by the EPA. This appendix presents a summary of the methodology used in the background soil investigation and the analytical results of the soil samples. In addition, this appendix presents the statistical evaluation of background for the Site.

1.1 Purpose of the Investigation

The purpose of the background soil investigation was to provide additional background data to augment the existing background data for the Site as presented in Appendix H of the RI/FS Work Plan. As described in the Work Plan, the CSC will establish the concentrations of ambient organic chemicals and inorganic chemicals occurring naturally in site soils to complete the risk assessments and plan site remediation.

1.2 Scope of the Investigation

Additional background soil samples were collected at the surface (0-1-foot depth) in areas of alluvium at 10 off-Site sample locations during the Phase 1 Remedial Investigation (RI) sampling conducted in July 2004. These samples were analyzed for metals, Polyaromatic Hydrocarbons (PAHs), Pesticides/Polychlorinated Biphenyls (PCBs) and Semi-volatile Organic Compounds (SVOCs) and combined with the previous background soil investigation data. Samples from five of the locations were also analyzed for dioxins. The historical and new data sets were statistically evaluated and analyzed to determine if they derive from the same population and are therefore similar enough to combine into one background data set. Preliminary statistical analyses were conducted to evaluate background concentrations for the Site in the Interim Progress Report which determined sufficient background samples have been collected.

As discussed above, sufficient samples were collected to distinguish between background and study area concentrations for the metals. However, potential stratigraphic differences were observed in background samples between alluvium and weathered claystone samples, in particular for arsenic, barium, cadmium, chromium and copper. In addition, aluminum and tin were not analyzed in historic background samples. As these metals are important from either a risk and/or background comparison perspective, additional samples were collected in Phase II sampling conducted in November 2005 and August 2006. The additional samples were collected at the same ten Phase 1 RI background sample locations (locations RISSBK-13 through 22) but at depths of five and ten feet below ground surface to provide a better understanding of these metal concentrations in weathered claystone. Additionally, after collection and review of the Phase 1 data, it was determined that background data on herbicides and PCB Congeners may be helpful in interpreting onsite results. Therefore, surface soil samples were also collected at the background locations and analyzed for herbicides. In addition, samples from two locations were analyzed for dioxins and PCB Congeners.

2.0 BACKGROUND SOIL SAMPLING METHODS AND PROCEDURES

Data found to be useable from the historical sampling were primarily from the brown (or weathered) claystone and gray (unweathered) claystone stratigraphic units at the site. Therefore, additional sampling was focused at near the surface (0 to 10 feet bgs) and in areas of alluvium so that this unit is represented in the background data set. Approximate sample locations were chosen based on mapped alluvium provided in the HSIR. These locations were located generally to the north and northwest of the site and generally upgradient of the locations that were previously identified as background by the Regional Water Quality Control Board (RWQCB). Figure A-1 shows the locations of the historical and new background soil samples.

2.1 Approach

Background soil sampling was conducted in accordance with the Casmalia Site Remediation RI/FS Work Plan [CSC, 2004]. Sampling activities followed the Standard Operating Procedures (SOP) contained in the Work Plan, Volume 2, Appendix A (Sampling and Analysis Plan (SAP)). For a detailed approach of the soil sampling methods used for the background investigation, refer to Appendix B. Information regarding sample identity, location, collection date and method, and analytical program are summarized in Table B-1 in Appendix B.

2.2 Deviations from the RI/FS Work Plan

The CSC did not deviate from the June 2004 RI/FS Work Plan in completing the background soil investigation.

3.0 INVESTIGATION RESULTS

3.1 Results of Background Soil Sample Analyses

Ten locations were sampled for background soil concentrations as a part of the Phase I and Phase II RI sampling. Chemicals analyzed include dioxins/furans, herbicides, metals, PAHs, PCBs, PCB Congeners, pesticides, and SVOCs. The analytical results of these additional RI background samples are summarized in Tables A-1. The historical results that were considered in conjunction with the RI background samples in the statistical analyses are summarized in Table A-2. Table A-3 presents a summary of the data used in the background analysis presented in Attachment A-1.

3.1.1 Dioxins Results

Dioxin congeners were detected in all of the background soil samples at varying frequencies. Table A-1 presents the concentration ranges for dioxins detected in the background soils. 2378-TCDD was detected in one of seven samples at a concentration of 0.22 pg/g (2.2 $x10^{-7}$ mg/kg) at location RISSBK-13. The highest detections were observed for OCDD ranging from 15.2 pg/g (1.5 $x10^{-5}$ mg/kg) to 1,324 pg/g (1.3 $x10^{-3}$ mg/kg) and OCDF which ranged from 1.4 pg/g (1.4 $x10^{-6}$ mg/kg) to 170 pg/g (1.7 $x10^{-4}$ mg/kg). These detections are not uncommon as OCDD and OCDF are typically present at higher concentrations in the environment. 2378-TCDD is the only dioxin congener for which a PRG has been established. The detection for this chemical (2.2 $x10^{-7}$) is well under the industrial PRG of 1.59 $x10^{-5}$. The TCDD-TEQ value of 6.7 pg/g (6.7 x 10^{-6} mg/kg) is also below the industrial PRG.

3.1.2 Herbicide Results

Three herbicides were detected in background soil samples. 2,4,5-Trichloro-phenoxyacetic Acid (2,4,5-T) was detected in one sample at a concentration of 0.006 mg/kg. 2,4-Dichlorophenoxyacetic acid (2,4-D) was detected in 3 samples at concentrations ranging from 0.005 to 0.009 mg/kg. 2,4-Dichlorophenoxybutyric acid (2,4-DB) was detected in one sample at a concentration of 0.004 mg/kg. These concentrations are well below their associated screening criteria.

3.1.3 Metals Results

The majority of the metals analyzed for were detected in the majority of samples with the exceptions of antimony (1 detect), lead (1 detect), mercury (9 detects), molybdenum (7 detects), selenium (3 detects), and silver (0 detects). Table A-1 presents the concentration ranges for metals detected in the background soils. Arsenic concentrations ranged from 0.74 mg/kg to 9 mg/kg. Barium concentrations ranged from 24 mg/kg to 120 mg/kg. Chromium ranged from 14 mg/kg to 43 mg/kg and lead ranged from 0 to 6.8 mg/kg. Arsenic was the only chemical detected above its industrial PRG value of 1.6 mg/kg (0.25 mg/kg for Cal-modified).

3.1.4 PAH Results

PAHs were analyzed by laboratory method 8270 SIM. Very few PAH detections were observed in the background soil samples. Chrysene was detected in 5 of 10 samples at concentrations ranging from ND to 0.004 mg/kg. Fluoranthene and pyrene were detected in one sample each

at concentrations of 0.004 mg/kg and 0.010 mg/kg, respectively. No PAHs were detected at concentrations exceeding their associated screening criteria.

3.1.5 PCB and PCB Congener Results

No PCBs were detected in any of the background soil samples. Several PCB Congeners were detected with the highest concentration of 97 pg/g (9.7 x 10^{-5} mg/kg) observed for 2,2',3,4,4',5,5'-HpCB-180. The sum of PCB Congeners ranged from 60.3 to 184.7 pg/g (6.0 x 10^{-5} to 1.85 x 10^{-4}).

3.1.6 Pesticide Results

No chlorinated pesticides were detected except for 4,4'-DDE, Dieldrin, and Hexachlorobenzene. 4,4'-DDE was detected in 4 of 10 samples at a maximum concentration of 0.002 mg/kg. Dieldrin was detected in 2 samples at a maximum concentration of 0.005 mg/kg. Hexachlorobenzene was only detected at location RISSBK-21 at a concentration of 0.002 mg/kg. No pesticides were detected at concentrations exceeding their associated screening criteria.

3.1.7 SVOC Results

SVOCs were very infrequently detected in background soil samples. Benzoic acid was detected in 2 samples at a maximum concentration of 0.13 mg/kg, well under its associated screening criteria. N-Nitrosodimethylamine (NDMA) was detected at location RISSBK-14 at a concentration of 0.012 mg/kg.

3.2 Background Soil Statistical Analyses

A statistical evaluation was conducted in accordance with approaches presented in the RI/FS Work Plan to evaluate background soils. This analysis included development of upper tolerance levels (UTLs) for background distributions consistent with Cal-EPA guidance (CalEPA, 1997) and a comparison of each study area to the background data sets using two-sample t-tests consistent with USEPA guidance (USEPA, 2002). The preliminary UTLs and comparisons were presented in the Interim Progress Report. The updated UTLs using both Phase I and Phase II background data are presented in this Appendix. A more detailed discussion is presented in Attachment A-1.

For inorganics, the background datasets include samples taken from both alluvium and weathered claystone. These same strata also occur within the top 5 to 10 feet of study areas across the site; the depth interval that is most relevant for assessing exposure and risk. For the purpose of comparing site levels to background both geological strata are included in the background data set including samples from the depth interval of 0 to less than 10 feet below ground surface. This sample depth range comprises the majority of samples collected for background and is consistent with the depth range evaluated in the risk assessments (0 to 5 feet bgs).

Earlier RI/FS submittals (IPR May 2005 and November 2005) evaluated metals concentrations in the two stratum separately to determine whether differences were substantial enough to warrant keeping metals separated between the two stratum. These reports found that potential differences between strata could be observed for a subset of the metals, however the added

uncertainty caused by reducing the background data sets into smaller subsets did not support the use of these stratum specific sets for comparison to the site data sets. The RI background locations were therefore revisited to collect subsurface samples to try to reduce uncertainty, as part of the Phase II sampling program. Due to the generally deep alluvium at these locations, only four of the subsurface samples (<10') were taken from claystone.

The aggregate UTL calculations (aggregating alluvium and claystone) were updated for the RI to include the addition of the Phase II background samples (Table A-4). In general the strategy of combining stratum is strengthened by addition of Phase II RI background samples. Many distribution fits improved (higher p values) even when sample size increased reflecting that Phase II data tended to blend or be intermediary to historic claystone and historic and RI alluvium concentrations. Table A-5 presents the sample data used in the background assessment.

With the addition of Phase II samples, the comparison of alluvium and claystone samples continued to indicate mixed and/or uncertain results due to censoring and some confounding of differences between RI and historical background data, such that statistical results were difficult to interpret. This comparison and implications for the aggregate UTLs are further discussed in Attachment A1.

For chromium, the data used in the Draft RI did not include all data (historical and RI) consistent with other metals. For the Draft Final RI all data has been included resulting in a UTL of 64 mg/kg. This revised UTL is used in Section 5 of the RI and in the final interpretation of risks but was not used in the COPC selection process and data mapping presented in Appendix B of the Draft Final RI. The initial more conservative UTL of 47 mg/kg was used in the COPC selection process and data mapping which was completed for the Draft RI report submitted in 2008.

Distribution analysis and UTL estimation for background datasets involved consideration of several statistical descriptors and graphical evidence, as consistent with principles in both CalEPA (1997) and USEPA (2002) background guidance. The analysis is summarized for each chemical in Figure Set A1-1 through A1-22 in Attachment A-1. UTLs are presented in Table A-4 with type of UTL formula identified. The formula used for each UTL was generally chosen to match the best fitting parametric distribution, whenever such a fit was reasonable when viewed graphically and/or with $p > 0.01$. In cases with poor distribution fit, the data maximum was used to estimate the UTL. Non-parametric formulas for the 95th percentile UTL, are most reliable when there is a large enough sample size to interpolate an estimate between two of the higher order statistics. With sample sizes less than about 40, the non-parametric approach defaults always to the data maximum. With no practical difference between the data maximum and the non-parametric UTL, the non-parametric UTL was not calculated.

4.0 EVALUATION OF ADDITIONAL DATA NEEDS

The background soil data obtained during this RI investigation along with the historical background dataset that was presented in the RI/FS Work Plan were evaluated with respect to the Data Quality Objectives (DQOs) identified in the RI/FS Work Plan. Work Plan Sections 4.1 through 4.3 identify specific decisions and decision rules for issues related to this background soils, including those related to human health and ecological risk assessment and contaminant fate extent and transport, groundwater modeling.

4.1 DQO Decisions Related to Background Soil Samples

The specific decisions and decision rules for issues related to background soil as stated in the RI/FS Work Plan are as follows:

- Are concentrations of chemicals of potential concern present in site soil above background or indicate a potentially unacceptable risk to human receptors? A 95% confidence against Type I errors (alpha = 0.05) and an 80% confidence against Type II errors (beta = 0.20) will be targeted for UCL calculations; and
- If the soil concentrations for chemicals that are naturally occurring are greater in each study area than background concentrations, the chemicals will be included as a COPC in risk assessment. For background comparisons alpha = 0.2 and beta = 0.1 will be targeted. Minimum detectable difference (MDD) for each case will be targeted to be within 20% of the background mean or within 100% of the toxicological screening level.

Appendix B of the RI, Attachment B-6, presents a detailed evaluation of the background-related DQOs. Background-related DQOs were evaluated using the MDD between the compound-specific background means and each the means for each study area. Cases were considered to meet background-related DQOs if either estimation uncertainty for a two-sample t-test is low OR the study area mean was well below the lowest toxicologically-based screening level.

The results of the statistical evaluation of the background samples indicate that generally sufficient data are available to evaluate the Site with respect to naturally occurring chemicals. For most metals, the power afforded by the RI background data set, or where appropriate both the RI and historical data set combined, allowed detection of relatively small differences between study area concentrations and background concentrations.

5.0 REFERENCES

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