TA16

ENCLOSURE

HUMAN-HEALTH AND ECOLOGICAL SCREENING ASSESSMENT FOR THE TA-16 BURN GROUND

REVISION 2

(LA-UR-10-02042)

excluded

1.0 HUMAN-HEALTH SCREENING ASSESSMENT

A human-health risk screening assessment for Technical Area 16 (TA-16) Burn Ground is presented in the following sections.

1.1 Conceptual Site Model

Only authorized Laboratory workers currently have access to the area around the TA-16 Burn Ground so the predominant land use is industrial. Therefore, Laboratory workers are the primary receptors and the industrial scenario is the defining scenario for the human health risk screening assessment (i.e., the scenario on which decisions are based). Because the site is located within the boundaries of an operational facility (TA-16), the reasonably foreseeable future land use will continue to be industrial. Residential exposure is also assessed and provided for comparison purposes.

Potential exposure pathways for a site worker (as well as a hypothetical resident) include incidental ingestion of soil, inhalation of fugitive dust or vapors, dermal contact with soil, and external irradiation by gamma-emitting radionuclides. Inhalation of gas-phase contaminants, such as tritium and/or organic chemicals emanating from the site into the atmosphere, is not a potential means of exposure. Other potential pathways from subsurface releases to potential receptors would be complete only if soil were to be excavated and brought to the surface. In such a case, the potential contaminant migration pathways and potential exposure pathways would be the same as those of a surface soil release.

The primary ecological exposure pathways include root uptake, ingestion of contaminated soil, and food-web transport.

1.2 Identification of Chemicals of Potential Concern

1.2.1 Sampling

Thirty-seven surface samples (0-1 ft) were collected from 37 locations across the TA-16 Burn Ground (Figure 1.2-1) and analyzed for Resource Conservation and Recovery Act (RCRA) metals and/or dioxin and furan congeners. One sample (09RCRA462) is a background sample and is therefore not included in the calculation of the risks from dioxin and furan congeners. The data used are summarized in the following paragraphs and are evauated in the human health and ecological risk screening assessments.

1.2.2 Evaluation of Inorganic Chemicals

Thirty-one surface samples were collected from 31 locations and analyzed for RCRA metals. Table 1.2-1 presents the comparison of the inorganic chemicals to soil background values (BVs) (LANL 1998, 059730). Barium, cadmium, and silver were detected above BVs in at least one soil sample (Figures 1.2-2, 1.2-3, 1.2-4). These three inorganic chemicals are retained as chemicals of potential concern (COPCs).

1.2.3 Evaluation of Organic Chemicals

Thirty-six surface samples were collected from 36 locations and analyzed for dioxin/furan congeners (Figure 1.2-5). Dioxin/furan congeners were detected in each sample (Table 1.2-2). The number of congeners detected ranged from 3 to 17. All detected dioxin/furan congeners were retained as COPCs.

1.3 Screening Evaluation

The exposure point concentration (EPC) for the dioxin and furan congeners is the sum of the detected congeners weighted by the World Health Organization (WHO) 1995 Toxic Equivalent Factors (TEFs) (http://www.epa.gov/ncea/pdfs/dioxin/part2/drich9.pdf); the sum is expressed as the tetrachlorodibenzodioxin (TCDD) [2,3,7,8-] equivalent concentration. The TEFs used are presented in Table 1.3-1 and the TEF calculations are presented in Table 1.3-2.

The EPCs are the 95% upper confidence limit (UCL) of the arithmetic mean. All samples were collected from 0-1 ft and all of the data are used to calculate 95% UCLs for the industrial and residential risk screening assessments. The 95% UCL for dioxin and furan congeners was calculated using the TCDD[2,3,7,8-] equivalent concentration for each sample (Table 1.3-2).

The 95% UCLs for each COPC were calculated as described in U.S. Environmental Protection Agency (EPA) guidance (EPA 2002, 073593). Tests for distributions were performed using ProUCL 4.00.04 to determine the appropriate method for UCL calculations and the recommended UCLs were used (Figures 1.3-1, 1.3-2, 1.3-3, and 1.3-4). The 95% UCLs for each COPC are presented in Table 1.3-3. The following methods were used to calculate 95% UCL concentrations (depending on the type of distribution found for the data set):

- Student's t-statistic procedure – normal distributions
- Chebyshev (Mean, Sd) procedure – nonparametric distributions
- H-UCL procedure – lognormal distributions

The EPC for each COPC was compared with the industrial and residential soil screening levels (SSLs).The chemical SSLs used in the evaluations were obtained from New Mexico Environment Department (NMED) guidance (NMED 2009, 106420). The SSLs for carcinogens are equivalent to a 1×10^{-5} cancer risk and for noncarcinogens represent a hazard quotient (HQ) of 1.0. The comparisons with SSLs are conducted separately for carcinogens and noncarcinogens for industrial and residential receptors (Tables 1.3-4 through 1.3-7).

The EPCs for noncarcinogenic COPCs were less than their respective industrial and residential SSLs. The hazard indices (HIs) for the noncarcinogenic COPCs are approximately 0.004 and 0.06, respectively (Tables 1.3-4 and 1.3-5), which are less than NMED's target HI of 1.0 (NMED 2009, 106420).

The EPCs for carcinogenic COPCs were less than their respective industrial and residential SSLs. The total excess cancer risks from exposure to carcinogenic COPCs are approximately 3×10^{-7} and 2×10^{-6}, respectively (Tables 1.3-6 and 1.3-7), which are less than the NMED target risk level of 1×10^{-5} (NMED 2009, 106420).

1.3.1 Uncertainty Analysis

The analysis for human health is subject to uncertainties associated with data evaluation, exposure assessment, and toxicity values. Each or all of these uncertainties may affect the assessment results.

1.3.1.1 Data Evaluation

Data evaluation uncertainties may include errors in sampling, laboratory analysis, and data analysis. Although concentrations used in this risk assessment were less than estimated quantitation limits for some COPCs, data evaluation uncertainties are expected to have little effect on the assessment results.

The J (estimated) qualification of detected concentrations of some organic COPCs does not affect the assessment.

Another data evaluation uncertainty relates to the use of the 95% UCL as the EPC for each COPC. Use of the 95% UCL may result in an overestimation of risk for analytes that have elevated detection limits. Use of the maximum concentration also overestimates the exposure to contamination. Receptors are not exposed to these concentrations across the site.

1.3.1.2 Exposure Assessment

The receptors used in the assessment are subject to exposures in a different manner than the exposure assumptions used to derive the SSLs. Assumptions for the industrial SSLs are that the potentially exposed individual is a Laboratory worker who is outside for 8 h/d for 225 d/yr (NMED 2009, 106420) and spends the entire 8 h on-site within the contaminated area. Because it is unlikely that the worker is within the contaminated area for the entire work day, the screening assessment overestimates the exposure. As a result, risk, hazard, and dose may be overestimated.

Assumptions underlying the exposure parameters, routes of exposure, amount of contaminated media available for exposure, and intake rates for routes of exposure are consistent with NMED parameters and default values (NMED 2006, 106420). In the absence of site-specific data, several upper-bound values for the assumptions may be combined to estimate exposure for any one pathway, and the resulting risk estimate can exceed the 99th percentile. Therefore, uncertainties in the assumptions underlying the exposure pathways may contribute to risk assessments that exceed the reasonably expected range.

1.3.1.3 Toxicity Values

The primary uncertainty associated with the screening values is related to the derivation of toxicity values used in their calculation. Toxicity values (slope factors [SFs] and reference doses [RfDs]) were used to derive the risk-based screening values used in the screening evaluation (NMED 2009, 106420). Uncertainties were identified in four areas with respect to the toxicity values: (1) extrapolation from other animals to humans, (2) interindividual variability in the human population, (3) the derivation of RfDs and SFs, and (4) the chemical form of the COPC.

The SFs and RfDs are often determined by extrapolation from animal data to humans, which may result in uncertainties in toxicity values because differences exist between animals and humans in chemical absorption, metabolism, excretion, and toxic responses. Differences in body weight, surface area, and pharmacokinetic relationships between animals and humans are taken into account to address these uncertainties in the dose-response relationship. However, conservatism is usually incorporated in each of these steps, resulting in the overestimation of potential risk.

For noncarcinogenic effects, the degree of variability in human physical characteristics is important both in determining the risks that can be expected at low exposures and in defining the no-observed-adverse-effect level (NOAEL). The NOAEL uncertainty factor approach incorporates a 10-fold factor to reflect individual variability within the human population that can contribute to uncertainty in the risk assessment. This factor of 10 is generally considered to result in a conservative estimate of risk to noncarcinogenic COPCs.

The SFs and RfDs are often determined by extrapolation from animal data to humans, which may result in uncertainties in toxicity values because differences exist between other animals and humans in chemical absorption, metabolism, excretion, and toxic response. Differences in body weight, surface area, and pharmacokinetic relationships between animals and humans are taken into account to address these uncertainties in the dose-response relationship. However, conservatism is usually incorporated into each of these steps, resulting in the overestimation of potential risk.

COPCs may be bound to the environmental matrix and not available for absorption into the human body. However, the exposure scenarios default to the assumption that the COPCs are bioavailable. This assumption can lead to an overestimation of the total risk.

1.3.1.4 Additive Approach

For noncarcinogens, the effects of exposure to multiple chemicals are generally unknown and possible interactions could be synergistic or antagonistic, resulting in either an overestimation or underestimation of the potential risk. Additionally, RfDs used in the risk calculations typically are not based on the same endpoints with respect to severity, effects, or target organs. Therefore, the potential for noncarcinogenic effects may be overestimated for individual COPCs that act by different mechanisms and on different target organs but are addressed additively.

1.3.2 Interpretation

Based on an industrial scenario, the HI (0.004) is less than NMED's target level of 1.0 and the cancer risk (3×10^{-7}) is less than the NMED target level of 1×10^{-5}. For the residential scenario, the HI (0.06) is less than NMED's target level of 1.0 and the cancer risk (2×10^{-6}) is less than the NMED target level of 1×10^{-5}. The screening assessments indicate that there is no potential unacceptable risk to human health at the TA-16 Burn Ground.

2.0 ECOLOGICAL SCREENING ASSESSMENT

An ecological risk screening assessment for the TA-16 Burn Ground is presented in the following sections.

2.1 Screening Evaluation

The ecological risk-screening evaluation identifies chemicals of potential ecological concern (COPECs) and is based on the comparison of EPCs to ecological screening levels (ESLs) in accordance with Laboratory guidance (LANL 2004, 087630). The EPCs used in the assessment are presented in Table 1.3-3 and the calculation is described in section 1.3. The ESLs obtained from ECORISK Database, Version 2.3 (LANL 2008, 103352) are presented in Table 2.1-1. In addition, the avian ESLs for TCDD[2,3,7,8-] from ECORISK Database, Version 2.0 (LANL 2003, 080117) are presented in Table 2.1-1. The ESLs are based on similar species and are derived from experimentally determined NOAELs, lowest-observed-adverse-effect levels (LOAELs), or doses determined lethal to 50% of the test population. Information relevant to the calculation of ESLs, including concentration equations, dose equations, bioconcentration factors, transfer factors, and TRVs are presented in the ECORISK Database, Versions 2.0 and 2.3 (LANL 2003, 080117; LANL 2008, 103352).

The HQs calculated for each COPEC and screening receptor are the ratios of the EPC to the ESLs for each ecological receptor. The higher the contaminant levels relative to the ESLs, the higher the potential risk to receptors; conversely, the higher the ESLs relative to the contaminant levels, the lower the potential risk to receptors. The analysis begins with a comparison of the minimum ESL for each COPC to the EPC. HQs greater than 0.3 are used to identify COPECs requiring additional evaluation (LANL 2004, 087630). Individual HQs for a receptor are summed to derive an HI; an HI greater than 1.0 is an indication that further assessment may be needed to be sure that exposure to multiple COPECs at a site will not lead to potential adverse impacts to a given receptor population. The HQ and HI analysis is a conservative indication of potential adverse effects and is designed to minimize the potential of overlooking possible COPECs at the site.

The HQs using the minimum ESLs exceeded 0.3 for barium, cadmium, silver, and TCDD[2,3,7,8-] (Table 2.1-2). All of the COPCs are retained as COPECs. An HQ for each COPEC/receptor combination was calculated and summed to obtain an HI for each receptor. The HI is the sum of HQs for chemicals with common toxicological endpoints for a given receptor. It is assumed for the purposes of ecological screening, that nonradionuclides have common toxicological effects and that HQs may be added. The calculations indicate that receptors, except the kestrel, robin (herbivore and omnivore), and cottontail, have HIs greater than 1.0 (Table 2.1-3). The results are discussed further in the uncertainty section.

2.2 Uncertainty Analysis

2.2.1 Chemical Form

The assumptions used in the ESL derivations are conservative and not necessarily representative of actual conditions. These assumptions include maximum chemical bioavailability, maximum receptor ingestion rates, minimum bodyweight, and additive effects of multiple COPECs. These factors tend to result in conservative ESL estimates, which may lead to an overestimation of the potential risk. The assumption of additive effects for multiple COPECs may result in an over- or underestimation of the potential risk to receptors.

The chemical form of the individual COPCs was not determined as part of the investigation. Toxicological data are typically based on the most toxic and bioavailable chemical species, which are not typically found in the environment. Inorganic, organic, and radionuclide COPECs are generally not 100% bioavailable to receptors in the natural environment because of interference from other natural processes, such as the adsorption of chemical constituents to matrix surfaces (e.g., soil) or rapid oxidation or reduction changes that render harmful chemical forms unavailable to biotic processes. The ESLs were calculated to ensure a conservative indication of potential risk (LANL 2004, 087630), and the values are biased toward overestimating the potential risk to receptors.

2.2.2 Exposure Assumptions

The EPCs used in the calculations of HQs are the 95% UCL concentrations. These EPCs are conservative estimates of exposure to each COPC. The sampling efforts focused on areas of known contamination, and receptors were assumed to ingest 100% of their food and spend 100% of their time at the site. These assumptions regarding the exposure for terrestrial receptors within the TA-16 Burn Ground are likely to result in an overestimation of potential ecological exposure and risk.

2.2.3 Toxicity Values

The HQs were calculated using ESLs, which are based on NOAELs as threshold effect levels; actual risk for a given COPEC/receptor combination occurs at a higher level, possibly somewhere between the NOAEL-based threshold and the threshold based on the LOAEL. The use of NOAELs leads to an overestimation of potential risk to ecological receptors. ESLs are based on laboratory studies requiring extrapolation to wildlife receptors. Laboratory studies are typically based on "artificial" and maintained populations with genetically similar individuals and are limited to single chemical exposures in isolated and controlled conditions using a single-exposure pathway. Wild species are concomitantly exposed to a variety of chemical and environmental stressors, potentially rendering them more susceptible to chemical stress. On the other hand, wild populations are likely more genetically diverse than laboratory populations, making wild populations, as a whole, less sensitive to chemical exposure than laboratory populations. The uncertainties associated with the ESLs tend to lead to an overestimation of potential risk.

The avian ESLs for TCDD[2,3,7,8-] obtained from ECORISK Database, Version 2.0 (LANL 2003, 080117) are based on a toxicity value using intraperitoneal injections. This route of exposure does not occur naturally and assumes that 2,3,7,8-TCDD bioavailability and absorption from the gastrointestinal tract and the abdominal cavity are not significantly different. However, exposure by this route likely overestimates the potential absorption of TCDD[2,3,7,8-] by the receptor and thereby overestimates the potential effect on the receptor.

2.2.4 Comparison of EPCs to Background Concentrations

The ecological risk-screening assessments are based on the exposure of ecological receptors to contamination to a depth of 5 ft bgs. The EPCs of some of the inorganic COPECs are similar to background concentrations, indicating that exposure of receptors to these inorganic chemicals is similar to background.

The EPC for cadmium is similar to background concentrations for soil, indicating that exposure is similar to background (Table 2.2-1). Cadmium is not retained as a COPEC because the EPC is similar to background. Barium and silver are retained as COPECs for further evaluation.

2.2.5 Area Use Factors

In addition to the direct comparison of the EPC with the ESLs, area use factors (AUFs) are used to account for the amount of time that a receptor is likely to spend within the contaminated areas based on the size of the receptor's home range (HR). The AUF for an individual organism is calculated by dividing the size of the site by the HR for that receptor. Because threatened and endangered species must be assessed on an individual basis (EPA 1999, 070086), the AUF is applicable for the Mexican spotted owl. The kestrel (top carnivore) is used as the surrogate receptor for the Mexican spotted owl. Because the unadjusted HI for the kestrel (top carnivore) is 0.5 (Table 2.2-2) an AUF for the Mexican spotted owl is not warranted. There is no potential adverse impact to the Mexican spotted owl because the kestrel (top carnivore) HI is less than 1.0.

2.2.6 Population Area Use Factors

EPA guidance is to manage the ecological risk to populations rather than to individuals, with the exception of threatened and endangered species (EPA 1999, 070086). One approach to addressing the potential effects on populations is to estimate the spatial extent of the area inhabited by the local population that overlaps with the contaminated area. The population area for each receptor is based on the individual receptor home range and its dispersal distance (Bowman et al. 2002, 073475). Bowman et al. (2002, 073475) estimate that the median dispersal distance for mammals is 7 times the linear dimension of the HR (i.e., the square root of the HR area). If only the dispersal distances for the mammals with HRs within the range of the screening receptors are used, the median dispersal distance becomes 3.6 times the square root of the HR ($R^2 = 0.91$) (Bowman et al. 2002, 073475). If it is assumed that the receptors can disperse over the same distance in any direction, the population area is circular and the dispersal distance is the radius of the circle. Therefore, the population area for each receptor can be derived by $\pi(3.6\sqrt{HR})^2$ or approximately 40HR.

The population area use factor (PAUF) is calculated by dividing the site area (approximately 2.6 hectares [ha] for the TA-16 Burn Ground) by the population area of the receptor (Table 2.2-2). The HQs and HIs are recalculated minus the COPEC (cadmium) eliminated based on similarity to background (section 2.2.4) and adjusted by multiplying by the PAUFs. The HQs and HIs for the earthworm and plant are not adjusted by a PAUF because these receptors do not have HRs.

The adjusted HIs are less than 1.0 for the kestrel, robin, cottontail, and red fox (Table 2.2-3). The adjusted HI for the shrew (4) is above 1.0, but less than 10, and is approximately 10 for the deer mouse (Table 2.2-3). The elevated HIs for the deer mouse and shrew are due to TCDD[2,3,7,8-] equivalent concentrations.

The TCDD[2,3,7,8-] equivalent concentrations are relatively consistent across the site, except for the two highest concentrations. Based on the spatial distribution of the data, the TCDD[2,3,7,8-] equivalent concentrations in one area east of 16-0399 are higher than the rest of the area sampled. The outlier test in ProUCL 4.00.04 indicates that the maximum TCDD[2,3,7,8-] equivalent concentration is an outlier for this data set. This may indicate, at least in part, that the dioxins and furans in this area are from other sources, e.g., the SWMUs/AOCs to the east of the burn ground area. The concentrations also bias the EPC and overestimate the potential risk to the receptor populations. The area east of 16-0399 is approximately 0.1 ha. Comparing the maximum TCDD[2,3,7,8-] equivalent concentration in this area (3.71E-05 mg/kg) to the ESLs results in HQs of 64 and 128 for the deer mouse and shrew, respectively (Table 2.2-4). Adjusting the HQs with the PAUFs in Table 2.2-5 results in HQs of 1.9 and 0.8 (Table 2.2-6), respectively, for this area.

The rest of the area around 16-0388 and 16-0399 is approximately 2.5 ha. Recalculating the TCDD[2,3,7,8-] equivalent EPC without the two highest concentrations in the area east of 16-0399 results in a 95% UCL of approximately 1.2E-06 mg/kg (Figure 2.2-1). Comparing the revised 95% UCL to the ESLs results in HQs of 2 and 4 for the deer mouse and shrew, respectively (Table 2.2-4). Adjusting the HQs by the PAUFs in Table 2.2-5 results in HQs of 1.7 and 0.6 (Table 2.2-6), respectively, for the larger area.

Given the conservative nature of the ESLs as described above, the HQs for the deer mouse and shrew are overestimated. In addition, Dourson and Stara (1983, 073474) conducted a study of uncertainty factors incorporated in calculating ESLs for ecological receptors. Based on their study, the LOAEL to NOAEL adjustment indicates that HIs up to 10 may not adversely affect ecological receptors. To maintain conservatism, they state that HIs less than 3 do not adversely affect ecological receptors. Therefore, the adjusted HIs for the shrew and deer mouse do not indicate potential risks to these receptors across the site. As indicated below previous studies by the Laboratory have found no effects to small mammal populations at similar dioxin and furan congener concentrations in the canyons.

Biota investigations have been conducted in canyon reaches in Los Alamos/Pueblo Canyon (LANL 2004, 087390), Mortandad Canyon (LANL 2006, 094161; LANL 2007, 098279), and Pajarito Canyon (LANL 2008, 104909). Field and laboratory studies included collection and analysis of soil, sediment, and water samples; cavity-nesting bird monitoring and analysis of eggs; small mammal trapping and analysis of whole organisms; earthworm bioaccumulation tests—measures of growth and survival, and analysis of whole organisms; and seedling germination tests. The studies found no effects from exposure to TCDD in any of the canyon reaches.

The TCDD equivalent concentrations reported in Kraig et al. (2002, 085536, Table 5 and Table A-6) ranged from 4.7×10^{-7} mg/kg to 3.5×10^{-6} mg/kg in samples from lower Los Alamos Canyon. These levels are similar to the TCDD concentrations in Los Alamos and Pueblo Canyons (LANL 2005, 091818); the range of concentrations is 1.71×10^{-10} mg/kg to 4.96×10^{-6} mg/kg. Dioxins and furans, therefore, appear to be present throughout the Los Alamos and Pueblo Canyons watershed at levels exceeding the screening levels for small mammals. The field studies conducted in the Los Alamos and Pueblo Canyons watershed included four locations where small-mammal populations were evaluated, and two small-mammal study areas were in the Pueblo Canyon watershed (reaches AC-3 and P-3W). No difference in population density, sex ratio, or reproductive classes was noted between these small-mammal study areas (LANL 2004, 087390). Because adverse ecological effects to mammals were not identified by the ecological risk assessment, the assessment implicitly demonstrated that there are no adverse ecological effects from dioxins and furans. In addition, TCDD concentrations ranged from 3.14×10^{-7} mg/kg to 3.09×10^{-6} mg/kg in Pajarito Canyon (dioxins and furans were not analyzed for in Mortandad Canyon) as part of the canyon investigation and no adverse effects were reported (LANL 2008, 104909).

The 95% UCL for TCDD[2,3,7,8-] equivalent across the site is 6.65×10^{-6} mg/kg, which is similar to the concentrations detected in Los Alamos, Pueblo, and Pajarito Canyons. Because no adverse ecological effects to mammals were identified following small mammal trapping and analysis of whole organisms in these canyons at similar concentrations, no adverse ecological effects are present within the TA-16 Burn Ground.

The HIs are above 1.0 for the earthworm (2) and the plant (6). Barium is the primary COPEC for the earthworm and plant. The barium ESLs for the earthworm (330 mg/kg) and plant (110 mg/kg) are similar to or less than the soil BV (295 mg/kg) and the maximum background concentration (410 mg/kg). A comparison of the barium EPC (704 mg/kg) to the maximum background concentration (410 mg/kg) results in a ratio of 1.7. Therefore, the EPC is less than twice background and not likely to impact the earthworm and plant. Furthermore, as noted above, the Dourson and Stara (1983, 073474) study indicated that HIs up to 10 may not adversely affect ecological receptors.

The plant community was observed to be typical of the surrounding area and appears healthy; no evidence was found that there are any adverse impacts of contamination to the plant community. No marked differences in vegetation were observed between this area and areas with similar topography that did not have elevated HIs. In addition, substantially higher concentrations of barium were reported in Cañon de Valle below the 260 Outfall as part of the Resource Conservation and Recovery Act facility investigations conducted from 1998-2002 (LANL 2003, 077965). Despite the substantially elevated barium concentrations (maximum concentration of 37300 mg/kg) in the canyon sediment, the plant community was observed to be typical of the surrounding area and is luxuriant and healthy; no evidence was found that there are any adverse impacts of any contamination in Cañon de Valle to the plant community. These observations support the conclusions that barium is not impacting the earthworm and plant at the TA-16 Burn Ground and the Dourson and Stara (1983, 073474) study. Because the plant community is not affected by the COPECs, the earthworm population is also likely not affected. Therefore, no COPECs are retained at this site.

2.2.7 LOAEL-Based Analysis

The TCDD ESLs for the deer mouse and shrew used in the above assessment are based on geometric mean TRVs of four NOAELs for reproductive effects from the ECORISK Database, Version 2.3 (LANL 2008, 103352). These TRVs and the ESLs have not changed in the more recent release of the database (LANL 2009, 107524). The ESLs were calculated using the minimum LOAEL (0.000001 mg/kg/d) in the dataset for TCDD. The LOAEL-based ESLs are 0.000001 mg/kg for the deer mouse and 0.00000052 mg/kg for the shrew. These ESLs were used to compare TCDD[2,3,7,8-] equivalent EPCs for the two areas evaluated above; the area east of 16-0399 and the rest of the site. Comparing the maximum TCDD[2,3,7,8-] equivalent concentration in the smaller area (3.71E-05 mg/kg) to the LOAEL-based ESLs resulted in HQs of 37 and 71 for the deer mouse and shrew, respectively (Table 2.2-4). Adjusting the HQs with the PAUFs presented in Table 2.2-5 resulted in HQs of 1.1 and 0.004 for the deer mouse and shrew

(Table 2.2-6), respectively, for this area. Comparing the revised 95% UCL for the larger area to the LOAEL-based ESLs resulted in HQs of 1.2 and 2 for the deer mouse and shrew, respectively (Table 2.2-4). Adjusting the HQs by the PAUFs presented in Table 2.2-5 resulted in HQs of 0.996 and 0.03 (Table 2.2-6), respectively, for the larger area.

3.0 CONCLUSIONS

The human-health screening assessment found that potential risks were below the NMED target levels for the industrial and residential scenarios. The HQs and HIs calculated based on literature derived ESLs are conservative and overestimate the potential risk to receptors. Therefore, LOAEL-based ESLs were also calculated for the deer mouse and shrew. The LOAEL is also often more representative of potential population risk. The screening assessment using the LOAEL-based ESLs resulted in HQs of 1.1 and 0.996 for the deer mouse and 0.004 and 0.03 for the shrew. These HQs are less than or equivalent to 1.0, indicating no potential risk to both receptors. The LOAEL assessment reduces the uncertainty associated with the screening assessment and strongly implies that risks to the deer mouse and shrew are unlikely. As a result, the ecological risk screening assessment found that no COPECs are retained for the open burn units. The results of field observations and previous canyons studies further indicated that the HIs do not reflect adverse ecological impacts to receptors at the site. Therefore, no potential unacceptable risks to human and ecological receptors are present at the TA-16 burn units.

4.0 REFERENCES

The following list includes all documents cited in this appendix. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the New Mexico Environment Department Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

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Table 1.2-1
Background Comparisons for Inorganic Chemicals at the TA-16 Burn Ground

Sample ID	Depth (ft)	Media	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg
Soil Background Value (mg/kg)			**8.17**	**295**	**0.4**	**19.3**	**22.3**	**0.1**	**1.52**	**1**
09RCRA696	0-1	Soil	1.94	**1180**	0.33	7.85	11	0.0154	1.01(U)	0.574
09RCRA698	0-1	Soil	2.23	**470**	**0.493**	6.25	11.5	0.0163	1.07(U)	0.634
09RCRA700	0-1	Soil	0.773(J)	242	0.326	3.05	6.03	0.00568(J)	1.05(U)	0.398(J)
09RCRA702	0-1	Soil	3.39	196	**0.487**	11.1	13	0.0196	1.11(U)	0.452(J)
09RCRA704	0-1	Soil	2.42	229	**0.555**	8.8	19.7	0.0122(J)	1.05(U)	0.537
09RCRA706	0-1	Soil	1.94	298	**0.562**	5.2	11.5	0.0103(J)	1.03(U)	0.39(J)
09RCRA708	0-1	Soil	0.944(J)	**970**	0.319	4.59	9.16	0.0061(J)	1.01(U)	0.692
09RCRA710	0-1	Soil	0.767(J)	**1780**	**0.453**	5.24	13.5	0.04	1.05(U)	**7.95**
09RCRA712	0-1	Soil	0.981(J)	**1730**	**0.425**	5.16	9.48	0.0203	1.17(U)	**1.59**
09RCRA714	0-1	Soil	1.53	105	0.325	5.72	8.74	0.0123	1.04(U)	0.373(J)
09RCRA716	0-1	Soil	2.15	**434**	**0.579**	7.83	15.3	0.0152	1.03(U)	0.446(J)
09RCRA718	0-1	Soil	1.8	**1260**	**0.68**	8.89	17.4	0.0209	1.13(U)	0.876
09RCRA720	0-1	Soil	2.5	199	0.313	13.1	10.9	0.00946(J)	1.10(U)	0.439(J)
09RCRA722	0-1	Soil	1.8	243	**0.46**	8.24	11.1	0.00976(J)	1.04(U)	0.375(J)
09RCRA724	0-1	Soil	1.96	**356**	0.362	6.77	12.5	0.0116	1.02(U)	0.622
09RCRA726	0-1	Soil	1.76	98.8	0.358	6.06	11.9	0.00683(J)	1.05(U)	0.352(J)
09RCRA728	0-1	Soil	1.34	**314**	0.389	6.01	11.1	0.00848(J)	1.02(U)	0.413(J)
09RCRA730	0-1	Soil	1.46	230	0.366	4.79	7.11	0.00794(J)	1.05(U)	0.331(J)
09RCRA732	0-1	Soil	1.84	267	**0.414**	6.85	11.8	0.0118	1.03(U)	0.297(J)
09RCRA734	0-1	Soil	1.79	**345**	0.381	7.24	13.3	0.00854(J)	1.05(U)	0.471(J)
09RCRA736	0-1	Soil	1.45	275	0.385	6.03	15.9	0.00817(J)	1.02(U)	0.449(J)
09RCRA738	0-1	Soil	1.24	141	0.219	11.6	10	0.00888(J)	1.05(U)	0.164(J)
09RCRA740	0-1	Soil	1.85	**612**	**0.439**	9.55	10.4	0.0184	1.03(U)	**1.12**
09RCRA742	0-1	Soil	1.17	**488**	**0.408**	7.41	9.64	0.0115(J)	1.06(U)	0.923
09RCRA744	0-1	Soil	2.26	**948**	**0.621**	9.74	11.4	0.0412	1.09(U)	**1.17**
09RCRA746	0-1	Soil	1.47	270	0.317	8.47	10.5	0.00913(J)	1.04(U)	0.509(J)
09RCRA748	0-1	Soil	1.54	**417**	**0.487**	8.05	11.2	0.0112(J)	1.05(U)	0.771
09RCRA750	0-1	Soil	1.21	**414**	0.32	6.3	10.7	0.008(J)	1.06(U)	0.821
09RCRA752	0-1	Soil	2.1	**486**	0.306	7.13	11.9	0.0135	1.05(U)	0.64
09RCRA754	0-1	Soil	1.48	**401**	0.373	6.52	12.9	0.0115(J)	1.07(U)	0.552
09RCRA756	0-1	Soil	1.77	**915**	**0.438**	9.12	13.4	0.0229	1.11(U)	**1.7**

Note: Source of BVs Is LANL (1998, 059730). Bolded values are above the soil BV.

Table 1.2-2
Dioxin and Furan Congener Concentrations in Samples Collected from the TA-16 Burn Ground

Congener	09RCRA460 (mg/kg)	09RCRA461 (mg/kg)	09RCRA463 (mg/kg)	09RCRA464 (mg/kg)	09RCRA465 (mg/kg)	09RCRA695 (mg/kg)	09RCRA697 (mg/kg)	09RCRA699 (mg/kg)	09RCRA701 (mg/kg)	09RCRA703 (mg/kg)
2,3,7,8-TCDD	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	1.03E-07	1.33E-07	Not detected	6.18E-07
1,2,3,7,8-PeCDD	Not detected	Not detected	Not detected	Not detected	1.92E-06	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,4,7,8-HxCDD	4.19E-07	Not detected	Not detected	Not detected	5.38E-06	Not detected	Not detected	Not detected	Not detected	7.33E-07
1,2,3,6,7,8-HxCDD	7.15E-07	Not detected	Not detected	Not detected	1.06E-05	Not detected	4.67E-07	5.61E-07	Not detected	1.58E-06
1,2,3,7,8,9-HxCDD	7.26E-07	Not detected	Not detected	Not detected	1.14E-05	Not detected	5.18E-07	5.20E-07	Not detected	1.65E-06
1,2,3,4,6,7,8-HpCDD	2.08E-05	4.22E-06	4.41E-06	1.08E-05	2.92E-04	4.50E-06	8.35E-06	1.31E-05	8.37E-06	3.67E-05
OCDD	1.41E-04	2.07E-05	2.70E-05	3.22E-05	1.55E-03	3.41E-05	8.61E-05	1.02E-04	5.06E-05	2.09E-04
2,3,7,8-TCDF	1.83E-07	Not detected	Not detected	Not detected	2.01E-07	3.14E-06	6.59E-07	5.72E-07	1.14E-06	Not detected
1,2,3,7,8-PeCDF	Not detected	Not detected	Not detected	Not detected	Not detected	1.59E-06	4.83E-07	8.30E-07	Not detected	Not detected
2,3,4,7,8-PeCDF	Not detected	Not detected	Not detected	6.33E-07	7.15E-07	Not detected	5.13E-07	Not detected	Not detected	4.66E-07
1,2,3,4,7,8-HxCDF	4.95E-07	Not detected	Not detected	7.30E-07	3.21E-06	6.73E-07	5.88E-07	5.83E-07	Not detected	9.55E-07
1,2,3,6,7,8-HXCDF	5.39E-07	Not detected	Not detected	1.02E-06	3.96E-06	Not detected	4.53E-07	4.82E-07	Not detected	8.90E-07
2,3,4,6,7,8-HxCDF	7.23E-07	Not detected	Not detected	1.09E-06	5.33E-06	Not detected	6.30E-07	5.67E-07	Not detected	1.13E-06
1,2,3,7,8,9-HxCDF	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,4,6,7,8-HpCDF	1.04E-05	1.63E-06	1.20E-06	5.09E-06	8.44E-05	2.33E-06	3.50E-06	4.30E-06	3.05E-06	1.27E-05
1,2,3,4,7,8,9-HpCDF	5.35E-07	Not detected	Not detected	1.38E-06	5.95E-06	Not detected	Not detected	Not detected	Not detected	1.02E-06
OCDF	1.77E-05	2.54E-06	2.83E-06	1.07E-05	1.87E-04	3.98E-06	1.25E-05	1.27E-05	5.82E-06	2.93E-05

Table 1.2-2
Dioxin and Furan Congener Concentrations in Samples Collected from the TA-16 Burn Ground (continued)

Congener	09RCRA705 (mg/kg)	09RCRA707 (mg/kg)	09RCRA709 (mg/kg)	09RCRA711 (mg/kg)	09RCRA713 (mg/kg)	09RCRA715 (mg/kg)	09RCRA717 (mg/kg)	09RCRA719 (mg/kg)	09RCRA721 (mg/kg)	09RCRA723 (mg/kg)
2,3,7,8-TCDD	Not detected	1.69E-07	5.49E-07	1.34E-06	1.38E-07	2.52E-07	1.50E-07	Not detected	1.28E-07	2.22E-07
1,2,3,7,8-PeCDD	Not detected	Not detected	5.13E-07	6.99E-06	6.73E-07	5.39E-07	6.33E-07	Not detected	Not detected	Not detected
1,2,3,4,7,8-HxCDD	7.41E-07	Not detected	7.71E-07	1.79E-05	1.47E-06	1.21E-06	5.53E-07	Not detected	Not detected	Not detected
1,2,3,6,7,8-HxCDD	1.40E-06	7.53E-07	1.28E-06	3.33E-05	2.80E-06	2.45E-06	1.01E-06	Not detected	Not detected	Not detected
1,2,3,7,8,9-HxCDD	1.49E-06	8.03E-07	1.40E-06	4.07E-05	3.42E-06	3.06E-06	1.01E-06	Not detected	Not detected	Not detected
1,2,3,4,6,7,8-HpCDD	3.66E-05	2.01E-05	3.23E-05	9.00E-04	5.81E-05	6.85E-05	2.02E-05	6.22E-07	4.64E-06	1.95E-05
OCDD	2.08E-04	1.29E-04	1.85E-04	4.80E-03	2.38E-04	3.69E-04	1.01E-04	2.92E-06	2.68E-05	1.06E-04
2,3,7,8-TCDF	5.45E-07	9.19E-07	5.95E-07	1.51E-06	3.84E-07	3.38E-07	1.65E-06	1.46E-07	3.25E-07	3.23E-07
1,2,3,7,8-PeCDF	Not detected	5.72E-07	4.76E-07	1.65E-06	Not detected	Not detected	1.87E-06	Not detected	Not detected	Not detected
2,3,4,7,8-PeCDF	Not detected	6.77E-07	4.97E-07	1.97E-06	Not detected	Not detected	1.82E-06	Not detected	Not detected	Not detected
1,2,3,4,7,8-HxCDF	7.64E-07	7.87E-07	7.66E-07	1.21E-05	9.65E-07	1.01E-06	2.02E-06	Not detected	Not detected	Not detected
1,2,3,6,7,8-HXCDF	7.60E-07	7.41E-07	7.37E-07	1.44E-05	1.52E-06	1.28E-06	1.50E-06	Not detected	Not detected	Not detected
2,3,4,6,7,8-HxCDF	9.33E-07	9.19E-07	8.63E-07	1.78E-05	1.69E-06	1.56E-06	1.82E-06	Not detected	Not detected	Not detected
1,2,3,7,8,9-HxCDF	Not detected	Not detected	Not detected	2.02E-06	Not detected	Not detected	4.86E-07	Not detected	Not detected	Not detected
1,2,3,4,6,7,8-HpCDF	1.13E-05	7.27E-06	8.71E-06	2.88E-04	2.34E-05	2.38E-05	1.01E-05	Not detected	1.49E-06	3.03E-06
1,2,3,4,7,8,9-HpCDF	9.20E-07	7.30E-07	7.41E-07	1.92E-05	8.20E-07	1.29E-06	7.29E-07	Not detected	Not detected	Not detected
OCDF	2.79E-05	1.95E-05	2.19E-05	6.57E-04	2.33E-05	4.71E-05	1.62E-05	Not detected	3.42E-06	6.36E-06

Table 1.2-2
Dioxin and Furan Congener Concentrations in Samples Collected from the TA-16 Burn Ground (continued)

Congener	09RCRA725 (mg/kg)	09RCRA727 (mg/kg)	09RCRA729 (mg/kg)	09RCRA731 (mg/kg)	09RCRA733 (mg/kg)	09RCRA735 (mg/kg)	09RCRA737 (mg/kg)	09RCRA739 (mg/kg)	09RCRA741 (mg/kg)	09RCRA743 (mg/kg)
2,3,7,8-TCDD	Not detected	2.76E-07	9.45E-08	4.61E-07	1.73E-07	Not detected	Not detected	Not detected	2.41E-07	1.33E-07
1,2,3,7,8-PeCDD	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,4,7,8-HxCDD	Not detected	5.22E-07	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,6,7,8-HxCDD	Not detected	9.35E-07	5.88E-07	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,7,8,9-HxCDD	Not detected	1.12E-06	7.07E-07	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,4,6,7,8-HpCDD	6.76E-07	2.26E-05	1.36E-05	5.93E-06	2.00E-06	3.55E-06	8.76E-07	3.76E-06	3.17E-06	4.19E-06
OCDD	4.00E-06	1.36E-04	7.97E-05	3.18E-05	1.10E-05	2.29E-05	3.57E-06	1.91E-05	1.38E-05	1.65E-05
2,3,7,8-TCDF	2.22E-07	3.17E-07	4.13E-07	2.45E-07	2.00E-07	3.19E-07	2.65E-07	2.86E-07	3.83E-07	3.42E-07
1,2,3,7,8-PeCDF	Not detected	Not detected	6.28E-07	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
2,3,4,7,8-PeCDF	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,4,7,8-HxCDF	Not detected	5.51E-07	5.90E-07	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,6,7,8-HXCDF	Not detected	5.39E-07	4.38E-07	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
2,3,4,6,7,8-HxCDF	Not detected	6.73E-07	5.17E-06	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,7,8,9-HxCDF	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,4,6,7,8-HpCDF	Not detected	8.01E-06	5.17E-06	2.02E-06	7.45E-07	1.68E-06	Not detected	7.53E-07	6.40E-07	6.87E-07
1,2,3,4,7,8,9-HpCDF	Not detected	5.06E-07	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
OCDF	Not detected	1.55E-05	8.65E-06	3.64E-06	1.19E-06	3.59E-06	Not detected	1.91E-06	1.51E-06	1.34E-06

Table 1.2-2
Dioxin and Furan Congener Concentrations in Samples Collected from the TA-16 Burn Ground (continued)

Congener	09RCRA745 (mg/kg)	09RCRA747 (mg/kg)	09RCRA749 (mg/kg)	09RCRA751 (mg/kg)	09RCRA753 (mg/kg)	09RCRA755 (mg/kg)
2,3,7,8-TCDD	Not detected	1.82E-07	1.76E-07	1.33E-07	Not detected	Not detected
1,2,3,7,8-PeCDD	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,4,7,8-HxCDD	Not detected	Not detected	Not detected	Not detected	Not detected	6.08E-07
1,2,3,6,7,8-HxCDD	Not detected	Not detected	Not detected	Not detected	Not detected	8.00E-07
1,2,3,7,8,9-HxCDD	Not detected	Not detected	Not detected	Not detected	Not detected	8.24E-07
1,2,3,4,6,7,8-HpCDD	1.54E-06	7.12E-06	6.39E-06	4.88E-06	4.89E-06	1.20E-05
OCDD	8.98E-06	4.47E-05	3.34E-05	2.83E-05	2.89E-05	3.76E-05
2,3,7,8-TCDF	3.25E-07	3.83E-07	4.38E-07	4.23E-07	3.77E-07	4.11E-07
1,2,3,7,8-PeCDF	Not detected	Not detected	Not detected	7.18E-07	5.05E-07	Not detected
2,3,4,7,8-PeCDF	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,4,7,8-HxCDF	Not detected	Not detected	Not detected	4.88E-07	Not detected	Not detected
1,2,3,6,7,8-HXCDF	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
2,3,4,6,7,8-HxCDF	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,7,8,9-HxCDF	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,4,6,7,8-HpCDF	Not detected	1.61E-06	1.38E-06	8.28E-07	1.12E-06	1.38E-06
1,2,3,4,7,8,9-HpCDF	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
OCDF	Not detected	5.33E-06	3.29E-06	2.57E-06	3.11E-06	4.04E-06

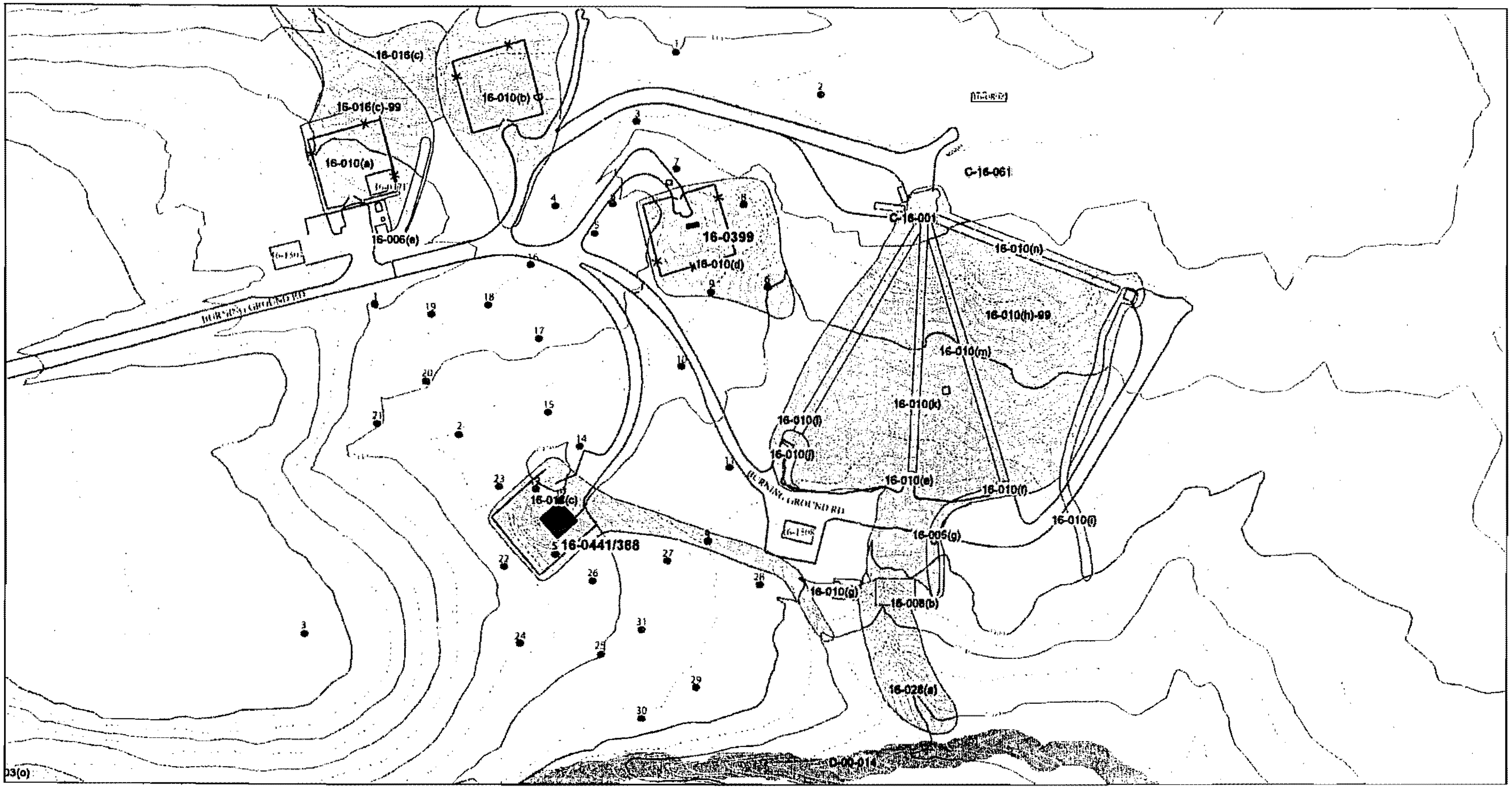

Figure 1.2-1: Technical Area 16 Burn Ground Soil Sample Locations For 2009 Soil Sample Collection Events

100-ft Contour
20-ft Contour
10-ft Contour
2-ft Contour

Fences
Roads, Paved
PRS and Areas of Concern
AOC
SWMU
● 08/26/09 Soil Sample Location
● 06/08/09 Soil Sample Location

RCRA waste management units
RWMU Structure
Other Structures

Los Alamos

DISCLAIMER
This map was created for work processes associated with the LANL Hazardous Waste Permit Facility Permit. All other uses for this map should be confirmed with LANL, ENV Division, Water Quality & RCRA.

1:1,600

Feet

Meters

1983 North American Datum
State Plane Coordinate System
New Mexico, Central Zone (US Feet)

DATA SOURCES

Addendum to Figure 1.2-1

	Dioxin-Furan Analysis	Metals Analysis
Sample Location on Figure	Sample ID	Sample ID
06/08/09 Location 1	09RCRA460	Not Applicable
06/08/09 Location 2	09RCRA461	Not Applicable
06/08/09 Location 3	09RCRA462	Not Applicable
06/08/09 Location 4	09RCRA463	Not Applicable
06/08/09 Location 5	09RCRA464	Not Applicable
06/08/09 Location 6	09RCRA465	Not Applicable
08/26/09 Location 1	09RCRA695	09RCRA696
08/26/09 Location 2	09RCRA697	09RCRA698
08/26/09 Location 3	09RCRA699	09RCRA700
08/26/09 Location 4	09RCRA701	09RCRA702
08/26/09 Location 5	09RCRA703	09RCRA704
08/26/09 Location 6	09RCRA705	09RCRA706
08/26/09 Location 7	09RCRA707	09RCRA708
08/26/09 Location 9	09RCRA709	09RCRA710
08/26/09 Location 8	09RCRA711	09RCRA712
08/26/09 Location 28	09RCRA713	09RCRA714
08/26/09 Location 29	09RCRA715	09RCRA716
08/26/09 Location 25	09RCRA717	09RCRA718
08/26/09 Location 30	09RCRA719	09RCRA720
08/26/09 Location 24	09RCRA721	09RCRA722
08/26/09 Location 26	09RCRA723	09RCRA724
08/26/09 Location 31	09RCRA725	09RCRA726
08/26/09 Location 27	09RCRA727	09RCRA728
08/26/09 Location 11	09RCRA729	09RCRA730
08/26/09 Location 10	09RCRA731	09RCRA732
08/26/09 Location 14	09RCRA733	09RCRA734
08/26/09 Location 12	09RCRA735	09RCRA736
08/26/09 Location 13	09RCRA737	09RCRA738
08/26/09 Location 22	09RCRA739	09RCRA740
08/26/09 Location 23	09RCRA741	09RCRA742
08/26/09 Location 16	09RCRA743	09RCRA744
08/26/09 Location 21	09RCRA745	09RCRA746
08/26/09 Location 20	09RCRA747	09RCRA748
08/26/09 Location 19	09RCRA749	09RCRA750
08/26/09 Location 18	09RCRA751	09RCRA752
08/26/09 Location 17	09RCRA753	09RCRA754
08/26/09 Location 15	09RCRA755	09RCRA756

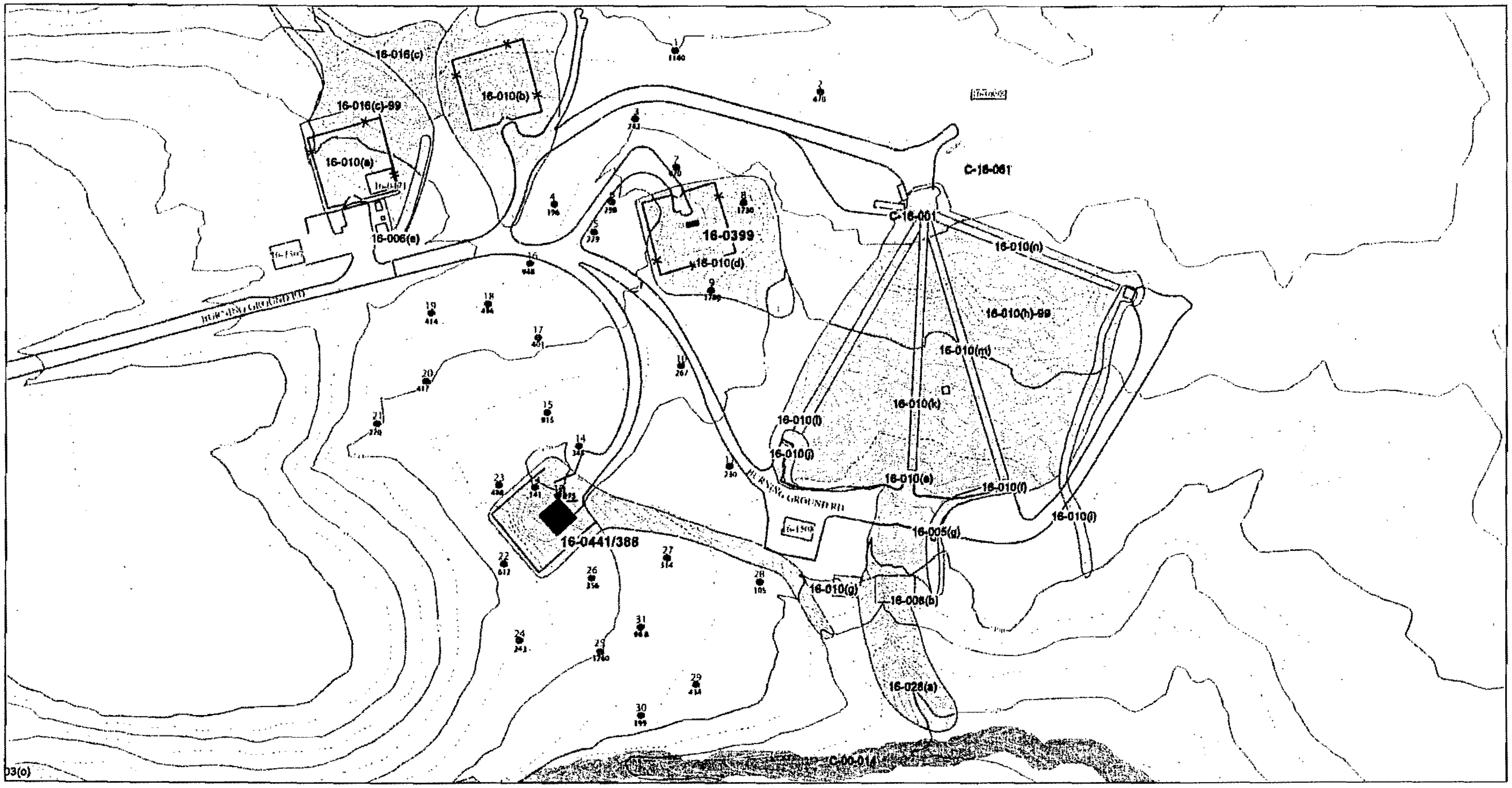

Figure 1.2-2: Technical Area 16 Burn Ground Barium Soil Concentrations

100-ft Contour	Fences	RCRA waste management units
20-ft Contour	Roads, Paved	RWMU Structure
10-ft Contour	PRS and Areas of Concern	Other Structures
2-ft Contour	AOC	
	SWMU	
	• 08/26/09 Soil Sample Location	

Los Alamos

* Concentrations values in black for each sample location are barium concentrations in milligrams per kilogram (mg/Kg).

DISCLAIMER
This map was created for work processes associated with the LANL Hazardous Waste Permit Facility Permit. All other uses for this map should be confirmed with LANL, ENV Division, Water Quality & RCRA.

1:1,600

0 45 90 180 Feet

0 3.5 7 14 21 28 Meters

1983 North American Datum
State Plane Coordinate System
New Mexico, Central Zone (US Feet)

DATA SOURCES

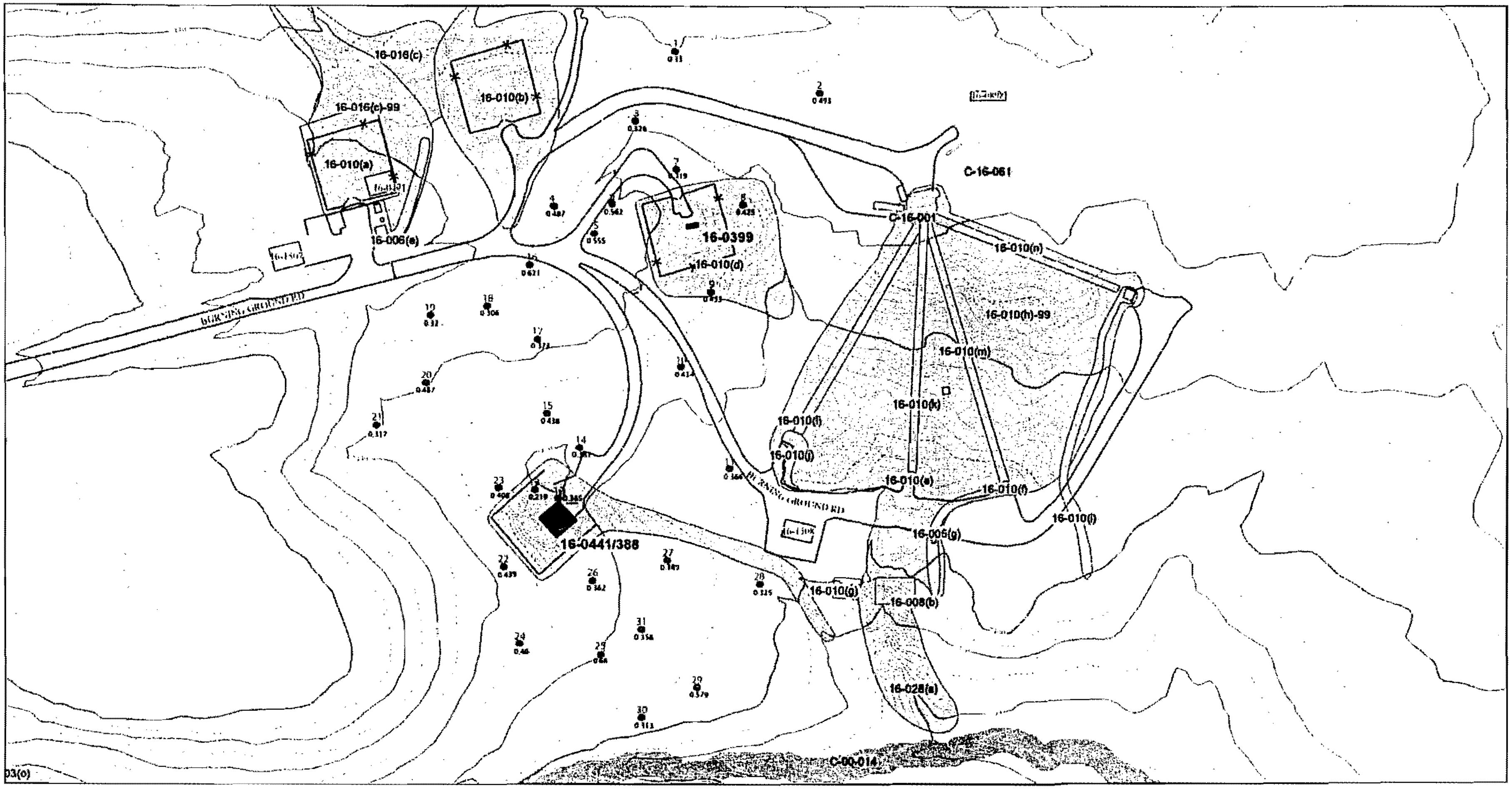

Figure 1.2-3: Technical Area 16 Burn Ground Cadmium Soil Concentrations

Legend		
100-ft Contour	Fences	RCRA waste management units
20-ft Contour	Roads, Paved	RWMU Structure
10-ft Contour	PRS and Areas of Concern	Other Structures
2-ft Contour	AOC	
	SWMU	
	08/26/09 Soil Sample Location	

* Concentrations values in black for each sample location are cadmium concentrations in milligrams per kilogram (mg/Kg).

DISCLAIMER.
This map was created for work processes associated with the LANL Hazardous Waste Permit Facility Permit. All other uses for this map should be confirmed with LANL, ENV Division, Water Quality & RCRA.

1:1,600

0 45 90 180 Feet

0 3.5 7 14 21 28 Meters

1983 North American Datum
State Plane Coordinate System
New Mexico, Central Zone (US Feet)

DATA SOURCES

PATH	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

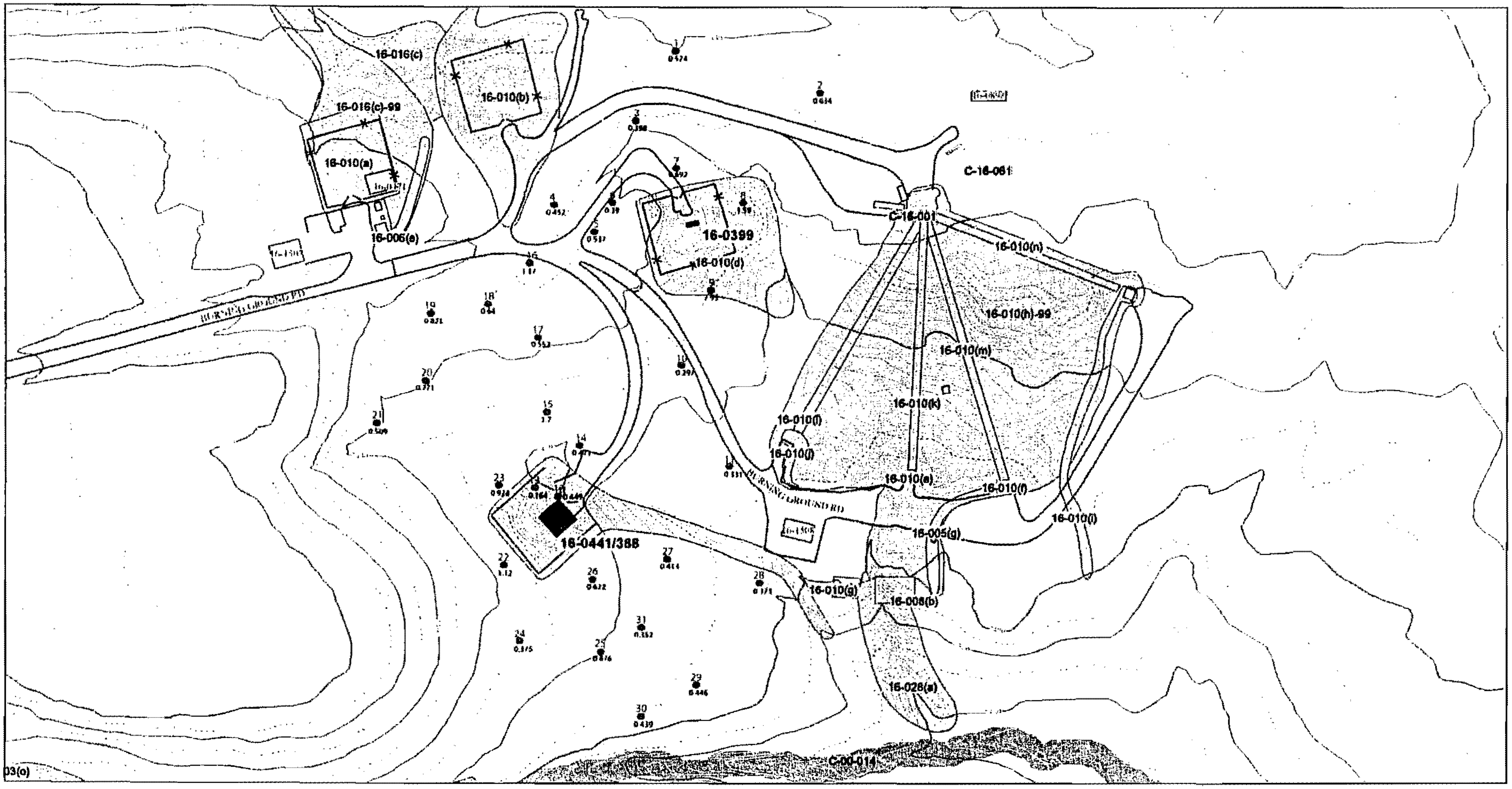

Figure 1.2-4: Technical Area 16 Burn Ground Silver Soil Concentrations

100-ft Contour
20-ft Contour
10-ft Contour
2-ft Contour

Fences
Roads, Paved

PRS and Areas of Concern
AOC
SWMU
• 08/26/09 Soil Sample Location

RCRA waste management units
RWMU Structure
Other Structures

Los Alamos

* Concentrations values in black for each sample location are silver concentrations in milligrams per kilogram (mg/Kg).

DISCLAIMER
This map was created for work processes associated with the LANL Hazardous Waste Permit Facility Permit. All other uses for this map should be confirmed with LANL, ENV Division, Water Quality & RCRA.

1:1,600

0 45 90 180 Feet

Meters 0 3.5 7 14 21 28

1983 North American Datum
State Plane Coordinate System
New Mexico, Central Zone (US Feet)

DATA SOURCES

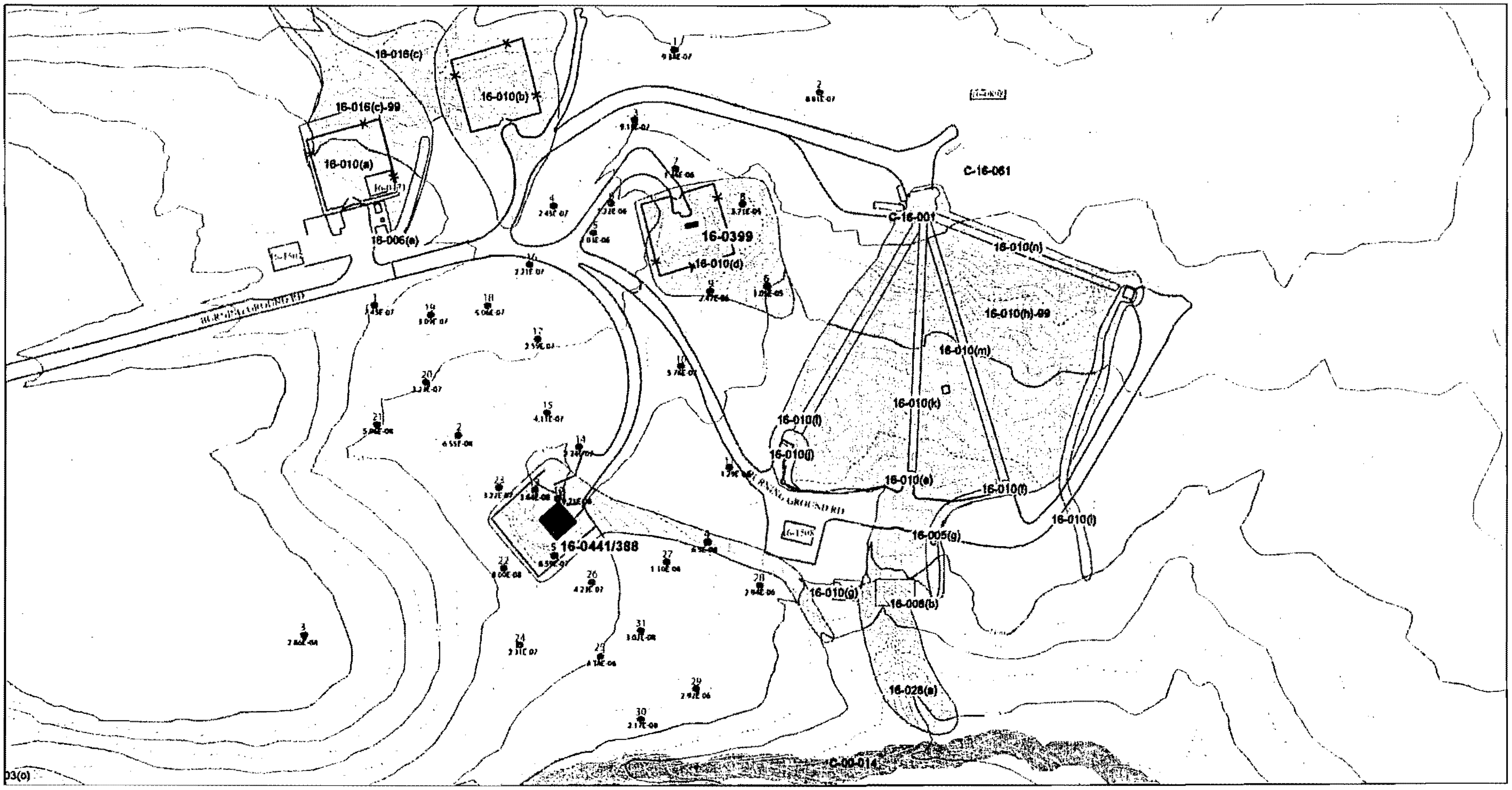

Figure 1.2-5: Technical Area 16 Burn Ground Dioxin/Furan Soil Concentrations

100-ft Contour	Fences	RCRA waste management units
20-ft Contour	Roads, Paved	RWMU Structure
10-ft Contour	PRS and Areas of Concern	Other Structures
2-ft Contour	AOC	
	SWMU	
	● 08/26/09 Soil Sample Location	
	● 06/08/09 Soil Sample Location	

* Concentrations values in black for each sample location are TCDD toxicity equivalent concentrations in milligrams per kilogram (mg/Kg).

DISCLAIMER: This map was created for work processes associated with the LANL Hazardous Waste Permit Facility Permit. All other uses for this map should be confirmed with LANL, ENV Division, Water Quality & RCRA.

1:1,600

0 45 90 180 Feet

Meters

1983 North American Datum
State Plane Coordinate System
New Mexico, Central Zone (US Feet)

DATA SOURCES

Table 1.3-1
Toxic Equivalency Factors (TEFs) Used for Calculating TCDD Equivalent Concentrations

Dioxin and Furan Congeners	WHO 1995* TEF
Tetrachlorodibenzodioxin[2,3,7,8-]	1
Pentachlorodibenzodioxin[1,2,3,7,8-]	1
Hexachlorodibenzodioxin[1,2,3,4,7,8-]	0.1
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	0.1
Hexachlorodibenzodioxin[1,2,3,7,8,9-]	0.1
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	0.01
Octachlorodibenzodioxin	0.0003
Tetrachlorodibenzofuran[2,3,7,8-]	0.1
Pentachlorodibenzofuran[1,2,3,7,8-]	0.03
Pentachlorodibenzofuran[2,3,4,7,8-]	0.3
Hexachlorodibenzofuran[1,2,3,4,7,8-]	0.1
Hexachlorodibenzofuran[1,2,3,6,7,8-]	0.1
Hexachlorodibenzofuran[1,2,3,7,8,9-]	0.1
Hexachlorodibenzofuran[2,3,4,6,7,8-]	0.1
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	0.01
Heptachlorodibenzofuran[1,2,3,4,7,8,9-]	0.01
Octachlorodibenzofuran	0.0003

*http://www.epa.gov/ncea/pdfs/dioxin/part2/drich9.pdf.

Table 1.3-2
Dioxin and Furan Congener Concentrations Converted Using the Toxicity Equivalency Factors

Congener	09RCRA460 (mg/kg)	09RCRA461 (mg/kg)	09RCRA463 (mg/kg)	09RCRA464 (mg/kg)	09RCRA465 (mg/kg)	09RCRA695 (mg/kg)	09RCRA697 (mg/kg)	09RCRA699 (mg/kg)	09RCRA701 (mg/kg)	09RCRA703 (mg/kg)
2,3,7,8-TCDD	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	1.03E-07	1.33E-07	Not detected	6.18E-07
1,2,3,7,8-PeCDD	Not detected	Not detected	Not detected	Not detected	1.92E-06	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,4,7,8-HxCDD	4.19E-08	Not detected	Not detected	Not detected	5.38E-07	Not detected	Not detected	Not detected	Not detected	7.33E-08
1,2,3,6,7,8-HxCDD	7.15E-08	Not detected	Not detected	Not detected	1.06E-06	Not detected	4.67E-08	5.61E-08	Not detected	1.58E-07
1,2,3,7,8,9-HxCDD	7.26E-08	Not detected	Not detected	Not detected	1.14E-06	Not detected	5.18E-08	5.20E-08	Not detected	1.65E-07
1,2,3,4,6,7,8,-HpCDD	2.08E-07	4.22E-08	4.41E-08	1.08E-07	2.92E-06	4.50E-08	8.35E-08	1.31E-07	8.37E-08	3.67E-07
OCDD	4.23E-08	6.21E-09	8.10E-09	9.66E-09	4.65E-07	1.02E-08	2.58E-08	3.06E-08	1.52E-08	6.27E-08
2,3,7,8-TCDF	1.83E-08	Not detected	Not detected	Not detected	2.01E-08	3.14E-07	6.59E-08	5.72E-08	1.14E-07	Not detected
1,2,3,7,8-PeCDF	Not detected	Not detected	Not detected	Not detected	Not detected	4.77E-07	1.45E-07	2.49E-07	Not detected	Not detected
2,3,4,7,8-PeCDF	Not detected	Not detected	Not detected	1.90E-07	2.15E-07	Not detected	1.54E-07	Not detected	Not detected	1.40E-07
1,2,3,4,7,8-HxCDF	4.95E-08	Not detected	Not detected	7.30E-08	3.21E-07	6.73E-08	5.88E-08	5.83E-08	Not detected	9.55E-08
1,2,3,6,7,8-HXCDF	5.39E-08	Not detected	Not detected	1.02E-07	3.96E-07	Not detected	4.53E-08	4.82E-08	Not detected	8.90E-08
2,3,4,6,7,8-HxCDF	7.23E-08	Not detected	Not detected	1.09E-07	5.33E-07	Not detected	6.30E-08	5.67E-08	Not detected	1.13E-07
1,2,3,7,8,9-HxCDF	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,4,6,7,8-HpCDF	1.04E-07	1.63E-08	1.20E-08	5.09E-08	8.44E-07	2.33E-08	3.50E-08	4.30E-08	3.05E-08	1.27E-07
1,2,3,4,7,8,9-HpCDF	5.35E-09	Not detected	Not detected	1.38E-08	5.95E-08	Not detected	Not detected	Not detected	Not detected	1.02E-08
OCDF	5.31E-09	7.62E-10	8.49E-10	3.21E-09	5.61E-08	1.19E-09	3.75E-09	3.81E-09	1.75E-09	8.79E-09
TCDD[2,3,7,8-] equivalent concentration	**7.45E-07**	**6.55E-08**	**6.50E-08**	**6.59E-07**	**1.05E-05**	**9.38E-07**	**8.81E-07**	**9.19E-07**	**2.45E-07**	**2.03E-06**

Table 1.3-2
Dioxin and Furan Congener Concentrations Converted Using the Toxicity Equivalency Factors (continued)

Congener	09RCRA705 (mg/kg)	09RCRA707 (mg/kg)	09RCRA709 (mg/kg)	09RCRA711 (mg/kg)	09RCRA713 (mg/kg)	09RCRA715 (mg/kg)	09RCRA717 (mg/kg)	09RCRA719 (mg/kg)	09RCRA721 (mg/kg)	09RCRA723 (mg/kg)
2,3,7,8-TCDD	Not detected	1.69E-07	5.49E-07	1.34E-06	1.38E-07	2.52E-07	1.50E-07	Not detected	1.28E-07	2.22E-07
1,2,3,7,8-PeCDD	Not detected	Not detected	5.13E-07	6.99E-06	6.73E-07	5.39E-07	6.33E-07	Not detected	Not detected	Not detected
1,2,3,4,7,8-HxCDD	7.41E-08	Not detected	7.71E-08	1.79E-06	1.47E-07	1.21E-07	5.53E-08	Not detected	Not detected	Not detected
1,2,3,6,7,8-HxCDD	1.40E-07	7.53E-08	1.28E-07	3.33E-06	2.80E-07	2.45E-07	1.01E-07	Not detected	Not detected	Not detected
1,2,3,7,8,9-HxCDD	1.49E-07	8.03E-08	1.40E-07	4.07E-06	3.42E-07	3.06E-07	1.01E-07	Not detected	Not detected	Not detected
1,2,3,4,6,7,8,-HpCDD	3.66E-07	2.01E-07	3.23E-07	9.00E-06	5.81E-07	6.85E-07	2.02E-07	6.22E-09	4.64E-08	1.05E-07
OCDD	6.24E-08	3.87E-08	5.55E-08	1.44E-06	7.14E-08	1.11E-07	3.03E-08	8.76E-10	8.04E-09	3.18E-08
2,3,7,8-TCDF	5.45E-08	9.19E-08	5.95E-08	1.51E-07	3.84E-08	3.38E-08	1.65E-07	1.46E-08	3.25E-08	3.23E-08
1,2,3,7,8-PeCDF	Not detected	1.72E-07	1.43E-07	4.95E-07	Not detected	Not detected	5.61E-07	Not detected	Not detected	Not detected
2,3,4,7,8-PeCDF	Not detected	2.03E-07	1.49E-07	5.91E-07	Not detected	Not detected	5.46E-07	Not detected	Not detected	Not detected
1,2,3,4,7,8-HxCDF	7.64E-08	7.87E-08	7.66E-08	1.21E-06	9.65E-08	1.01E-07	2.02E-07	Not detected	Not detected	Not detected
1,2,3,6,7,8-HXCDF	7.60E-08	7.41E-08	7.37E-08	1.44E-06	1.52E-07	1.28E-07	1.50E-07	Not detected	Not detected	Not detected
2,3,4,6,7,8-HxCDF	9.33E-08	9.19E-08	8.63E-08	1.78E-06	1.69E-07	1.56E-07	1.82E-07	Not detected	Not detected	Not detected
1,2,3,7,8,9-HxCDF	Not detected	Not detected	Not detected	2.02E-07	Not detected	Not detected	4.86E-08	Not detected	Not detected	Not detected
1,2,3,4,6,7,8-HpCDF	1.13E-07	7.27E-08	8.71E-08	2.88E-06	2.34E-07	2.38E-07	1.01E-07	Not detected	1.49E-08	3.03E-08
1,2,3,4,7,8,9-HpCDF	9.20E-09	7.30E-09	7.41E-09	1.92E-05	8.20E-09	1.29E-08	7.29E-09	Not detected	Not detected	Not detected
OCDF	8.37E-09	5.85E-09	6.57E-09	1.97E-07	6.99E-09	1.41E-08	4.86E-09	Not detected	1.03E-09	1.91E-09
TCDD[2,3,7,8-] equivalent concentration	**1.22E-06**	**1.36E-06**	**2.47E-06**	**3.71E-05**	**2.94E-06**	**2.92E-06**	**3.38E-06**	**2.17E-08**	**2.31E-07**	**4.23E-07**

Table 1.3-2
Dioxin and Furan Congener Concentrations Converted Using the Toxicity Equivalency Factors (continued)

Congener	09RCRA725 (mg/kg)	09RCRA727 (mg/kg)	09RCRA729 (mg/kg)	09RCRA731 (mg/kg)	09RCRA733 (mg/kg)	09RCRA735 (mg/kg)	09RCRA737 (mg/kg)	09RCRA739 (mg/kg)	09RCRA741 (mg/kg)	09RCRA743 (mg/kg)
2,3,7,8-TCDD	Not detected	2.76E-07	9.45E-08	4.61E-07	1.73E-07	Not detected	Not detected	Not detected	2.41E-07	1.33E-07
1,2,3,7,8-PeCDD	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,4,7,8-HxCDD	Not detected	5.22E-08	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,6,7,8-HxCDD	Not detected	9.35E-08	5.88E-08	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,7,8,9-HxCDD	Not detected	1.12E-07	7.07E-08	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,4,6,7,8,-HpCDD	6.76E-09	2.26E-07	1.36E-07	5.93E-08	2.00E-08	3.55E-08	8.76E-09	3.76E-08	3.17E-08	4.19E-08
OCDD	1.20E-09	4.08E-08	2.39E-08	9.54E-09	3.30E-09	6.87E-09	1.07E-09	5.73E-09	4.14E-09	4.95E-09
2,3,7,8-TCDF	2.22E-08	3.17E-08	4.13E-08	2.45E-08	2.00E-08	3.19E-08	2.65E-08	2.86E-08	3.83E-08	3.42E-08
1,2,3,7,8-PeCDF	Not detected	Not detected	1.88E-07	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
2,3,4,7,8-PeCDF	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,4,7,8-HxCDF	Not detected	5.51E-08	5.90E-08	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,6,7,8-HXCDF	Not detected	5.39E-08	4.38E-08	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
2,3,4,6,7,8-HxCDF	Not detected	6.73E-08	5.17E-07	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,7,8,9-HxCDF	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,4,6,7,8-HpCDF	Not detected	8.01E-08	5.17E-08	2.02E-08	7.45E-09	1.68E-08	Not detected	7.53E-09	6.40E-09	6.87E-09
1,2,3,4,7,8,9-HpCDF	Not detected	5.06E-09	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
OCDF	Not detected	4.65E-09	2.60E-09	1.09E-09	3.57E-10	1.08E-09	Not detected	5.83E-10	4.53E-10	4.02E-10
TCDD[2,3,7,8-] equivalent concentration	**3.02E-08**	**1.10E-06**	**1.29E-06**	**5.76E-07**	**2.24E-07**	**9.21E-08**	**3.64E-08**	**8.00E-08**	**3.22E-07**	**2.21E-07**

Table 1.3-2
Dioxin and Furan Congener Concentrations Converted Using the Toxicity Equivalency Factors (continued)

Congener	09RCRA745 (mg/kg)	09RCRA747 (mg/kg)	09RCRA749 (mg/kg)	09RCRA751 (mg/kg)	09RCRA753 (mg/kg)	09RCRA755 (mg/kg)
2,3,7,8-TCDD	Not detected	1.82E-07	1.76E-07	1.33E-07	Not detected	Not detected
1,2,3,7,8-PeCDD	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,4,7,8-HxCDD	Not detected	Not detected	Not detected	Not detected	Not detected	6.08E-08
1,2,3,6,7,8-HxCDD	Not detected	Not detected	Not detected	Not detected	Not detected	8.00E-08
1,2,3,7,8,9-HxCDD	Not detected	Not detected	Not detected	Not detected	Not detected	8.24E-08
1,2,3,4,6,7,8-HpCDD	1.54E-08	7.12E-08	6.39E-08	4.88E-08	4.89E-08	1.20E-07
OCDD	2.69E-09	1.34E-08	1.00E-08	8.49E-09	8.67E-09	1.13E-08
2,3,7,8-TCDF	3.25E-08	3.83E-08	4.38E-08	4.23E-08	3.77E-08	4.11E-08
1,2,3,7,8-PeCDF	Not detected	Not detected	Not detected	2.15E-07	1.52E-07	Not detected
2,3,4,7,8-PeCDF	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,4,7,8-HxCDF	Not detected	Not detected	Not detected	4.88E-08	Not detected	Not detected
1,2,3,6,7,8-HXCDF	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
2,3,4,6,7,8-HxCDF	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,7,8,9-HxCDF	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
1,2,3,4,6,7,8-HpCDF	Not detected	1.61E-08	1.38E-08	8.28E-09	1.12E-08	1.38E-08
1,2,3,4,7,8,9-HpCDF	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
OCDF	Not detected	1.60E-09	9.87E-10	7.71E-10	9.33E-10	1.21E-09
TCDD[2,3,7,8-] equivalent concentration	**5.06E-08**	**3.23E-07**	**3.09E-07**	**5.06E-07**	**2.59E-07**	**4.11E-07**

Table 1.3-3
Exposure Point Concentrations for the Industrial and Residential Scenarios and Ecological Receptors

COPC	Number of Analyses	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Mean Concentration (mg/kg)	Distribution	EPC (mg/kg)	EPC Method
Barium	31	98.8	1780	526.3	Lognormal	704.4	95% H-UCL
Cadmium	31	0.219	0.68	0.416	Normal	0.448	95% Student's-t UCL
Silver	31	0.164	7.95	0.872	Nonparametric	1.94	95% Chebyshev (Mean, Sd) UCL
TCDD[2,3,7,8-] equivalent	36	0.0000000217	0.0000371	0.00000212	Nonparametric	0.00000665	95% Chebyshev (Mean, Sd) UCL

Table 1.3-4
Industrial Screening Evaluation of Noncarcinogenic COPCs

COPC	EPC (mg/kg)[a]	Industrial SSL (mg/kg)[b]	Hazard Quotient
Barium	704.4	224000	0.003
Cadmium	0.448	1120	0.0004
Silver	1.94	5680	0.0003
		HI	**0.004**

[a] The EPC is the 95% UCL.
[b] SSLs are from NMED (2009, 106420).

Table 1.3-5
Industrial Screening Evaluation of Carcinogenic COPCs

COPC	EPC (mg/kg)[a]	Industrial SSL (mg/kg)[b]	Cancer Risk
TCDD[2,3,7,8-] equivalent	0.00000665	0.000204	3×10^{-7}
		Total Excess Cancer Risk	**3×10^{-7}**

[a] The EPC is the 95% UCL.
[b] SSL is from NMED (2009, 106420).

Table 1.3-6
Residential Screening Evaluation of Noncarcinogenic COPCs

COPC	EPC (mg/kg)[a]	Residential SSL (mg/kg)[b]	Hazard Quotient
Barium	704.4	15600	0.05
Cadmium	0.448	77.9	0.006
Silver	1.94	391	0.005
		HI	**0.06**

[a] The EPC is the 95% UCL.
[b] SSLs are from NMED (2009, 106420).

Table 1.3-7
Residential Screening Evaluation of Carcinogenic COPCs

COPC	EPC (mg/kg)[a]	Residential SSL (mg/kg)[b]	Cancer Risk
TCDD[2,3,7,8-] equivalent	0.00000665	0.0000414	2×10^{-6}
		Total Excess Cancer Risk	**2×10^{-6}**

[a] The EPC is the 95% UCL.
[b] SSL is from NMED (2009, 106420).

Dioxin/Furan

General Statistics

Number of Valid Observations	36	Number of Distinct Observations	36

Raw Statistics		Log-transformed Statistics	
Minimum	2.17E-08	Minimum of Log Data	-17.65
Maximum	0.0000371	Maximum of Log Data	-10.2
Mean	2.082E-06	Mean of log Data	-14.56
Median	4.645E-07	SD of log Data	1.645
SD	6.281E-06		
Coefficient of Variation	N/A		
Skewness	5.299		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.329	Shapiro Wilk Test Statistic	0.978
Shapiro Wilk Critical Value	0.935	Shapiro Wilk Critical Value	0.935
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	3.85E-06	95% H-UCL	4.476E-06
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	4.366E-06
95% Adjusted-CLT UCL	4.791E-06	97.5% Chebyshev (MVUE) UCL	5.523E-06
95% Modified-t UCL	4.005E-06	99% Chebyshev (MVUE) UCL	7.795E-06

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.421	**Data appear Lognormal at 5% Significance Level**	
Theta Star	4.951E-06		
MLE of Mean	2.082E-06		
MLE of Standard Deviation	3.21E-06		
nu star	30.28		
Approximate Chi Square Value (.05)	18.71	Nonparametric Statistics	
Adjusted Level of Significance	0.0428	95% CLT UCL	3.804E-06
Adjusted Chi Square Value	18.3	95% Jackknife UCL	3.85E-06
		95% Standard Bootstrap UCL	3.756E-06
Anderson-Darling Test Statistic	2.058	95% Bootstrap-t UCL	1.202E-05
Anderson-Darling 5% Critical Value	0.826	95% Hall's Bootstrap UCL	1.052E-05
Kolmogorov-Smirnov Test Statistic	0.206	95% Percentile Bootstrap UCL	4.079E-06
Kolmogorov-Smirnov 5% Critical Value	0.156	95% BCA Bootstrap UCL	5.553E-06
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	6.645E-06
		97.5% Chebyshev(Mean, Sd) UCL	8.619E-06
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1.25E-05
95% Approximate Gamma UCL	3.369E-06		
95% Adjusted Gamma UCL	3.445E-06		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	6.645E-06

Figure 1.3-1. ProUCL printout of dioxin/furan UCL calculations for the TA-16 Burn Ground.

Barium

General Statistics

Number of Valid Observations	31	Number of Distinct Observations	31
Raw Statistics		**Log-transformed Statistics**	
Minimum	98.8	Minimum of Log Data	4.593
Maximum	1780	Maximum of Log Data	7.484
Mean	526.3	Mean of log Data	5.979
Median	356	SD of log Data	0.752
SD	446.9		
Coefficient of Variation	0.849		
Skewness	1.654		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.777	Shapiro Wilk Test Statistic	0.958
Shapiro Wilk Critical Value	0.929	Shapiro Wilk Critical Value	0.929
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	662.5	95% H-UCL	704.4
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	851.8
95% Adjusted-CLT UCL	683.8	97.5% Chebyshev (MVUE) UCL	996.1
95% Modified-t UCL	666.5	99% Chebyshev (MVUE) UCL	1280
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.734	Data appear Lognormal at 5% Significance Level	
Theta Star	303.5		
MLE of Mean	526.3		
MLE of Standard Deviation	399.6		
nu star	107.5		
Approximate Chi Square Value (.05)	84.58	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0413	95% CLT UCL	658.3
Adjusted Chi Square Value	83.45	95% Jackknife UCL	662.5
		95% Standard Bootstrap UCL	657.1
Anderson-Darling Test Statistic	1.001	95% Bootstrap-t UCL	694.7
Anderson-Darling 5% Critical Value	0.76	95% Hall's Bootstrap UCL	687.1
Kolmogorov-Smirnov Test Statistic	0.185	95% Percentile Bootstrap UCL	661.1
Kolmogorov-Smirnov 5% Critical Value	0.16	95% BCA Bootstrap UCL	689.7
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	876.1
		97.5% Chebyshev(Mean, Sd) UCL	1028
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1325
95% Approximate Gamma UCL	668.9		
95% Adjusted Gamma UCL	678		
Potential UCL to Use		Use 95% H-UCL	704.4

Figure 1.3-2. ProUCL printout of barium UCL calculations for the TA-16 Burn Ground.

Cadmium

General Statistics

Number of Valid Observations	31	Number of Distinct Observations	30
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.219	Minimum of Log Data	-1.519
Maximum	0.68	Maximum of Log Data	-0.386
Mean	0.416	Mean of log Data	-0.907
Median	0.389	SD of log Data	0.246
SD	0.104		
Coefficient of Variation	0.251		
Skewness	0.723		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.948	Shapiro Wilk Test Statistic	0.975
Shapiro Wilk Critical Value	0.929	Shapiro Wilk Critical Value	0.929
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.448	95% H-UCL	0.451
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.497
95% Adjusted-CLT UCL	0.449	97.5% Chebyshev (MVUE) UCL	0.532
95% Modified-t UCL	0.448	99% Chebyshev (MVUE) UCL	0.601
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	15.48	**Data appear Normal at 5% Significance Level**	
Theta Star	0.0269		
MLE of Mean	0.416		
MLE of Standard Deviation	0.106		
nu star	959.8		
Approximate Chi Square Value (.05)	888.9	Nonparametric Statistics	
Adjusted Level of Significance	0.0413	95% CLT UCL	0.447
Adjusted Chi Square Value	885.1	95% Jackknife UCL	0.448
		95% Standard Bootstrap UCL	0.446
Anderson-Darling Test Statistic	0.387	95% Bootstrap-t UCL	0.449
Anderson-Darling 5% Critical Value	0.745	95% Hall's Bootstrap UCL	0.45
Kolmogorov-Smirnov Test Statistic	0.0982	95% Percentile Bootstrap UCL	0.448
Kolmogorov-Smirnov 5% Critical Value	0.158	95% BCA Bootstrap UCL	0.449
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.498
		97.5% Chebyshev(Mean, Sd) UCL	0.533
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.602
95% Approximate Gamma UCL	0.449		
95% Adjusted Gamma UCL	0.451		
Potential UCL to Use		Use 95% Student's-t UCL	0.448

Figure 1.3-3. ProUCL printout of cadmium UCL calculations for the TA-16 Burn Ground.

Silver

General Statistics

Number of Valid Observations	31	Number of Distinct Observations	31

Raw Statistics		Log-transformed Statistics	
Minimum	0.164	Minimum of Log Data	-1.808
Maximum	7.95	Maximum of Log Data	2.073
Mean	0.872	Mean of log Data	-0.496
Median	0.537	SD of log Data	0.69
SD	1.361		
Coefficient of Variation	1.561		
Skewness	5.001		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.386	Shapiro Wilk Test Statistic	0.872
Shapiro Wilk Critical Value	0.929	Shapiro Wilk Critical Value	0.929
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	1.287	95% H-UCL	1.005
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	1.211
95% Adjusted-CLT UCL	1.509	97.5% Chebyshev (MVUE) UCL	1.404
95% Modified-t UCL	1.323	99% Chebyshev (MVUE) UCL	1.784

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.41	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.619		
MLE of Mean	0.872		
MLE of Standard Deviation	0.734		
nu star	87.39		
Approximate Chi Square Value (.05)	66.84	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0413	95% CLT UCL	1.274
Adjusted Chi Square Value	65.84	95% Jackknife UCL	1.287
		95% Standard Bootstrap UCL	1.268
Anderson-Darling Test Statistic	2.718	95% Bootstrap-t UCL	2.337
Anderson-Darling 5% Critical Value	0.763	95% Hall's Bootstrap UCL	2.699
Kolmogorov-Smirnov Test Statistic	0.212	95% Percentile Bootstrap UCL	1.322
Kolmogorov-Smirnov 5% Critical Value	0.161	95% BCA Bootstrap UCL	1.626
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1.937
		97.5% Chebyshev(Mean, Sd) UCL	2.398
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	3.304
95% Approximate Gamma UCL	1.14		
95% Adjusted Gamma UCL	1.157		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	1.937

Figure 1.3-4. ProUCL printout of silver UCL calculations for the TA-16 Burn Ground.

Table 2.1-1
Ecological Screening Levels for Terrestrial Receptors

Chemical	Kestrel (Avian insectivore)	Kestrel (carnivore)	Robin (herbivore)	Robin (insectivore)	Robin (omnivore)	Deer mouse	Desert cottontail	Earthworm	Plant	Montane shrew	Red fox
Barium	11000	37000	820	1000	930	1800	3300	330	110	1300	41000
Cadmium	2	580	4.4	0.29	0.54	0.51	9.9	140	32	0.27	510
Silver	19	840	11	2.6	4.3	24	150	na[a]	560	14	4100
TCDD[2,3,7,8-] equivalent	0.000014[b]	0.000014[b]	0.00024[b]	0.0000041[b]	0.0000081[b]	0.00000058	0.000048	5	na	0.00000029	0.0000012

Note: ESLs from ECORISK Database, Version 2.3 (LANL 2008, 103352) unless otherwise noted.

[a] na = Not available.

[b]Avian ESLs for TCDD taken from ECORISK Database, Version 2.0 (LANL 2000, 080117).

Table 2.1-2
Comparison of EPCs with the Minimum ESLs

COPC	EPC[a] (mg/kg)	Minimum ESL[b] (mg/kg)	Receptor	Hazard Quotient
Barium	704.4	110	Plant	**6.4**
Cadmium	0.448	0.27	Montane shrew	**1.7**
Silver	1.94	2.6	Robin (insectivore)	**0.7**
TCDD[2,3,7,8-] equivalent	0.00000665	0.00000029	Montane shrew	**22.9**

[a] The EPC the 95% UCL.

[b] ESLs from ECORISK Database, Version 2.3 (LANL 2008, 103352).

Table 2.1-3
Hazard Quotient Analysis

COPECs	EPC (mg/kg)	Kestrel (Avian insectivore)	Kestrel (carnivore)	Robin (herbivore)	Robin (insectivore)	Robin (omnivore)	Deer mouse	Desert cottontail	Earthworm	Plant	Montane shrew	Red fox
Barium	704.4	0.06	0.02	**0.9**	**0.7**	0.08	**0.4**	0.2	**2.1**	**6.4**	**0.5**	0.02
Cadmium	0.448	0.2	0.0008	0.1	**1.5**	**0.8**	**0.9**	0.05	0.003	0.01	**1.7**	0.0009
Silver	1.94	0.1	0.002	0.2	**0.7**	**0.5**	0.08	0.01	na*	0.003	0.1	0.0005
TCDD[2,3,7,8-] equivalent	6.65E-06	**0.5**	**0.5**	0.03	**1.6**	**0.8**	**11.5**	0.1	0.000001	na	**22.9**	**5.5**
HI		0.9	0.5	1	**5**	**2**	**13**	0.4	**2**	**6**	**25**	**6**

Note: Bolded values indicate HQs greater than 0.3 or HIs greater than 1.0.

* na = Not available.

Table 2.2-1
Comparison of EPCs to Background Concentrations in Soil

COPEC	EPC (mg/kg)	Soil Background Concentrations (mg/kg)
Barium	704.4	21-410
Cadmium	0.448	0.2–2.6
Silver	1.94	1

Table 2.2-2
Population Area Use Factors for Ecological Receptors

Receptor	Home Range[a] (ha)	Population Area[b] (ha)	PAUF[c]
Kestrel	106	4240	0.0006
Robin	0.42	16.8	0.15
Deer mouse	0.077	3.0	0.87
Desert cottontail	3.1	124	0.02
Montane shrew	0.39	15.6	0.17
Red fox	1038	41,520	0.00006

[a] Values from EPA 1993, 059384.

[b] Derived by 40HR.

[c] PAUF is calculated as the area of the site (2.6 ha) divided by the population area.

Table 2.2-3
Adjusted Hazard Quotient Analysis

COPECs	EPC (mg/kg)	Kestrel (Avian insectivore)	Kestrel (carnivore)	Robin (herbivore)	Robin (insectivore)	Robin (omnivore)	Deer mouse	Desert cottontail	Earthworm	Plant	Montane shrew	Red fox
Barium	704.4	0.00004	0.00001	0.1	0.1	0.01	0.3	0.004	**2.1**	**6.4**	0.09	0.000001
Silver	1.94	0.00006	0.000001	0.03	0.1	0.08	0.07	0.0002	na*	0.003	0.02	0.00000003
TCDD[2,3,7,8-] equivalent	6.65E-06	0.0003	0.0003	0.005	0.2	0.1	**10**	0.002	0.000001	na	**4**	0.0003
Adjusted HI		0.0004	0.0003	0.1	0.4	0.2	**10**	0.0006	**2**	**6**	**4**	0.0003

Note: Bolded values indicate HQs greater than 0.3 or HIs greater than 1.0.

* na = Not available.

Table 2.2-4
Area Adjusted Hazard Quotient Analyses for TCDD[2,3,7,8-] equivalent

COPECs	EPC (mg/kg)	Deer mouse		Montane shrew	
		NOAEL-Based ESL HQ	LOAEL-Based ESL HQ	NOAEL-Based ESL HQ	LOAEL-Based ESL HQ
TCDD[2,3,7,8-] equivalent for area east of 16-0399	3.71E-05	64	37	128	71
TCDD[2,3,7,8-] equivalent for rest of area around 16-388 and 16-0399	1.2E-06	2	1.2	4	2

Table 2.2-5
Population Area Use Factors for Ecological Receptors

Receptor	Home Range[a] (ha)	Population Area[b] (ha)	PAUF for Area East of 16-0399[c]	PAUF for Rest of Area Around 16-0388 and 16-0399[d]
Deer mouse	0.077	3.0	0.03	0.83
Montane shrew	0.39	15.6	0.006	0.16

[a] Values from EPA 1993, 059384.
[b] Derived by 40HR.
[c] PAUF calculated as the area of the site (0.1 ha) divided by the population area.
[d] PAUF calculated as the area of the site (2.5 ha) divided by the population area.

Table 2.2-6
Area and PAUF Adjusted Hazard Quotient Analyses for TCDD[2,3,7,8-] equivalent

COPECs	EPC (mg/kg)	Deer mouse		Montane shrew	
		NOAEL-Based ESL HQ	LOAEL-Based ESL HQ	NOAEL-Based ESL HQ	LOAEL-Based ESL HQ
TCDD[2,3,7,8-] equivalent for area east of 16-0399	3.71E-05	1.9	1.1	0.8	0.004
TCDD[2,3,7,8-] equivalent for rest of area around 16-0388 and 16-0399	1.2E-06	1.7	0.996	0.6	0.3

Dioxin/Furan data w/o highs

General Statistics

Number of Valid Observations	34	Number of Distinct Observations	34
Raw Statistics		**Log-transformed Statistics**	
Minimum	2.17E-08	Minimum of Log Data	-17.65
Maximum	3.38E-06	Maximum of Log Data	-12.6
Mean	8.042E-07	Mean of log Data	-14.78
Median	4.17E-07	SD of log Data	1.398
SD	9.224E-07		
Coefficient of Variation	N/A		
Skewness	1.574		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.778	Shapiro Wilk Test Statistic	0.954
Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	1.072E-06	95% H-UCL	2.086E-06
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	2.22E-06
95% Adjusted-CLT UCL	1.11E-06	97.5% Chebyshev (MVUE) UCL	2.765E-06
95% Modified-t UCL	1.079E-06	99% Chebyshev (MVUE) UCL	3.836E-06
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.745	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	1.08E-06		
MLE of Mean	8.042E-07		
MLE of Standard Deviation	9.319E-07		
nu star	50.64		
Approximate Chi Square Value (.05)	35.3	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0422	95% CLT UCL	1.064E-06
Adjusted Chi Square Value	34.67	95% Jackknife UCL	1.072E-06
		95% Standard Bootstrap UCL	1.06E-06
Anderson-Darling Test Statistic	0.335	95% Bootstrap-t UCL	1.133E-06
Anderson-Darling 5% Critical Value	0.786	95% Hall's Bootstrap UCL	1.107E-06
Kolmogorov-Smirnov Test Statistic	0.0924	95% Percentile Bootstrap UCL	1.056E-06
Kolmogorov-Smirnov 5% Critical Value	0.157	95% BCA Bootstrap UCL	1.116E-06
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1.494E-06
		97.5% Chebyshev(Mean, Sd) UCL	1.792E-06
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	2.378E-06
95% Approximate Gamma UCL	1.154E-06		
95% Adjusted Gamma UCL	1.175E-06		
Potential UCL to Use		Use 95% Approximate Gamma UCL	1.154E-06

Figure 2.2-1. ProUCL printout of dioxin/furan UCL calculations without the highest values for the TA-16 Burn Ground.

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