Contract No: EP-W-09-002
WA #: 032-RICO-02KD

Region 2 RAC2
Remedial Action Contract

Final Step 3a
Ecological Risk Assessment

Matteo & Sons, Inc. Site

Remedial Investigation/Feasibility Study

Thorofare, New Jersey

September 21, 2018

565356

CDM Smith

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Acronyms and Abbreviations

BAF	bioaccumulation factor
BSAF	biota-sediment accumulation factor
COPC	chemical of potential concern
CSM	conceptual site model
EPA	United States Environmental Protection Agency
EPC	exposure point concentration
ESL	ecological screening level
HQ	hazard quotient
In prep	in preparation
LOAEL	lowest-observed-adverse-effect level
mg/kg	milligram per kilogram
NJ	New Jersey
NOAEL	no-observed-adverse-effect level
%	percent
PCB	polychlorinated biphenyl
PRG	preliminary remediation goal
SFF	site foraging factor
site	Matteo & Sons, Inc. Site
SLERA	screening level ecological risk assessment
SMDP	scientific management decision point
SVOC	semi-volatile organic compound
TCDD	tetrachlorodibenzodioxin
TEQ	toxic equivalent
TRV	toxicity reference value
UCL	upper confidence limit

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Section 1
Introduction

This document serves as an addendum to the Final Screening Level Ecological Risk Assessment (SLERA) Report (CDM Smith 2018) conducted for the Matteo & Sons, Inc. Site (the site) located in Thorofare, West Deptford Township, Gloucester County, New Jersey (NJ). Results of the SLERA indicated the potential for ecological risk from a variety of inorganic and organic chemicals present in site media (CDM Smith in prep). The purpose of this supplemental evaluation is to proceed to the next step of the ecological risk assessment process which involves the refinement of chemicals of potential concern (COPCs) identified in the SLERA and to further characterize the potential for risk.

United States Environmental Protection Agency (EPA) guidance recommends using the findings of a SLERA as a basis of a scientific management decision point (SMDP) to determine the next steps in the ecological risk assessment process (EPA 1997). This next step, specifically Step 3a, is conducted in order to refine the list of COPCs that were identified in the SLERA. This step of the risk assessment process initiates the problem formulation phase of the baseline ecological risk assessment.

1.1 Objectives

The objective of this Step 3a evaluation is to further refine the list of COPCs identified in the SLERA. At this stage in the risk assessment process, less conservative and more realistic assumptions are used to characterize risks.

This document is composed of the following sections along with supporting tables and an appendix:

Section 1	Introduction – provides an overview of the objectives and organization of the report.
Section 2	Step 3a Approach – discusses the overall approach and less conservative assumptions used in the Step 3a evaluation.
Section 3	Conceptual Site Model and Assessment Endpoints – presents the conceptual site model (CSM) and assessment endpoints and associated measurement endpoints used in the Step 3a evaluation.
Section 4	Refined Chemicals of Potential Concern – presents the results of the refinement of COPCs.
Section 5	Uncertainties – discusses the uncertainties associated with the assumptions used in this Step 3a evaluation.
Section 6	Summary and Conclusions – presents the summary of results and conclusions of the Step 3a evaluation.
Section 7	Preliminary Remedial Goal Development – presents the preliminary remediation goals (PRGs) calculated for site-related chemicals posing a risk to modeled receptor species.
Section 8	References – provides a list of references cited.

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Section 2
Step 3a Approach

In the Revised Draft SLERA Report, maximum concentrations of chemicals detected in surface soil, sediment, surface water, sediment porewater, and seeps were compared to ecological screening levels (ESLs). In addition, maximum concentrations of bioaccumulative chemicals detected in soil and sediment were evaluated through use of food chain exposure models that incorporated conservative life history and exposure parameters for modeled receptor species. Results of these evaluations indicated the potential for ecological risk from both direct exposure, and through dietary exposure to several inorganic and organic chemicals. A summary of chemicals identified as COPCs can be found in Sections 5.2, 7.1, and 7.2 of the Final SLERA Report (CDM Smith 2018).

As reported in the Final SLERA Report, EPA had performed soil, sediment, surface water, sediment, porewater and seep water sampling from October 2011 to January 2012. Because organic data from soil samples were determined to be of unknown quality, these results are not reported or used in this report. CDM Smith conducted additional soil sampling from the same locations from December 2014 to March 2015. These 2015 soil samples were analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, and polychlorinated biphenyl (PCB) Aroclors. Thus, the soil organic data evaluated in this Step 3a and SLERA are from the 2015 soil samples.

In general, a similar approach was taken in the Step 3a evaluation in order to refine the list of COPCs identified in the SLERA; however, a less conservative and more realistic approach was used. As part of this approach, only those chemicals initially identified as COPCs in the SLERA were further evaluated. Thus, the list of chemicals evaluated in each medium either through a comparison to ESLs (direct exposure) or, in the case of bioaccumulative chemicals, through food chain exposure models (dietary exposure) differed since risks noted in the SLERA varied between media types and modeled receptors. For this evaluation, both means of evaluating risk, either through a comparison to ESLs or through food chain exposure models, were done so following the hazard quotient (HQ) approach discussed in detail of Sections 5.1.1 and 5.1.2 of the Final SLERA Report (CDM Smith 2018). Potentially hazardous chemicals detected in site media for which ESLs are unavailable are also retained as COPCs and these are discussed in Section 5, Uncertainties.

2.1 Comparison to Ecological Screening Levels

In the refined COPC selection, an exposure point concentration (EPC) of the lower of the 95 percent (%) upper confidence limit (UCL) of the arithmetic mean, or the maximum detected concentration for each chemical retained as a COPC in the SLERA, was calculated. In instances where a 95% UCL could not be calculated due to a limited number of detected values or a small dataset, the maximum concentration of that chemical was used as the EPC. Values used in the calculation of the 95% UCL were from the same data set evaluated in the SLERA. The resultant EPCs were compared to the same ESLs used in the SLERA. Prior to screening, the detection frequency of chemicals was taken into account; any chemicals detected in 5 percent or less of the samples in a dataset of 20 samples or more

were removed from consideration. Tables 2-1 through 2-5 present the EPC values and associated ESLs for each chemical retained in the SLERA as a COPC in its respective media.

2.2 Food Chain Exposure Models

Similar to the screening exercise noted in Section 2.1, 95% UCL values for site media were used in the food chain exposure models assessed in this Step 3a evaluation. All soil, sediment, and surface water EPC, with the exception of a few samples for which a 95% UCL could not be calculated, consist of the 95% UCL values for those chemicals found in exceedance of no-observed-adverse-effect level (NOAEL) and/or lowest-observed-adverse-effect-level (LOAEL)-based toxicity reference values (TRVs) in the SLERA (SLERA Sections 5.2.2. and 7.2, Tables 5-2 and 5-3, and Appendix D). In addition, the models are run in this refinement step using less conservative input parameters such as average reported body weights and average food ingestion rates, and when appropriate, more realistic site foraging factors (SFF) for modeled species that are not expected to reside at the site yearlong (Table 2-6).

In keeping with a less conservative approach of Step 3a, all resultant estimated total daily doses of chemicals calculated in each model were evaluated through a comparison to their respective LOAEL-based dietary TRVs (Tables 2-7 and 2-8). For this Step 3a evaluation the same LOAEL-based TRVs used in the Final SLERA Report were utilized. Biota-sediment accumulation factors (BSAFs) used in the models to estimate food item concentrations in the absence of site-specific tissue data also remain unchanged from the SLERA and are presented in Table 2-9. Additional sampling was performed to collect paired site-specific tissue and soil data to calculate site-specific bioaccumulation factors (BAFs) for lead and zinc to use in the models to estimate food item concentrations. The results of this sampling is summarized in Appendix A, and both the site-specific and literature based BAFs are presented on Table 2-9.

Section 3

Conceptual Site Model and Assessment Endpoints

3.1 Conceptual Site Model

In the SLERA, the CSM was used to depict the fate and transport of chemicals from source(s) to exposure media and to illustrate potential exposure pathways to ecological receptors. Generally speaking, the CSM developed and presented in Section 2.2 and Figure 2-1 of the SLERA remains unchanged in the Step 3a evaluation as risks were noted for all assessment endpoints that were developed based on the exposure pathways identified in the CSM. Those risks are summarized in Sections 5.2, 7.1, and 7.2 of the Final SLERA Report (CDM Smith 2018).

3.2 Assessment and Measurement Endpoints

In the SLERA, 11 assessment endpoints and associated measurement endpoints were selected to evaluate whether chemicals posed a risk to ecological receptors. Assessment endpoints 1 and 2 were addressed through a comparison of site media chemistry results to ESLs. Assessment endpoints 3 through 11 were addressed through food chain exposure models using 10 receptors representative of avian and mammalian communities assumed to utilize the site. An evaluation of all 11 assessment endpoints indicated risk to ecological receptors. As a result, all 11 assessment endpoints were re-visited in the Step 3a evaluation to better refine the list of COPCs unique to each assessment endpoint by following a more representative and less conservative approach (Sections 2.1 and 2.2).

In summary, the following assessment endpoints and associated measurement endpoints were included in this Step 3a evaluation.

- Assessment Endpoint 1: Survival, growth, and reproduction of terrestrial organisms

  Measurement Endpoint: Further evaluate the toxicity of COPCs in soil by comparing revised EPCs to soil-specific ESLs.

- Assessment Endpoint 2: Survival, growth, and reproduction of aquatic organisms

  Measurement Endpoint: Further evaluate the toxicity of COPCs in sediment, surface water, sediment porewater, and seeps by comparing revised EPCs to sediment- and surface water-specific ESLs.

- Assessment Endpoint 3: Survival, growth, and reproduction of piscivorous birds

  Measurement Endpoint: Further evaluate risk from dietary exposure to COPCs detected in sediment and surface water via food chain model using the selected receptor species, the bald eagle (*Haliaeetus leucocephalus*) and great blue heron (*Ardea herodias*). The estimated daily exposure doses for each species are compared with literature-based dietary LOAELs for birds.

- Assessment Endpoint 4: Survival, growth, and reproduction of piscivorous mammals

  Measurement Endpoint: Further evaluate risk from dietary exposure to COPCs detected in sediment and surface water via food chain model using the selected receptor species, the mink (*Mustela vison*). The estimated daily exposure doses are compared with literature-based dietary LOAELs for mammals.

- Assessment Endpoint 5: Survival, growth, and reproduction of herbivorous mammals

  Measurement Endpoint: Further evaluate risk from dietary exposure to COPCs detected in sediment and surface water via food chain model using the selected receptor species, the muskrat (*Ondatra zibethicus*). The estimated daily exposure doses are compared with literature-based dietary LOAELs for mammals.

- Assessment Endpoint 6: Survival, growth, and reproduction of omnivorous birds

  Measurement Endpoint: Further evaluate risk from dietary exposure to COPCs detected in sediment and surface water via food chain model using the selected receptor species, the wood duck (*Aix sponsa*). The estimated daily exposure doses are compared with literature-based dietary LOAELs for birds.

- Assessment Endpoint 7: Survival, growth, and reproduction of omnivorous mammals

  Measurement Endpoint: Further evaluate risk from dietary exposure to COPCs detected in sediment and surface water via food chain model using the selected receptor species, the raccoon (*Procyon lotor*). The estimated daily exposure doses are compared with literature-based dietary LOAELs for mammals.

- Assessment Endpoint 8: Survival, growth, and reproduction of insectivorous birds

  Measurement Endpoint: Further evaluate risk from dietary exposure to COPCs detected in soil and surface water via food chain model using the selected receptor species, the American robin (*Turdus migratorius*). The estimated daily exposure doses are compared with literature-based dietary LOAELs for birds.

- Assessment Endpoint 9: Survival, growth, and reproduction of insectivorous mammals

  Measurement Endpoint: Further evaluate risk from dietary exposure to COPCs detected in soil and surface water via food chain model using the selected receptor species, the short-tailed shrew (*Blarina brevicauda*). The estimated daily exposure doses are compared with literature-based LOAELs for mammals.

- Assessment Endpoint 10: Survival, growth, and reproduction of carnivorous birds

Measurement Endpoint: Further evaluate risk from dietary exposure to COPCs detected in soil and surface water via food chain model using the selected receptor species, the red-tailed hawk (*Buteo jamaicensis*). The estimated daily exposure doses are compared with literature-based dietary LOAELs for birds.

- Assessment Endpoint 11: Survival, growth, and reproduction of carnivorous mammals

  Measurement Endpoint: Further evaluate risk from dietary exposure to COPCs detected in soil and surface water via food chain model using the selected receptor species, the red fox (*Vulpes vulpes*). The estimated daily exposure doses are compared with literature-based dietary LOAELs for mammals.

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Section 4
Refined Chemicals of Potential Concern

The following subsections present the results, by assessment endpoint, of the Step 3a evaluation based on either direct exposure or food chain exposure.

4.1 Direct Exposure

Assessment endpoints 1 and 2 were addressed through a comparison of 95% UCL values to ESLs (Section 2.1 and Tables 2-1 through 2-5). Assessment endpoint 1 focused on receptors exposed to site soils, while assessment endpoint 2 evaluated risks to receptors exposed to site sediment, surface water, sediment porewater, and seeps.

4.1.1 Assessment Endpoint 1

Assessment endpoint 1, survival, growth, and reproduction of terrestrial organisms, is addressed through a comparison of soil EPCs to ESLs. Based on this comparison, the following chemicals are retained as COPCs for site soils:

- SVOCs: benzo(a)anthracene
- Pesticides: 4,4'-DDE, 4,4'-DDT, dieldrin, and endrin
- PCB Aroclors: Aroclor 1260
- Dioxins/furans: dioxins/furans (based on total 2,3,7,8-tetrachlorodibenzodioxin [TCDD] toxic equivalents [TEQs])
- Inorganics: antimony, cadmium, copper, lead, mercury, vanadium, and zinc

4.1.2 Assessment Endpoint 2

Assessment endpoint 2, survival, growth, and reproduction of aquatic organisms, is addressed through a comparison of sediment, surface water, sediment porewater, and seep EPCs to ESLs. Based on this comparison, the following chemicals are retained as COPCs for their respective media:

Sediment

- PCB Aroclors: Aroclors 1248 and 1254
- PCB congeners: dioxin-like PCB congeners (PCB 156, 105, 167, 118, 169, 126, and 77) and total sum of all detected congeners
- Dioxins/Furans: dioxins/furans based on total 2,3,7,8-TCDD TEQs
- Inorganics: antimony, arsenic, barium, cadmium, chromium copper, cyanide, iron, lead, mercury, nickel, selenium, silver, and zinc

Surface Water

- SVOCs: benzo(a)anthracene, benzo(a)pyrene, and bis(2-ethylhexyl)phthalate
- Inorganics (total): aluminum, barium, beryllium, cadmium, copper, iron, lead, manganese, nickel, vanadium, and zinc
- Inorganics (dissolved): iron and manganese

Sediment Porewater

- Pesticides: 4,4'-DDE
- PCB Aroclors: Aroclor 1254
- Inorganics (total): aluminum, barium, beryllium, cadmium, chromium, cobalt, copper, cyanide, iron, lead, manganese, nickel, vanadium, and zinc
- Inorganics (dissolved): aluminum, barium, cadmium, chromium, iron, lead, manganese, vanadium, and zinc

Seeps

- PCB Aroclors: Aroclor 1254
- Inorganics (total): aluminum, barium, beryllium, cadmium, chromium, cobalt, copper, cyanide, iron, lead, manganese, nickel, vanadium, and zinc
- Inorganics (dissolved): aluminum, cadmium, copper, iron, lead, manganese, and zinc

4.2 Food Chain Exposure Model Risks

The following sections summarize the results of the food chain exposure models. A total of 10 species, each representing a specific assessment endpoint (Section 3.2), are evaluated. Results of the models are discussed below and summarized in Table 4-1. The models are presented in Appendix B.

4.2.1 Sediment: Assessment Endpoints 3 through 7

Bald eagle, great blue heron, mink, muskrat, wood duck, and raccoon food chain exposure models were used to evaluate risks to piscivorous bird and mammal, aquatic herbivorous mammal, and omnivorous bird and mammal communities (Table 4-1).

No dietary risks from exposure to COPCs in site sediment were predicted for receptors represented by bald eagle, mink, muskrat, wood duck, or raccoon. Risk to piscivorous birds from exposure to lead in sediment was predicted based on the great blue heron model.

4.2.2 Soil: Assessment Endpoints 8 through 11

Short-tailed shrew, American robin, red-tailed hawk, and red fox food chain exposure models were used to evaluate risks to insectivorous birds and mammals and carnivorous birds and mammals, respectively (Table 4-1).

Results of the red-tailed hawk model indicate risk to carnivorous birds from exposure to lead and 4,4'-DDT in soil. Results of the red fox model indicate risk to carnivorous mammals from exposure to Aroclor 1248 in soil. As reported in the Revised Draft SLERA Report (in prep), Aroclor 1248 was only detected in 1 out of 25 soil samples.

Risks to insectivorous bird and mammal communities were predicted based on the American robin and short-tailed shrew models from exposure to the following COPCs in soil:

- American robin: lead, zinc, 4,4'-DDE, 4,4'-DDT, gamma-chlordane, endrin, and Aroclor 1248
- Short-tailed shrew: lead, zinc, gamma-chlordane, endrin, Aroclor 1248, and dioxin/furans (based on total 2,3,7,8-TCDD TEQs)

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Section 5
Uncertainties

Inherent in the risk assessment process is some degree of uncertainty. Although more realistic assumptions and less conservative EPCs are utilized in this evaluation when compared to the SLERA, there is still a high level of uncertainty and conservativeness as discussed below.

In this evaluation, it was assumed that COPCs in environmental media were 100% bioavailable. This is a conservative assumption that overestimates risk. Bioavailability can be affected by factors including chemical speciation, sorption onto soils or sediment, complexation, aging, competition with environmental ligands, or precipitation in anoxic environments in the presence of sulfides (Chapman et al. 2003). Soil and sediment particle size can also influence exposure concentrations and bioavailability; soil/sediment comprised of fine particles will tend to have higher chemical concentrations than coarser textured ones due to the larger surface area and increased number of potential adsorption sites. Additionally, uncertainties are also associated with COPCs identified in the SLERA due to lack of corresponding ESLs. These COPCs were not evaluated in SLERA nor in this Step 3a. Thus, this most likely underestimates risks in the SLERA as well as in the Step 3a.

The recommended dose-based LOAELs presented in Sample et al. (1996) for avian and mammalian receptors were derived from an extensive literature review by the authors. These well-accepted values are therefore considered appropriate dose-based TRVs for the receptors modeled in this evaluation. The same assumption applies to TRVs from other sources that were reviewed when no values were available in the Sample et al. (1996) document.

This Step 3a, similar to the SLERA, utilized simplifying assumptions in the food chain models, since it is difficult to mimic a complete diet. Thus, for the purpose of the models, receptor species are assumed to only consume a single food item. The exception was for modeled omnivorous receptors, the wood duck and raccoon, where their diets were assumed to consist of vegetation and mollusks. This is a conservative approach as all modeled receptors are expected to opportunistically consume a wide range of prey/food items (e.g., the American robin). A considerable portion of the American robin's diet consists of fruit, especially outside of the breeding season. The assumption that the American robin's diet is comprised solely of soil invertebrates is a conservative assumption.

With the exception of the American robin, SFFs for the remaining species modeled in the food chain exposure models are still assumed to be 1 or 100% site use (Table 2-6). This is a conservative assumption, as it is unlikely that all foraging takes place on the site for representative receptors with large foraging ranges. Use of SFF of one therefore likely overestimates exposure potential for bald eagle, red-tailed hawk, and red fox, species with large foraging ranges. In addition, bald eagles and wood ducks may also migrate, and may only be present within the area of the site for a portion of the year.

Ninety-five percent UCLs could not be calculated for some chemicals due to the small sample size or low frequency of detection and are identified in the screening tables (Tables 2-1 through 2-4). In these

instances, the maximum detected concentration was used as the EPC. Risk from exposure to these chemicals is therefore most likely over-estimated.

Soil invertebrate (worm) tissue were only collected to provide site-specific information for tissue burden concentrations in food items consumed by the American robin model. Fish, soil invertebrate, small mammal, mollusk, and plant tissue were not collected to support this evaluation. In the absence of such data, literature-based BSAFs and BAFs were used to derive hypothetical tissue burden concentrations in food items consumed by model receptors. Use of these values in the absence of site-specific data is not representative of site conditions, and may over-or under-estimate concentrations of COPCs in food items when compared to those found on site. Use of these values to calculate a daily dietary dose introduces more uncertainties into the models.

Section 6
Summary and Conclusions

Chemicals retained as COPCs in the SLERA were reassessed in the Step 3a evaluation. This section summarizes the results and conclusions of this reassessment.

6.1 Direct Exposure

Assessment endpoints 1 and 2 were addressed through a comparison of EPCs to ESLs (Section 2.1 and Tables 2-1 through 2-5). Assessment endpoint 1 focused on receptors exposed to site soils, while assessment endpoint 2 evaluated risks to receptors exposed to site sediment, surface water, sediment porewater, and seeps.

6.1.1 Assessment Endpoint 1

Assessment endpoint 1, survival, growth, and reproduction of terrestrial organisms, was addressed through a comparison of soil EPCs to ESLs. Based on this comparison, the following chemicals were retained as COPCs for site soils:

- SVOCs: benzo(a)anthracene
- Pesticides: 4,4'-DDE, 4,4'-DDT, dieldrin, and endrin
- PCB Aroclors: Aroclor 1260
- Dioxins/furans (based on total TEQs)
- Inorganics: antimony, cadmium, copper, lead, mercury, vanadium, and zinc

6.1.2 Assessment Endpoint 2

Assessment endpoint 2, survival, growth, and reproduction of aquatic organisms, was addressed through a comparison of sediment, surface water, sediment porewater, and seep water EPCs to ESLs. Based on this comparison, the following chemicals were retained as COPCs for their respective media:

Sediment

- PCB Aroclors: Aroclors 1248 and 1254
- PCB congeners: dioxin-like congeners (PCB 156, 105, 167, 118, 169, 126, and 77) and total sum of all detected congeners
- Dioxins/furans (based on total TEQs)
- Inorganics: antimony, arsenic, barium, cadmium, chromium, copper, cyanide, iron, lead, mercury, nickel, selenium, silver, and zinc

Surface Water

- SVOCs: benzo(a)anthracene, benzo(a)pyrene, and bis(2-ethylhexyl)phthalate
- Inorganics (total): aluminum, barium, beryllium, cadmium, copper, iron, lead, manganese, nickel, vanadium, and zinc
- Inorganics (dissolved): iron and manganese

Sediment Porewater

- Pesticides: 4,4'-DDE
- PCB Aroclors: Aroclor 1254
- Inorganics (total): aluminum, barium, beryllium, cadmium, chromium, cobalt, copper, cyanide, iron, lead, manganese, nickel, vanadium, and zinc
- Inorganics (dissolved): aluminum, barium, cadmium, chromium, iron, lead, manganese, vanadium, and zinc

Seep Water

- PCB Aroclors: Aroclor 1254
- Inorganics (total): aluminum, barium, beryllium, cadmium, chromium, cobalt, copper, cyanide, iron, lead, manganese, nickel, vanadium, and zinc
- Inorganics (dissolved): aluminum, cadmium, copper, iron, lead, manganese, and zinc

6.2 Food Chain Exposure Model Risks

Assessment endpoints 3 through 11 were addressed using food chain exposure models. A total of 10 species, each representing a specific assessment endpoint aimed at the protection of receptors utilizing the site, were evaluated. Results of the models are summarized below and are presented in Table 4-1.

6.2.1 Sediment: Assessment Endpoints 3 through 7

Based on the results of the bald eagle, mink, muskrat, wood duck, and raccoon models, no risks are noted for piscivorous bird and mammal, aquatic herbivorous mammal, and omnivorous bird and mammal communities from exposure to chemicals present in site sediment.

Risk from exposure to lead in sediment was noted in a second model representing piscivorous birds using the great blue heron.

6.2.2 Soil: Assessment Endpoints 8 through 11

Based on the results of the models, risks are noted for the insectivorous and carnivorous bird and mammal communities from exposure to chemicals present in site soils.

Results of the red-tailed hawk model indicate risk to carnivorous birds from exposure to lead and 4,4'-DDT in soil. Results of the red fox model indicate risk to carnivorous mammals from exposure to Aroclor 1248 in soil. As shown in Table 2-1, Aroclor 1248 was only detected in 1 out of 25 soil samples.

Risk to insectivorous birds and mammals from exposure to the following chemicals in site soil were noted based on the following models:

- American robin: lead, zinc, 4,4'-DDE, 4,4-DDT, gamma-chlordane, endrin and Aroclor 1248
- Short-tailed shrew: lead, zinc, gamma-chlordane, endrin, Aroclor 1248, and dioxin/furans (based on total 2,3,7,8-TCDD TEQs)

6.3 Conclusions

Results of the Step 3a evaluation indicated fewer or reduced magnitude risks from exposure to chemicals detected in site media when compared to the SLERA. Metals continue to be the primary risk driver in all site media based on direct exposure. Dioxins/furans, pesticides, and PCBs also pose a risk; however, it should be noted that exceedances of ESLs for PCB Arolcors in soil and sediment were minimal (Tables 2-1 and 2-2). Due to the limited number of samples and detected concentrations, 95% UCLs could not be calculated for dioxins/furans and PCBs in sediment and pesticides in soil, and maximum concentrations were used. The use of maximum values as EPCs most likely over estimates risk.

Although sediment COPCs pose risks to aquatic receptors, primarily benthic invertebrates, COPCs in sediment appear to pose little risk to upper trophic level ecological receptors based on food chain exposure models. The only exception was exposure to lead for piscivorous birds based on the great blue heron model where a HQ of 1.2 was calculated. Such a low HQ is not necessarily indicative of minimal risk because of varying degrees of uncertainty in the model and TRVs used. However, it can be suggested that minimal risk exists since the daily dose of lead calculated is so close to the dietary TRV for lead. In addition, despite less conservative assumptions in the models when compared to the SLERA, conservative assumptions are still used. These include setting the SFF to 1, and assuming the great blue heron's diet consists only of fish. Based on these conservative inputs, risk from exposure to lead in sediment is most likely over-estimated for piscivorous avian receptors represented by great blue heron.

Chemicals identified as risk drivers in soil based on food chain exposure models consist primarily of the site-related metals lead and zinc. Pesticides, PCB Aroclors, and dioxins/furans were also noted as risk drivers based on the American robin and short-tailed shrew models used to represent insectivorous birds and mammals. With the exception of gamma-chlordane and endrin, model results for these pesticides produced relatively low but still significant HQs (not exceeding 7).

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Section 7

Preliminary Remediation Goal Development

Preliminary remediation goals were developed for site-related chemicals, based on the results of the food chain exposure models. The food chain models show that two metals (lead and zinc), four pesticides (4,4'-DDE, 4,4'-DDT, gamma-chlordane, and endrin), one PCB (Aroclor 1248), and dioxins/furans are associated with elevated risks in the models. Among these chemicals, lead, zinc and PCBs are considered site-related chemicals. The four pesticides (4,4'-DDE, 4,4'-DDT, gamma-chlordane and endrin) and dioxins/furans, are not considered site-related. These five chemicals were identified as risk drivers based on the food chain exposure models for the American robin and short-tailed shrew. Aroclor 1248 in the red fox model showed an HQ of 3.2). However, Aroclor 1248 was detected infrequently (in 1 out of 25 samples), suggesting minimal risk. Thus, PRGs were only developed for lead and zinc.

Derivation of PRGs was conducted by adjusting concentrations of lead in sediment and lead and zinc in soil until a LOAEL-based HQ of 1.0 regulatory acceptable risk was achieved. The resultant concentrations in sediment and soil were selected as the PRG for that particular medium.

The great blue heron model was used to derive a PRG for lead in sediment as this was the only model which indicated risk from exposure to bioaccumulative COPCs in sediment. Using the great blue heron model, a PRG for lead in sediment of 636 milligrams per kilogram (mg/kg) was calculated (Table 7-1).

The American robin model was used to derive PRGs for lead and zinc in soil since it was the most sensitive receptor of all the models used to evaluate risk from exposure to chemicals in soil. By calculating PRGs for the most sensitive modeled species, the assumption can be made that the resultant values are protective for other receptors exposed to site soils via diet. Based on the American robin model, PRGs of 139 mg/kg and 321 mg/kg were calculated for lead and zinc, respectively (Table 7-2).

At the request of EPA, a second set of PRGs for lead and zinc were calculated based on the American robin model using a SFF of 1.0. The initial set of PRGs described above used a seasonally adjusted SFF value of 0.58. Using a SSF of 1.0, PRGs of 80 mg/kg and 186 mg/kg were calculated for lead and zinc, respectively (Table 7-3).

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Section 8
References

CDM Federal Programs Corporation (CDM Smith), 2018. Final Screening Level Ecological Risk Assessment, Matteo & Sons, Inc. Site, Thorofare, New Jersey.

Chapman, P. M., F. Wang, C. R. Janssen, R. R. Goulet, and C. N. Kamunde. 2003. Conducting ecological risk assessments of inorganic metals and metalloids: Current status. Human Ecol. Risk Assess. 9(4): 641-697.

United States Environmental Protection Agency (EPA). 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. EPA 540-R-97-006. June.

Sample, B.E., D.M. Opresko, and G.W. Suter II. 1996. Toxicological Benchmarks for Wildlife, Revision, Prepared for the Department of Energy by Lockheed-Martin Energy Systems, Inc., Oak Ridge National Laboratory. ES/ER/TM-86/R3.

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Tables

Table 2-1
Refined List of Chemicals of Potential Concern Detected in Soil
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Chemical	CAS No.	95% UCL	Frequency of Detection	Screening Value	Hazard Quotient	COPC	Rationale
Semi-Volatile Organic Compounds							
Benzo(a)anthracene	56-55-3	1,300 d	6 / 7	1,100 A	1.2	Yes	ASL
Pesticides (µg/kg)							
4,4'-DDE	72-55-9	42 d	2 / 8	21 A	2.0	Yes	ASL
4.4'-DDT	50-29-3	250 d	3 / 8	21 A	11.9	Yes	ASL
Dieldrin	60-57-1	32 d	2 / 8	4.9 A	6.5	Yes	ASL
Endrin	72-20-8	12 d	1 / 8	10.1 C	1.2	Yes	ASL
PCB Aroclors (µg/kg)							
Aroclor 1248	12672-29-6	3,400 d	1 / 25	371 B,a	9.2	No	IFD
Aroclor 1254	11097-69-1	301	11 / 25	371 B,a	0.8	No	BSL
Aroclor 1260	11096-82-5	851	14 / 25	371 B,a	2.3	Yes	ASL
Dioxins/Furans (ng/kg)							
TOTAL 2,3,7,8-TCDD TEQ[c]	NA	28.5	NA	0.199 C	143	Yes	ASL
Inorganics (mg/kg)							
Antimony	7440-36-0	7.8	11 / 19	0.27 A	29	Yes	ASL
Cadmium	7440-43-9	1.8	7 / 19	0.36 A	5.0	Yes	ASL
Chromium	7440-47-3	18	19 / 19	26 A,b	0.68	No	BSL
Copper	7440-50-8	113	19 / 19	28 A	4.0	Yes	ASL
Lead	7439-92-1	7,807	19 / 19	11 A	710	Yes	ASL
Manganese	7439-96-5	216	19 / 19	220 A	0.98	No	BSL
Mercury	7439-97-6	0.13	6 / 19	0.00051 B	247	Yes	ASL
Nickel	7440-02-0	28	19 / 19	38 A	0.74	No	BSL
Vanadium	7440-62-2	46	19 / 19	7.8 A	5.9	Yes	ASL
Zinc	7440-66-6	7,821	19 / 19	46 A	170	Yes	ASL

Notes:

A - EPA Ecological Soil Screening Levels (EcoSSLs). http://www.epa.gov/ecotox/ecossl/. Values selected are the lowest of the soil screening values for plants, avain, invertebrate, and mammalian receptors.

B - Efroymson, R.A., G.W. Suter II, B.E. Sample, and D.S. Jones. 1997. Preliminary Remediation Goals (PRGs) for Ecological Endpoints Prepared for the U.S. Department of Energy, Office of Environmental Management Contract No. DE-AC05-84OR21401

C - EPA 2003. EPA Region 5 Resource Conservation and Recovery Act (RCRA) Ecological Screening Levels

a - value for PCBs

b - value for trivalent chromium

c - dioxins/furans evaluated via comparison of the sum of 2,3,7,8-TCDD TEQs to an ecological screening level for 2,3,7,8-TCDD

d - maximum concentration used when dataset consists of less than five samples or when there are less than four detected values

ASL - above screening level

BSL - below screening level

CAS - Chemical Abstracts Service

COPC - chemical of potential concern

IFD - infrequent detected (<5%)

NA - no CAS number available

mg/kg - milligrams per kilogram

ng/kg - nanograms per kilogram

TCDD - tetrachlorodibenzodioxin

TEQ - toxicity equivalent

UCL - upper confidence limit

µg/kg - micrograms per kilogram

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Table 2-2
Refined List of Chemicals of Potential Concern Detected in Sediment
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Chemical	CAS No.	95% UCL	Frequency of Detection	Screening Value	Hazard Quotient	COPC	Rationale
PCB Aroclors (µg/kg)							
Aroclor 1248	12672-29-6	42	13 / 46	30 A	1.4	Yes	ASL
Aroclor 1254	11097-69-1	230	42 / 46	60 A	3.8	Yes	ASL
Aroclor 1268	11100-14-4	34	22 / 46	59.8 B,a	0.56	No	BSL
Dioxin-Like PCB Congeners (pg/g)							
2,3,3',4,4',5-Hexachlorobiphenyl (156)	38380-08-4	9,800 c	4 / 4	1,200 C	8.2	Yes	ASL
2,3,3',4,4'-Pentachlorobiphenyl (105)	32598-14-4	18,400 c	4 / 4	940 C	20	Yes	ASL
2,3',4,4',5,5'-Hexachlorobiphenyl (167)	52663-72-6	3,390 c	4 / 4	1,200 C	2.8	Yes	ASL
2,3',4,4',5-Pentachlorobiphenyl (118)	31508-00-6	70,400 c	4 / 4	1,200 C	59	Yes	ASL
3,3',4,4',5,5'-Hexachlorobiphenyl (169)	32774-16-6	50 c	1 / 4	1.2 C	42	Yes	ASL
3,3',4,4',5-Pentachlorobiphenyl (126)	57465-28-8	64.9 c	3 / 4	0.28 C	232	Yes	ASL
3,3',4,4'-Tetrachlorobiphenyl (77)	32598-13-3	1,780 c	4 / 4	8 C	223	Yes	ASL
Total PCB Congeners (pg/g)	NA	2,372,089 c	NA	59,800 B,a	40	Yes	ASL
Dioxins/Furans (ng/kg)							
TOTAL 2,3,7,8-TCDD TEQ[b]	NA	6.5 c	NA	0.12 A	54	Yes	ASL
Inorganics (mg/kg)							
Antimony	7440-36-0	3.3	54 / 60	3 A	1.1	Yes	ASL
Arsenic	7440-38-2	17	60 / 60	6 A	2.9	Yes	ASL
Barium	7440-39-3	155	59 / 60	48 A	3.2	Yes	ASL
Cadmium	7440-43-9	3.4	59 / 60	0.6 A	5.7	Yes	ASL
Chromium	7440-47-3	91	60 / 60	26 A	3.5	Yes	ASL
Copper	7440-50-8	95	60 / 60	16 A	5.9	Yes	ASL
Cyanide	57-12-5	0.48	16 / 60	0.0001 A	4,840	Yes	ASL
Iron	7439-89-6	25,875	60 / 60	20,000 B	1.3	Yes	ASL
Lead	7439-92-1	755	60 / 60	31 A	24	Yes	ASL
Manganese	7439-96-5	363	60 / 60	630 A	0.6	No	BSL
Mercury	7439-97-6	0.40	51 / 60	0.2 A	2.0	Yes	ASL
Nickel	7440-02-0	31	59 / 60	16 A	2.0	Yes	ASL
Selenium	7782-49-2	2.5	60 / 60	2 B	1.2	Yes	ASL
Silver	7440-22-4	1.8	40 / 60	0.5 A	3.6	Yes	ASL
Zinc	7440-66-6	509	60 / 60	120 A	4.2	Yes	ASL

Notes:
A - NJDEP Ecological Evaluation Technical Guidance. (http://www.nj.gov/dep/srp/guidance/index.html). August 2011.
B - EPA Freshwater Sediment Screening Benchmarks . August 2006. http://www.epa.gov/reg3hscd/risk/eco/btag/sbv/fwsed/screenbench.htm.

C - Oregon Department of Environmental Quality, Land Quality Division. 2007. Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment. April.
a - value for total PCBs
b - dioxins/furans evaluated via comparison of the sum of 2,3,7,8-TCDD TEQs to an ecological screening level for 2,3,7,8-TCDD
c - maximum concentration used when dataset consists of less than five samples or when there are less than four detected values
ASL - above screening level
BSL - below screening level
C - Identified co-eluting congeners
CAS - Chemical Abstracts Service
COPC - chemical of potential concern
mg/kg - milligram per kilogram
NA - no CAS number available
ng/kg - nanograms per kilogram
pg/g - picogram per gram
TCDD - tetrachlorodibenzodioxin
TEQ - toxicity equivalent
UCL - upper confidence limit
µg/kg - microgram per kilogram

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Table 2-3
Refined List of Chemicals of Potential Concern Detected in Surface Water
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Chemical	CAS No.	95% UCL	Frequency of Detection	Screening Value	Hazard Quotient	COPC	Rationale
Semi-Volatile Organic Compounds (µg/L)							
Benzo(a)anthracene	56-55-3	0.18 d	2 / 27	0.025 A	7.2	Yes	ASL
Benzo(a)pyrene	50-32-8	0.32 d	2 / 27	0.014 A	23	Yes	ASL
Bis(2-ethylhexyl)phthalate	117-81-7	1.2 e	6 / 27	0.3 A	4.0	Yes	ASL
Pesticides (µg/L)							
4,4'-DDD	72-54-8	0.055 d	1 / 27	0.001 A,a	55	No	IFD
Gamma-chlordane	5103-74-2	0.027 d	1 / 27	0.0043 A,b	6.3	No	IFD
Total Inorganics (µg/L)							
Aluminum	7429-90-5	7,929	11 / 27	87 C	91	Yes	ASL
Barium	7440-39-3	297	27 / 27	220 A	1.3	Yes	ASL
Beryllium	7440-41-7	11.4 d	3 / 27	3.6 A	3.2	Yes	ASL
Cadmium	7440-43-9	3.5	12 / 27	0.134 A,c	26	Yes	ASL
Chromium	7440-47-3	39	11 / 27	42 A	0.92	No	BSL
Cobalt	7440-48-4	18	22 / 27	24 A	0.77	No	BSL
Copper	7440-50-8	32	27 / 27	6.2 A,c	5.1	Yes	ASL
Iron	7439-89-6	127,354	19 / 27	1,000 B	127	Yes	ASL
Lead	7439-92-1	133	27 / 27	5.4 A	25	Yes	ASL
Manganese	7439-96-5	306	27 / 27	120 C	2.5	Yes	ASL
Nickel	7440-02-0	67	19 / 27	32.5 A,c	2.0	Yes	ASL
Silver	7440-22-4	1 d	1 / 27	0.12 A	8.3	No	IFD
Vanadium	7440-62-2	155 d	3 / 27	12 A	13	Yes	ASL
Zinc	7440-66-6	449	27 / 27	83.9 A,c	5.4	Yes	ASL
Dissolved Inorganics (µg/L)							
Iron	7439-89-6	3,235	22 / 27	1,000 B	3.2	Yes	ASL
Manganese	7439-96-5	124	27 / 27	120 C	1.0	Yes	ASL

Notes:

A - NJDEP Surface Water Quality Standards. (web page http://www.nj.gov/dep/rules/rules/njac7_9b.pdf). April 2011

B - EPA 2009. National Recommended Water Quality Criteria. Criteria based on Freshwater CCC (chronic) values http://www.epa.gov/waterscience/criteria/wqctable/. Note several values for metals were adjusted based on site specific water hardness

C -EPA 2006. EPA Region 3 Biological Technical Assistance Group Freshwater Screening Benchmarks, Mid-Atlantic Risk Assessment: Ecological Risk Assessment, http://www.epa.gov/reg3hwmd/risk/eco/index.htm

a - value for DDT

b - value for chlordane

c - dissolved criteria corrected for site-specific hardness geometric mean of 69.8 milligrams per liter

d - maximum concentration used when dataset consists of less than five samples or when there are less than four detected values

e - maximum concentration used because UCL value is higer than the maximum concentration

ASL - above screening level

BSL - below screening level

CAS - Chemical Abstracts Service

COPC - chemical of potential concern

IFD - infrequent detection

UCL - upper confidence limit

µg/L - micrograms per liter

CDM Smith

Table 2-4
Refined List of Chemicals of Potential Concern Detected in Sediment Porewater
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Chemical	CAS No.	95% UCL	Frequency of Detection	Screening Value	Hazard Quotient	COPC	Rationale
Pesticides (µg/L)							
4,4'-DDE	72-55-9	0.028 e	1 / 10	0.001 A,a	28	Yes	ASL
PCB Aroclors (µg/L)							
Aroclor 1254	11097-69-1	1.1 e	2 / 10	0.014 A,b	79	Yes	ASL
Total Inorganics (µg/L)							
Aluminum	7429-90-5	46,232	10 / 10	87 C	531	Yes	ASL
Barium	7440-39-3	2,290	10 / 10	220 A	10	Yes	ASL
Beryllium	7440-41-7	16	10 / 10	3.6 A	4.3	Yes	ASL
Cadmium	7440-43-9	16	10 / 10	0.224 A,c	71	Yes	ASL
Chromium	7440-47-3	189	10 / 10	42 A	4.5	Yes	ASL
Cobalt	7440-48-4	94	10 / 10	24 A	3.9	Yes	ASL
Copper	7440-50-8	36	10 / 10	11.2 A,c	3.2	Yes	ASL
Cyanide	57-12-5	6.4	4 / 9	5.2 A	1.2	Yes	ASL
Iron	7439-89-6	395,746	10 / 10	1,000 B	396	Yes	ASL
Lead	7439-92-1	7,895	10 / 10	5.4 A	1,462	Yes	ASL
Manganese	7439-96-5	8,331	10 / 10	120 C	69	Yes	ASL
Nickel	7440-02-0	127	10 / 10	58.1 A,c	2.2	Yes	ASL
Vanadium	7440-62-2	510	10 / 10	12 A	43	Yes	ASL
Zinc	7440-66-6	3,925	10 / 10	150 A,c	26	Yes	ASL
Dissolved Inorganics (µg/L)							
Aluminum	7429-90-5	6,200 f	10 / 10	87 C	71	Yes	ASL
Barium	7440-39-3	259	10 / 10	220 A	1.2	Yes	ASL
Cadmium	7440-43-9	0.51	4 / 10	0.19 A,d	2.7	Yes	ASL
Chromium	7440-47-3	58.2 f	10 / 10	42 A	1.4	Yes	ASL
Iron	7439-89-6	37,423	10 / 10	1,000 B	37	Yes	ASL
Lead	7439-92-1	453	10 / 10	5.4 A	84	Yes	ASL
Manganese	7439-96-5	2,216	10 / 10	120 C	18	Yes	ASL
Vanadium	7440-62-2	49	9 / 10	12 A	4.1	Yes	ASL
Zinc	7440-66-6	284	10 / 10	124 A,d	2.3	Yes	ASL

Notes:

A - NJDEP Surface Water Quality Standards. (web page http://www.nj.gov/dep/rules/rules/njac7_9b.pdf). April 2011

B - EPA 2009. National Recommended Water Quality Criteria. Criteria based on Freshwater CCC (chronic) values
http://www.epa.gov/waterscience/criteria/wqctable/. Note several values for metals were adjusted based on site specific water hardness

C -EPA 2006. EPA Region 3 Biological Technical Assistance Group Freshwater Screening Benchmarks,
Mid-Atlantic Risk Assessment: Ecological Risk Assessment, http://www.epa.gov/reg3hwmd/risk/eco/index.htm

a - value for DDT

b - value for PCBs

c - dissolved criteria corrected for site-specific hardness geometric mean of 138.4 milligrams per liter

d - dissolved criteria corrected for site-specific hardness geometric mean of 110.8 milligrams per liter

e - maximum concentration used when dataset consists of less than five samples or when there are less than four detected values

f - maximum concentration used because UCL value is higer than the maximum concentration

ASL - above screening level

CAS - Chemical Abstracts Service

COPC - chemical of potential concern

UCL - upper confidence limit

µg/L - micrograms per liter

CDM Smith

Table 2-5
Refined List of Chemicals of Potential Concern Detected in Seep Water
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Chemical	CAS No.	95% UCL	Frequency of Detection	Screening Value	Hazard Quotient	COPC	Rationale
PCB Aroclors (µg/L)							
Aroclor 1254	11097-69-1	0.39	6 / 9	0.014 Aa	28	Yes	ASL
Total Inorganics (µg/L)							
Aluminum	7429-90-5	71,600 d	9 / 9	87 C	823	Yes	ASL
Barium	7440-39-3	3,930 d	9 / 9	220 A	18	Yes	ASL
Beryllium	7440-41-7	14	4 / 9	3.6 A	3.9	Yes	ASL
Cadmium	7440-43-9	38	8 / 9	0.2 Ab	192	Yes	ASL
Chromium	7440-47-3	168	9 / 9	42	4.0	Yes	ASL
Cobalt	7440-48-4	245	9 / 9	24	10	Yes	ASL
Copper	7440-50-8	564 d	9 / 9	10 Ab	56	Yes	ASL
Cyanide	57-12-5	328	4 / 9	5.2 A	63	Yes	ASL
Iron	7439-89-6	208,392	9 / 9	1,000 B	208	Yes	ASL
Lead	7439-92-1	251,000 d	9 / 9	5.4 A	46,481	Yes	ASL
Manganese	7439-96-5	50,700 d	9 / 9	120 C	423	Yes	ASL
Nickel	7440-02-0	396 d	9 / 9	52.3 Ab	7.6	Yes	ASL
Vanadium	7440-62-2	634	8 / 9	12 A	53	Yes	ASL
Zinc	7440-66-6	25,700 d	9 / 9	135 Ab	190	Yes	ASL
Dissolved Inorganics (µg/L)							
Aluminum	7429-90-5	497	5 / 9	87 C	5.7	Yes	ASL
Cadmium	7440-43-9	0.87	7 / 9	0.15 Ac	5.8	Yes	ASL
Copper	7440-50-8	11	9 / 9	6.8 Ac	1.7	Yes	ASL
Iron	7439-89-6	1,385	9 / 9	1,000 B	1.4	Yes	ASL
Lead	7439-92-1	802 d	8 / 9	5.4 A	149	Yes	ASL
Manganese	7439-96-5	913	9 / 9	120 C	7.6	Yes	ASL
Nickel	7440-02-0	23	9 / 9	35.5 Ac	0.65	No	BSL
Zinc	7440-66-6	553	9 / 9	91.7 Ac	6.0	Yes	ASL

Notes:

A - NJDEP Surface Water Quality Standards. (web page http://www.nj.gov/dep/rules/rules/njac7_9b.pdf). April 2011

B - EPA 2009. National Recommended Water Quality Criteria. Criteria based on Freshwater CCC (chronic) values
http://www.epa.gov/waterscience/criteria/wqctable/. Note several values for metals were adjusted based on site specific water hardness

C -EPA 2006. EPA Region 3 Biological Technical Assistance Group Freshwater Screening Benchmarks,
Mid-Atlantic Risk Assessment: Ecological Risk Assessment, http://www.epa.gov/reg3hwmd/risk/eco/index.htm

a - value for PCBs

b - dissolved criteria corrected for site-specific hardness geometric mean of 122.2 milligrams per liter

c - dissolved criteria corrected for site-specific hardness geometric mean of 77.5 milligrams per liter

d - maximum concentration used because UCL value is higer than the maximum concentration

ASL - above screening level
BSL - below screening level
CAS - Chemical Abstracts Service
COPC - chemical of potential concern
UCL - upper confidence limit
µg/L - micrograms per liter

CDM Smith

Table 2-6
Food Chain Exposure Model Input Parameters
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Modeled Receptor	Body Weight (kg)	Ingestion Rates			Foraging Range (area, ha)[11]	Matteo Property (area, ha)	Site Foraging Factor
		Food (kg/day)	Soil/Sediment (kg/day)	Water (L/day)			
Bald Eagle [1,3,6,8]	3.75	0.377	0.0038	0.135	1830 - 3494	approximately 33	1
Great Blue Heron [1,3,6,8]	2.34	0.421	0.014	0.105	0.6 - 8.4		1
Mink [1,3,6,8]	1.02	0.161	0.015	0.107	7.8 - 380		1
Muskrat [1,3,6,7]	1.17	0.351	0.0330	0.114	0.11 - 0.17		1
Wood Duck [2,4,6,7]	0.658	0.044	0.00488	0.045	111 - 620[11]		1
Raccoon [1,5,6,8]	5.78	0.291	0.0273	0.477	39 - 2560		1
Short-tailed Shrew [1,3,6,8]	0.017	0.0094	0.00049	0.0038	0.1 - 1.8		1
American Robin [1,3,6,8,9]	0.081	0.098	0.010	0.011	0.15 - 0.81		0.58
Red-tailed Hawk [1,3,6,8]	1.13	0.112	0.0011	0.064	60 - 1770		1
Red Fox [1,3,6,8]	4.54	0.510	0.014	0.386	96 - 1967		1

Notes:

1 - Body weights are the average of mean adult (male and female) values as reported in Wildlife Exposure Factors Handbook (WEFH) (EPA 1993)

2 - Body weights consist of the average of adult values as reported by the Cornell Lab of Ornithology (www.allaboutbirds.org)

3 - Food ingestion rates (FIR) normalized to body weight were calculated based on the average of values reported in the WEFH (EPA 1993)

4 - No FIR available; value derived following the Nagy (1987) equation for birds. FIR = 0.0582 x (body weight) $^{0.651}$

5 - No FIR rate available; value derived following the Nagy (1987) equation for mammals. FIR = 0.0687 x (body weight) $^{0.822}$

6 - Soil/sediment ingestion rates calculated using the values presented in Section 3.2 of the Final SLERA Report (CDM Smith 2014)

7 - No suitable water ingestion rate (WIR) available; value derived following the Calder and Braun (1983) equations:
BIRDS - WIR = 0.059 x (body weight)$^{0.67}$
MAMMALS - WIR = 0.099 x (body weight)$^{0.9}$

8 - Water ingestion rate from WEFH (EPA 1993), BW-normalized from reported (g water ingested per g BW per day) values in WEFH (EPA 1993)

9 - Site foraging factor (SFF) seasonally adjusted for the American robin. Based on WEFH (EPA 1993) a residence time of seven months is assumed resulting in a SSF of 0.58 (7 months divided by 12 months)

10 - Foraging ranges are range of means (or range if mean not presented) from WEFH (EPA 1993)

11 - Foraging range for wood duck based on mallard (WEFH, EPA 1993)

kg - kilogram

kg/day - kilogram per day

L/day - liters per day

CDM Smith

Table 2-7
Avian Toxicity Reference Values
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Chemical	Lowest-Observed-Adverse-Effect-Level				
	Great Blue Heron	Bald Eagle	Wood Duck	American Robin	Red-tailed Hawk
Cadmium	Not evaluated *	Not evaluated *	Not evaluated *	20 a	Not evaluated *
Copper	Not evaluated *	Not evaluated *	Not evaluated *	61.7 a	Not evaluated *
Lead	11.3 a	11.3 a	11.3 a	11.3 a	11.3 a
Selenium	1 a	Not evaluated *	Not evaluated *	Not evaluated *	Not evaluated *
Silver	Not evaluated *	Not evaluated *	Not evaluated *	Not evaluated *	Not evaluated *
Zinc	131 a	131 a	131 a	131 a	131 a
Benzo(a)anthracene	Not evaluated *	Not evaluated *	Not evaluated *	20 b,d	Not evaluated *
Benzo(b)fluoranthene	Not evaluated *	Not evaluated *	Not evaluated *	20 b,d	Not evaluated *
Benzo(k)fluoranthene	Not evaluated *	Not evaluated *	Not evaluated *	20 b,d	Not evaluated *
Chrysene	Not evaluated *	Not evaluated *	Not evaluated *	20 b,d	Not evaluated *
4,4'-DDE	Not evaluated *	Not evaluated *	Not evaluated *	0.028 a,f	0.028 af
4,4'-DDT	Not evaluated *	Not evaluated *	Not evaluated *	0.028 a	0.028 a
delta-BHC	Not evaluated *	Not evaluated *	Not evaluated *	2.25 a	Not evaluated *
gamma-chlordane	Not evaluated *	Not evaluated *	Not evaluated *	10.7 a,e	Not evaluated *
Dieldrin	Not evaluated *	Not evaluated *	Not evaluated *	0.77 a	Not evaluated *
Endrin	Not evaluated *	Not evaluated *	Not evaluated *	0.1 a	Not evaluated *
Aroclor 1248	Not evaluated *	Not evaluated *	Not evaluated *	1.8 a.g	1.8 a,g
Aroclor 1254	Not evaluated *	Not evaluated *	Not evaluated *	1.8 a	Not evaluated *
Aroclor 1260	Not evaluated *	Not evaluated *	Not evaluated *	1.8 a.g	1.8 a.g
Total 2,3,7,8-TCDD TEQs[1]	Not evaluated *	Not evaluated *	Not evaluated *	0.00014 a,h	Not evaluated *

Notes:

1 - Includes the total sum of dioxin/furan and dioxin-like PCB congeners toxic equivalents for sediment; PCB congeners not analyzed in soil samples

a - TRVs taken from Sample, B.E., D.M. Opresko and G.W. Suter II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. ES/ER/TM-86/R3. Oak Ridge National Laboratoy, Oakridge, TN.

b - TRVs taken from Lockheed-Martin. 2002. Final Report, Atlantic Wood Industries, Ecological Risk Assessment, Portsmouth, Virginia. EPA Contract 68-C-99-223.

c - TRVs taken from EPA Region 6 Screening Level Ecological Risk Assessment Protocol Appendix E: Toxicity Reference Vaules August 1999

d - value for high molecular weight PAHs

e - value for chlordane

f - value for DDT and metabolites

g- value for Aroclor 1254

h - value for 2,3,7,8-tetrachlorodibenzodioxin

* - chemical not evaluated as no risks were noted in the SLERA for the modeled receptor species identified in coulmn title

Table 2-8
Mammalian Toxicity Reference Values
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Chemical	Lowest-Observed-Adverse-Effect-Level									
	Mink		Muskrat		Raccoon		Short-tailed Shrew		Red Fox	
Arsenic	0.524	a	0.524	a[3]	0.524	a[4]	1.498	a	0.36	a
Cadmium	Not evaluated	*	Not evaluated	*	Not evaluated	*	21.2	a	Not evaluated	*
Copper	15.4	a	Not evaluated	*	Not evaluated	*	Not evaluated	*	Not evaluated	*
Lead	61.53	a	61.53	a[3]	61.53	a[4]	175.83	a	42.25	a
Selenium	0.254	a	Not evaluated	*	Not evaluated	*	Not evaluated	*	Not evaluated	*
Zinc	246.1	a	Not evaluated	*	Not evaluated	*	703.3	a	Not evaluated	*
Benzo(a)anthracene	Not evaluated	*	Not evaluated	*	Not evaluated	*	6.15	b	Not evaluated	*
Benzo(b)fluoranthene	Not evaluated	*	Not evaluated	*	Not evaluated	*	6.15	b	Not evaluated	*
Benzo(k)fluoranthene	Not evaluated	*	Not evaluated	*	Not evaluated	*	6.15	b	Not evaluated	*
Chrysene	Not evaluated	*	Not evaluated	*	Not evaluated	*	6.15	b	Not evaluated	*
gamma-chlordane	Not evaluated	*	Not evaluated	*	Not evaluated	*	10.9	a,e	Not evaluated	*
Dieldrin	Not evaluated	*	Not evaluated	*	Not evaluated	*	0.44	a	0.106	a
Endrin	Not evaluated	*	Not evaluated	*	Not evaluated	*	1.094	a	Not evaluated	*
Aroclor 1248	0.15	a	Not evaluated	*	Not evaluated	*	0.427	a	0.103	a
Aroclor 1254	Not evaluated	*	Not evaluated	*	Not evaluated	*	0.668	a	0.474	a
Aroclor 1260	Not evaluated	*	Not evaluated	*	Not evaluated	*	0.668	a,f	0.474	a,f
Total 2,3,7,8-TCDD TEQs[1]	0.00000224	h	Not evaluated	*	Not evaluated	*	0.000022	a,g	0.0000053	a,g
Total PCB congeners[2]	0.69	a,d	Not evaluated	*	Not evaluated	*	Not evaluated	*	Not evaluated	*

Notes:
1 - Includes the total sum of dioxin/furan and dioxin-like PCB congeners toxic equivalents for sediment; PCB congeners not analyzed in soil samples
2 - Total sum of PCB congeners excludes those with dioxin-like effects which are evaluated along with dioxins/furans for sediment
3 - no TRV for muskrat located in Sample and Suter (1996); value for mink used
4 - no TRV for raccoon located in Sample and Suter (1996); value for mink used
a - TRVs taken from Sample, B.E., D.M. Opresko and G.W. Suter II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. ES/ER/TM-86/R3. Oak Ridge National Laboratoy, Oakridge, TN
b - TRVs taken from EPA. 2007. Eco-SSLs for Poly Aromatic Hydrocarbons (PAHs). Washington, DC. US Environmental Protection Agency
c - value for high molecular weight PAHs
d - no LOAEL located; value derived by multiplying the NOAEL by a factor of 10
e - value for chlordane
f- value for Aroclor 1254
g - value for 2,3,7,8-tetrachlorodibenzodioxin
h - TRV taken from Tillitt et. al. 1996. Dietary Exposure of Mink to Carp from Saginaw Bay. Characterization of Dietary Exposure to Planar Halogenated Hydrocarbons, Dioxin Equivalents, and Biomagnification
* - chemical not evaluated as no risks were noted in the SLERA for the modeled receptor species identified in coulmn title

Table 2-9
Biota-Sediment Accumulation Factors and Bioaccumulation Factors
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Chemical	Biota-Sediment Accumulation Factor				Bioaccumulation Factor					
	Fish		Mollusk		Plant		Earthworm		Small Mammal	
Arsenic	0.12	h,i	0.029	o	0.036	b	0.11	b	0.05	c,g
Cadmium	Not applicable	*	Not applicable	*	Not applicable	*	0.96	b	Not applicable	*
Copper	1.0	m	Not applicable	*	Not applicable	*	0.04	b	Not applicable	*
Lead	0.18	h,i	0.0046	o	0.045	b	0.03/0.23	b,e	64	c,g
Selenium	1.0	m	Not applicable	*	Not applicable	*	Not applicable	*	Not applicable	*
Zinc	1.8	h,i	1.1	h,k	0.0000000000012	b	0.56/2.33	b,e	154	c,g
Benzo(a)anthracene	Not applicable	*	Not applicable	*	Not applicable	*	1.59	c	Not applicable	*
Benzo(b)fluoranthene	Not applicable	*	Not applicable	*	Not applicable	*	2.6	c	Not applicable	*
Benzo(k)fluoranthene	Not applicable	*	Not applicable	*	Not applicable	*	2.6	c	Not applicable	*
Chrysene	Not applicable	*	Not applicable	*	Not applicable	*	2.3	c	Not applicable	*
4,4-DDE	Not applicable	*	Not applicable	*	Not applicable	*	1.26	b,f	4.9	c,f
4,4'-DDT	Not applicable	*	Not applicable	*	Not applicable	*	1.26	b	4.9	c
delta-BHC	Not applicable	*	Not applicable	*	Not applicable	*	6.34	c	Not applicable	*
gamma-chlordane	Not applicable	*	Not applicable	*	Not applicable	*	7,925.7	b,d	Not applicable	*
Dieldrin	Not applicable	*	Not applicable	*	Not applicable	*	14.7		14.4	c
Endrin	Not applicable	*	Not applicable	*	Not applicable	*	1,296.6	b,d	Not applicable	*
Aroclor 1248	2.3	a,n	Not applicable	*	Not applicable	*	1.13	b	1.0	*
Aroclor 1254	Not applicable	*	Not applicable	*	Not applicable	*	1.13	b	1.0	m
Aroclor 1260	Not applicable	*	Not applicable	*	Not applicable	*	1.13	b	1.0	m
Total PCB Congeners[1]	4.2	a,p	Not applicable	*	Not applicable	*	Not applicable	*	Not applicable	*
Total 2,3,7,8-TCDD TEQs[2]	0.2	q,r	Not applicable	*	Not applicable	*	1.59	b,r	1.0	m

Notes:

1 - Total sum of PCB congeners excludes those with dioxin-like effects which are evaluated along with dioxins/furans for sediment

2 - Includes the total sum of dioxin/furan and dioxin-like PCB congeners toxic equivalents for sediment; PCB congeners not analyzed in soil samples

a - EPA BSAF Database, Office of Research and Development, National Health and Environmental Effects Research Laboratory, Mid-Continent Ecology Division

b - EPA Region 6 Multimedia Planning and Permitting Division, Office of Solid Waste., August 1999, Screening Level Ecological risk Assessment Protocol: Appendix C: Media to Receptor BCF Values

c - EPA Guidance for Developing Ecological Soil Screening Levels, Attachment 4-1 Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs, OSWER Directive 9285.7-55, Revised April 2007.

d - BAF calculated using the regression equation: $LogBCF=(0.819*logK_{ow})-1.146$ as per Appendix C in source"b".

e- Site Specific BAF calculated from data collected in April 2016 as shown in Appendix A.

f - value for DDT

g - no BAF values located; values shown are estimated tissue concentrations calculated using the regression equation as presented in source "c"

h - PTI Environmental Services. 1995. Bioaccumulation Factor Approach Analysis for Metals and Polar Organic Compounds, Final Report submitted to Washington State Department of Ecology. October.

i - average of all whole body values with the exception of arsenic where only one value was provided

k - average of values for the freshwater mussel *Elliptio complanata*

m- default value of "1" used when no BSAF/BAF were located

n - value for total PCBs

o - average values for *Corbicula fluminea* taken from CDM and Stillwater Sciences. 2011. Screening Level Evaluation of Contaminants in Sediments from Three Reservoirs and the Estuary of the Klamath River, 2009-2011. Prepared for U.S. Department of the Interior Klamath Dam Removal Water Quality Sub Team Klamath River Secretarial Determination. September

p - average value for total PCBs measured in whole body freshwater fish

q - EPA Framwork for the Application of the Toxicity Equivalence Methodology for Polychlorinated Dioxins, Furan, and Biphenyls in Ecological Risk Assessment

r - value for 2,3,7,8-TCDD

* - no food chain exposure models were evaluated which required specific media to tissue BAF/BSAF

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Table 4-1
Food Chain Exposure Model Summary
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Chemical	Food Chain Exposure Model Receptor Species									
	Sediment Exposure						Soil Exposure			
	Bald Eagle	Great Blue Heron	Mink	Muskrat	Wood Duck	Raccoon	American Robin	Short-tailed Shrew	Red-tailed Hawk	Red Fox
Arsenic	NA	NA	0.52	0.60	NA	0.10	NA	0.23	NA	0.04
Cadmium	NA	NA	NA	NA	NA	NA	0.06	0.04	NA	NA
Copper	NA	NA	0.49	NA	NA	NA	0.2	NA	NA	NA
Lead	0.59	**1.2**	0.24	0.24	0.28	0.03	**56**	**1.8**	**1.0**	0.65
Selenium	NA	0.20	0.75	NA	NA	NA	NA	NA	NA	NA
Zinc	0.33	0.59	0.29	NA	0.08	NA	**24**	**3.3**	0.16	NA
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	0.1	0.17	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	0.1	0.21	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	0.1	0.15	NA	NA
Chrysene	NA	NA	NA	NA	NA	NA	0.1	0.18	NA	NA
4,4'-DDE	NA	NA	NA	NA	NA	NA	**1.2**	NA	0.61	NA
4,4'-DDT	NA	NA	NA	NA	NA	NA	**7**	NA	**3.6**	NA
delta-BHC	NA	NA	NA	NA	NA	NA	0.1	NA	NA	NA
gamma-chlordane	NA	NA	NA	NA	NA	NA	**25**	**19**	NA	NA
Dieldrin	NA	NA	NA	NA	NA	NA	0.4	0.5	NA	0.4
Endrin	NA	NA	NA	NA	NA	NA	**92**	**6.6**	NA	NA
Aroclor 1248	NA	NA	0.05	NA	NA	0.00002	**1.4**	**4**	0.16	**3.2**
Aroclor 1254	NA	NA	NA	NA	NA	NA	0.1	0.2	NA	0.05
Aroclor 1260	NA	NA	NA	NA	NA	NA	0.3	0.7	0.04	0.17
Total PCB congeners	NA	NA	0.98	NA	NA	NA	NA	NA	NA	NA
Total 2,3,7,8-TCDD TEQs	NA	NA	0.12	NA	NA	NA	0.2	**1.2**	NA	0.63

Notes:
NA - not applicable; chemical not evaluated in food chain models using the designated receptor
Shaded cells indicate hazard quotient greater than or equal to 1

Table 7-1
Preliminary Remediation Goal for Lead in Sediment based on the Great Blue Heron Food Chain Model
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Food Chain Model Parameters1	Value	Unit	Chemical	Bioaccumulation Factor	LOAEL TRV (mg/kg-day)	LOAEL-based PRG (mg/kg)
Hazard Quotient (HQ)	1	unitless	Lead	0.18	11.3	636
Sediment Ingestion Rate (IR-S)	0.014	kg/day				
Food Ingestion Rate (IR-food)	0.421	kg/day				
Body Weight (BW)	2.34	kg				
Site Foraging Factor (SFF)	1	--------				
Percent of Diet (%D)	100%	--------				

Notes:

1 - Food chain model parameters and calculations are presented in Table 2-6

kg/day - kilograms per day

LOAEL - lowest-observed-adverse-effect-level

mg/kg - milligrams per kilogram

mg/kg-day - milligrams per kilogram per day

PRG - preliminary remediation goal

TRV - toxicity reference value

PRGs calculated using the following equation:

PRG = ((HQ x BW x TRV)/(SFF x (IR-S + BAF x %D x IR-food)))/(1-Moisture)

Table 7-2
Preliminary Remediation Goals for Lead and Zinc in Soil based on the American Robin Food Chain Model using a Seasonally Adjusted Site Foraging Factor
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Lead

Food Chain Model Parameters[1]	Value	Unit	Chemical	Bioaccumulation Factor	Percent Moisture	LOAEL TRV (mg/kg-day)	LOAEL-based PRG (mg/kg)
Hazard Quotient (HQ)	1	unitless	Lead	0.03[2]	12.1	11.3	137
Soil Ingestion Rate (IR-S)	0.01	kg/day		0.23[3]	12.1	11.3	55
Food Ingestion Rate (IR-food)	0.098	kg/day					
Body Weight (BW)	0.081	kg					
Site Foraging Factor (SFF)	0.58	--------					
Percent of Diet (%D)	100%	--------					

Zinc

Food Chain Model Parameters[1]	Value	Unit	Chemical	Bioaccumulation Factor	Percent Moisture	LOAEL TRV (mg/kg-day)	LOAEL-based PRG (mg/kg)
Hazard Quotient (HQ)	1	unitless	Zinc	0.56[2]	12.1	131	320
Soil Ingestion Rate (IR-S)	0.01	kg/day		3.33[3]	12.1	131	62
Food Ingestion Rate (IR-food)	0.098	kg/day					
Body Weight (BW)	0.081	kg					
Site Foraging Factor (SFF)	0.58	--------					
Percent of Diet (%D)	100%	--------					

Notes:

1 - Food chain model parameters and calculations are presented in Table 2-6

2 - BAF from EPA Region 6 Multimedia Planning and Permitting Division, Office of Solid Waste., August 1999, Screening Level Ecological risk Assessment Protocol: Appendix C: Media to Receptor BCF Values

3- Site Specific BAF calculated from data collected in April 2016 as shown in Appendix A.

kg/day - kilograms per day

LOAEL - lowest-observed-adverse-effect-level

mg/kg - milligrams per kilogram

mg/kg-day - milligrams per kilogram per day

PRG - preliminary remediation goal

TRV - toxicity reference value

PRGs calculated using the following equation:

PRG = ((HQ x BW x TRV)/(SFF x (IR-S + BAF x %D x IR-food)))/(1-Moisture)

Table 7-3
Preliminary Remediation Goals for Lead and Zinc in Soil based on the American Robin Food Chain Model using a Site Foraging Factor of 1.0
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Lead

Food Chain Model Parameters[1]	Value	Unit	Chemical	Bioaccumulation Factor	Percent Moisture	LOAEL TRV (mg/kg-day)	LOAEL-based PRG (mg/kg)
Hazard Quotient (HQ)	1	unitless	Lead	0.03	12.1	11.3	80
Soil Ingestion Rate (IR-S)	0.01	kg/day					
Food Ingestion Rate (IR-food)	0.098	kg/day					
Body Weight (BW)	0.081	kg					
Site Foraging Factor (SFF)	1	--------					
Percent of Diet (%D)	100%	--------					

Zinc

Food Chain Model Parameters[1]	Value	Unit	Chemical	Bioaccumulation Factor	Percent Moisture	LOAEL TRV (mg/kg-day)	LOAEL-based PRG (mg/kg)
Hazard Quotient (HQ)	1	unitless	Zinc	0.56	12.1	131	186
Soil Ingestion Rate (IR-S)	0.01	kg/day					
Food Ingestion Rate (IR-food)	0.098	kg/day					
Body Weight (BW)	0.081	kg					
Site Foraging Factor (SFF)	1	--------					
Percent of Diet (%D)	100%	--------					

Notes:

1 - Food chain model parameters and calculations are presented in Table 2-6

kg/day - kilograms per day

LOAEL - lowest-observed-adverse-effect-level

mg/kg - milligrams per kilogram

mg/kg-day - milligrams per kilogram per day

PRG - preliminary remediation goal

TRV - toxicity reference value

PRGs calculated using the following equation:

$$PRG = ((HQ \times BW \times TRV)/(SFF \times (IR\text{-}S + BAF \times \%D \times IR\text{-}food)))/(1\text{-}Moisture)$$

Appendix A

Appendix A

Final Biota Sampling Technical Memorandum

Contract No.: EP-W-09-002
WA No.: 032-RICO-02KD

Region 2 RAC2
Remedial Action Contract

Final
Biota Sampling Technical Memorandum

Matteo & Sons, Inc. Site

Remedial Investigation/Feasibility Study

Thorofare, New Jersey

December 5, 2016

CDM Smith

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Acronyms and Abbreviations

BAF	bioaccumulation factor
CLP	Contract Laboratory Program
DESA	Division of Environmental Science and Assessment
LOAEL	lowest-observed-adverse-effect level
mg/kg	milligram per kilogram
ms	matrix spike
MS/D	matrix spike/ lab duplicate
NJ	New Jersey
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
%	percent
PRG	preliminary remediation goal
RI	Remedial Investigation
SFF	site foraging factor
site	Matteo & Sons, Inc. Site
SLERA	screening level ecological risk assessment
TAL	target analyte list
UCL	upper confidence limit
USEPA	United States Environmental Protection Agency

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Section 1
Introduction

This technical memorandum serves as an addendum to the Draft Final Step 3a Evaluation (CDM Smith 2016a) conducted for the Matteo & Sons, Inc. Site (the site) located in Thorofare, West Deptford Township, Gloucester County, New Jersey (NJ).

This memorandum summarizes results from the biota tissue and soil sampling activities that were conducted to support development of site-specific bioaccumulation factors (BAFs) for use in refining food chain models used to calculate ecological based preliminary remediation goals (PRGs) for the site. The work summarized in this memorandum was performed as described in the January 27, 2016 Work Plan Letter (CDM Smith 2016b) and the Final Quality Assurance Plan Addendum (QAPP) No. 2 – Biota sampling dated April 1, 2016 (CDM Smith 2016c).

1.1 Purpose of the Technical Memorandum

CDM Smith collected earthworm tissue and co-located surface soil samples to develop site-specific BAFs for lead and zinc, in order to recalculate PRGs via food chain models for the site. The data provided from this event will be used to supplement the existing data set to support the ecological risk assessment.

1.2 Technical Memorandum Organization

This technical memorandum is organized in the following manner:

Section 1 Introduction – presents the purpose of the biota sampling effort.

Section 2 Field Program –summarize the biota field sampling program.

Section 3 Results and Conclusions – presents a summary of the results, calculations of BAFs and PRGs that will be supplemental to the Step 3a report.

Section 4 References – provides a list of the sources cited in the preparation of this technical memorandum.

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Section 2
Field Program

CDM Smith performed biota sampling on April 5th and 6th 2016, at the site to provide site-specific biota tissue data. Earthworms and surface soil were collected from 10 index areas within the open field/waste disposal and scrapyard areas of the site. Figure 2-1 provides the final locations of the index areas. The areas were selected to represent a range of soil lead concentrations (as determined during previous remedial investigation (RI) Sampling) across the site and were labeled A through J.

A hand-held GPS unit was used to navigate to each index area. Upon arrival, the index area was flagged and gently turned over using a rake and shovel. Earthworms were typically collected within the top 4 inches of the organic topsoil either by hand or with the aid of a metal shovel and rake. The shovel and rake were properly decontaminated between sample locations. Earthworms were weighed in the field using a digital scale. A minimum of 20 grams of earthworm tissue was collected at each of the 10 index areas.

In addition, co-located surface soil was collected from the locations (and depths) where earthworms were collected in each index area. Collected surface soil samples were homogenized using disposable plastic trowels and foil pans prior to filling sample containers. Additional volume was collected for quality assurance (QA) samples including the field duplicate and MS/D. Field blanks were also collected.

Earthworm and soil samples were immediately put on ice upon collection. Surface soil samples were hand delivered to the United States Environmental Protection (USEPA) Region 2 Division of Environmental Science and Assessment (DESA) laboratory for target analyte list (TAL) metals and mercury analysis. The earthworms were delivered to the CDM Smith warehouse for further processing.

Earthworms from each index area were rinsed with deionized water, weighed and placed into a plastic container lined with a moist paper towel. Earthworm samples were then placed into a refrigerator and allowed to purge their guts for 24 hours. After 24 hours, the worms were rinsed again with deionized water, patted dry, weighed, and placed into a plastic container. Each earthworm sample was placed into a cooler packed with dry ice and shipped to the USEPA contract laboratory program (CLP) laboratory for TAL metals and mercury analysis. Sampling and processing details are presented on Table 2-1.

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Section 3
Results and Conclusions

The biota sampling results and conclusions based on the sampling results are presented in this section. All analytical data was validated and reviewed to ensure its validity for use in this assessment.

3.1 Data Usability

The soil and tissue metals data were validated by United States Environmental Protection Agency (EPA) and have been reviewed to assess whether data quality is sufficient to support the project decisions. The sample set included ten environmental samples, one field duplicate and two rinsate blanks. In general, all laboratory analyses were method compliant. Some quality control (QC) parameters were outside criteria; associated sample results were qualified accordingly. Data qualified as estimated (J/K/UJ) are usable for project decisions; no data was rejected. QC outliers noted within the data validation reports are described below.

Initial Calibration Blank (ICB), Continuation Calibration Blank (CCB), and Preparation Blank - Calibration blanks (ICB and CCB) are used to ensure a stable instrument baseline before and during the analysis of analytical samples. The preparation blank is used to assess the level of contamination introduced to the analytical samples throughout the sample preparation process. Laboratory method blanks showed low levels of detections below the contract required quantification limit. As a result, associated metal sample results were appropriately qualified as non-detect (U) in several earthworm samples.

Spike Sample Analysis (Inorganics) – Cadmium spike sample analysis did not meet QC criteria. This affected one sample result (EW-J), which was qualified as estimated (J) by the data validator.

Duplicate Sample Analysis – The laboratory duplicate sample used to demonstrate acceptable method precision did not meet the technical criteria. The data validator estimated affected metals sample results (aluminum, iron, and manganese in EW-J). As reported in the data validation report, field duplicate results for aluminum, lead and manganese were estimated due to exceedance of the precision criterion in samples MBCYZ2 [EW-J], MBCYY6 [EW-D] and MBCYZ3 [EW-9D]). Serial dilution is used to determine if there are physical or chemical interferences due to sample matrix. The result for barium exceeded the technical criterion and was estimated in sample EW-J.

All estimated data results (J) may be used for their intended purpose, to determine whether biological evaluation is required. Qualified data that: a) are outliers, b) are near the edge of contaminated areas, or c) are suspect concentrations based on historical information, duplicate data, or multiple lines of evidence, may be further assessed to determine their usability as inputs to project decisions.

The final percentages of valid data are 100 % for soil and earthworm samples. The ninety percent completeness goal for usable data has been met.

3.2 Results

Analytical results of soil and biota (earthworm) samples are presented in Table 3-1. BAFs and PRGs for lead and zinc based on analytical results of site-specific paired earthworm and soil samples are presented in Table 3-2. The food chain model for the American robin that was developed in the Step 3a evaluation was used to calculate revised PRGs. Specific parameters utilized in the food chain models are presented in Section 7 and Tables 2-6, 7-2 and 7-3 of the Final Step3A Report.

In summary, the calculated BAFs based on analytical data of paired site soil and earthworm show that for both lead and zinc, almost all calculated BAFs are higher than the literature-based BAFs originally used in the Step 3a report; consequently, the resultant PRGs are lower than the PRGs developed in the Step 3a report. Detailed results are described below:

Lead

- BAF: The calculated lead BAFs range from 0.02 to 0.42. Lead BAFs from all locations, except the "B" location (0.02), and the 95% upper confidence limit (UCL) BAF (0.23) are above the lead BAF of 0.03 which was the lead BAF used in the Step 3a report dated April 2016.
- PRG: Following the same approach as that in the Step 3a report, PRGs for lead were calculated under two scenarios - using two site foraging factors (SFF) of 1 and a seasonally adjusted SFF of 0.58.
    - SFF = 1: Calculated PRGs range from 20 to 88 mg/kg. The PRG of 88 mg/kg was from the "B" location which had a BAF (0.02) lower than the BAF of 0.03 used in the Step 3a report. The remaining 9 PRGs (20 to 68 mg/kg) and the 95% upper confidence limit (UCL) PRG (32 mg/kg) are lower than the PRG of 80 mg/kg presented in the Step 3a report.
    - SFF = 0.58: PRGs range from 35 to 151 mg/kg. Similar to above, all PRGs, except the "B" location (151 mg/kg), as well as the 95% UCL PRG (55 mg/kg) are lower than the PRG (139 mg/kg) presented in the Step 3a report.

Zinc

- BAF: The calculated zinc BAFs range from 0.05 to 4.75. BAFs from three locations ("B", "I", and "J") are lower than the BAF of 0.56 used in the Step 3a report. BAFs from the remaining 7 locations (0.57 to 4.75), and the 95% UCL BAF (3.33) are above the BAF of 0.56 in the Step 3a report.
- PRG: PRGs for zinc were also calculated for two different site foraging factors (1 and 0.58)
    - SFF = 1: PRGs range from 25 to 799 mg/kg. The PRGs from "B", "I", and "J" locations are 232, 799, and 369 mg/kg, respectively. The remaining 7 PRGs (25 to 184 mg/kg) and the 95% UCL (36 mg/kg) are lower than the PRG of 186 mg/kg presented in the Step 3a report.

- SFF = 0.58: PRGs range from 44 to 1,377 mg/kg. Similar to above, all PRGs, except the "B", "I", and "J" locations (44 to 317 mg/kg), as well as the 95% UCL (62 mg/kg) are lower than the PRG (321 mg/kg) presented in the Step 3a report.

3.2 Conclusions

The biota sampling conducted at the site provided site-specific BAFs for lead and zinc. These site-specific BAFs were input into the food chain model for the American robin resulting in the following PRGs, which will replace the literature-based BAF values provided in the Step 3a Report.

Table 3-1 Summary of Results

Chemical	95% UCL BAF (unitless)	PRG – SSF = 1 (mg/kg)	PRG – SSF = 0.58 (mg/kg)
Lead	0.23	32	55
Zinc	3.33	36	62

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Section 4
References

CDM Smith. 2016a. Draft Final Step 3a Ecological Risk Assessment. Matteo & Sons, Inc. Site, Thorofare, Gloucester County, New Jersey. April 13, 2016.

CDM Smith. 2016b. Work Plan Letter – Biota Sampling and Report Revisions. Matteo & Sons, Inc. Site, Thorofare, Gloucester County, New Jersey. January 27, 2016

CDM Smith. 2016c. Quality Assurance Plan Addendum (QAPP) No. 2, Biota sampling. Matteo & Sons, Inc. Site, Thorofare, Gloucester County, New Jersey. March 10, 2016.

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Tables

Table 2-1
Biota Sampling Summary
Matteo Sons, Inc. Site
Thorofare, New Jersey

Sample Name	Matrix	Analyses	Sample Type	Sample Date	Ship Date
Bonner Analytical Testing Company					
EW-9D	Earthworm Tissue	TAL Metals + Hg	Field Duplicate of EW-D	4/5/2016	4/7/2016
EW-A	Earthworm Tissue	TAL Metals + Hg	Field Sample	4/5/2016	4/7/2016
EW-B	Earthworm Tissue	TAL Metals + Hg	Field Sample	4/5/2016	4/7/2016
EW-C	Earthworm Tissue	TAL Metals + Hg	Field Sample	4/6/2016	4/7/2016
EW-D	Earthworm Tissue	TAL Metals + Hg	Field Sample	4/5/2016	4/7/2016
EW-E	Earthworm Tissue	TAL Metals + Hg	Field Sample	4/6/2016	4/7/2016
EW-F	Earthworm Tissue	TAL Metals + Hg	Field Sample	4/6/2016	4/7/2016
EW-G	Earthworm Tissue	TAL Metals + Hg	Field Sample	4/6/2016	4/7/2016
EW-H	Earthworm Tissue	TAL Metals + Hg	Field Sample	4/5/2016	4/7/2016
EW-I	Earthworm Tissue	TAL Metals + Hg	Field Sample	4/5/2016	4/7/2016
EW-J	Earthworm Tissue	TAL Metals + Hg	MS/MSD	4/5/2016	4/7/2016
DESA					
ES-9D	Soil	TAL Metals + Hg	Field Duplicate of EW-D	4/5/2016	4/6/2016
ES-A	Soil	TAL Metals + Hg	Field Sample	4/5/2016	4/6/2016
ES-B	Soil	TAL Metals + Hg	Field Sample	4/5/2016	4/6/2016
ES-C	Soil	TAL Metals + Hg	Field Sample	4/6/2016	4/6/2016
ES-D	Soil	TAL Metals + Hg	Field Sample	4/5/2016	4/6/2016
ES-E	Soil	TAL Metals + Hg	Field Sample	4/6/2016	4/6/2016
ES-F	Soil	TAL Metals + Hg	Field Sample	4/6/2016	4/6/2016
ES-G	Soil	TAL Metals + Hg	Field Sample	4/6/2016	4/6/2016
ES-H	Soil	TAL Metals + Hg	Field Sample	4/5/2016	4/6/2016
ES-I	Soil	TAL Metals + Hg	Field Sample	4/5/2016	4/6/2016
ES-J	Soil	TAL Metals + Hg	MS/D	4/5/2016	4/6/2016

Acronyms:

Hg - mercury

MS/D - matrix spike/ laboratory duplicate

MS/MSD - matrix spike / matrix spike duplicate

TAL - target analyte list

Table 3-1
Soil and Biota Analytical Results
Matteo Sons, Inc. Site
Thorofare, New Jersey

Sample Information			Sample Results (mg/kg)																	
Sample Name	Sample Type	Sample Date	Aluminum		Antimony		Arsenic		Barium		Beryllium		Cadmium		Calcium		Chromium	
ES-A	Soil	04/05/2016	1,900		2	U	2.8		16		0.31	U	0.31	U	1,200		5.6	
ES-B	Soil	04/05/2016	3,800		11		6.2		92		0.34	U	3.1		1,600		19	
ES-C	Soil	04/05/2016	2,300		2.2	U	2		12		0.33	U	0.33	U	550		5.3	
ES-D	Soil	04/05/2016	2,100		69		5		12		0.33	U	0.33	U	430		8.8	
ES-9D*	Soil	04/05/2016	2,700		28		5.4		11		0.31	U	0.31	U	510		11	
ES-E	Soil	04/05/2016	2,200		2.2	U	3.1		22		0.33	U	0.33	U	890		6.6	
ES-F	Soil	04/05/2016	2,100		2.2	U	2.5		23		0.33	U	0.33	U	820		5.8	
ES-G	Soil	04/05/2016	2,700		4.1		4		33		0.32	U	1.1		2,700		8	
ES-H	Soil	04/05/2016	4,600		4.2		4.5		27		0.33	U	0.77		2,100		21	
ES-I	Soil	04/05/2016	5,800		13		9.7		110		0.57	U	4.6		8,700		100	
ES-J	Soil	04/05/2016	8,000		32		12		130		0.7	U	2.4		7,400		67	
EW-A	Tissue	04/05/2016	239		5.4	UJ	0.9	UJ	18	UJ	0.45	UJ	1.1		903		0.61	J
EW-B	Tissue	04/05/2016	266		5.5	UJ	0.92	UJ	18.3	UJ	0.46	UJ	9.3		1,020		0.69	J
EW-C	Tissue	04/05/2016	249		5.5	UJ	0.92	UJ	18.3	UJ	0.46	UJ	1.6		862		0.78	J
EW-D	Tissue	04/05/2016	213		5.4	UJ	0.89	UJ	17.9	UJ	0.45	UJ	1.4		662		1.2	
EW-9D**	Tissue	04/05/2016	387		4.4		0.71		13.6	UJ	0.34	UJ	1.6		793		1.8	
EW-E	Tissue	04/05/2016	300		5.3	UJ	0.88	UJ	17.7	UJ	0.44	UJ	2.8		1,310		0.83	J
EW-F	Tissue	04/05/2016	255		4.8	UJ	0.81	UJ	16.1	UJ	0.4	UJ	1.2		1,070		0.68	J
EW-G	Tissue	04/05/2016	502		5.5	UJ	0.92	UJ	18.3	UJ	0.46	UJ	3		801		1.2	
EW-H	Tissue	04/05/2016	634		5.9	UJ	0.98	UJ	19.6	UJ	0.49	UJ	3.1		2,440		2.2	
EW-I	Tissue	04/05/2016	269		5.7	UJ	0.95	UJ	19	UJ	0.48	UJ	3		1,110		2.3	
EW-J	Tissue	04/05/2016	97.8		6	UJ	2.3		20	UJ	0.5	UJ	9.5	J	2,260		0.64	J

Notes

*	Duplicate of ES-D
**	Duplicate of EW-D
J	estimated value
mg/kg	milligram per kilogram
U	non-detect
UJ	non-detect, estimated value

Table 3-1
Soil and Biota Analytical Results
Matteo Sons, Inc. Site
Thorofare, New Jersey

Sample Information			Sample Results (mg/kg)													
Sample Name	Sample Type	Sample Date	Cobalt		Copper		Iron		Lead		Magnesium		Manganese		Mercury		Nickel	
ES-A	Soil	04/05/2016	2	U	4		4,100		33		340		58		0.052	U	2	
ES-B	Soil	04/05/2016	4.2		150		13,000		1,000		800		150		0.88		15	
ES-C	Soil	04/05/2016	2.2	U	6.4		4,600		53		590		37		0.053	U	3.2	
ES-D	Soil	04/05/2016	3.7		2.8		7,200		14		310		34		0.044	U	2.2	U
ES-9D*	Soil	04/05/2016	2.2		3.5		9,000		15		430		40		0.04	U	2.1	U
ES-E	Soil	04/05/2016	2.2	U	10		5,100		83		460		77		0.06		4.7	
ES-F	Soil	04/05/2016	2.2	U	5.6		4,200		56		430		88		0.059		2.6	
ES-G	Soil	04/05/2016	2.1	U	13		5,900		450		620		99		0.074		4.3	
ES-H	Soil	04/05/2016	2.2		87		15,000		380		820		92		0.14		10	
ES-I	Soil	04/05/2016	6.2		340		49,000		2,100		1,600		690		7.8		57	
ES-J	Soil	04/05/2016	11		160		33,000		7,000		2,500		1,300		0.64		27	
EW-A	Tissue	04/05/2016	4.5	UJ	2.3	UJ	507		4		187	J	9.1		0.073	J	0.25	J
EW-B	Tissue	04/05/2016	4.6	UJ	4.6		523		19		176	J	8		0.2		0.56	J
EW-C	Tissue	04/05/2016	4.6	UJ	2.3	U	538		22		224	J	8		0.026	J	0.37	J
EW-D	Tissue	04/05/2016	4.5	UJ	2.2	UJ	824		1.5		163	J	7.7		0.057	J	0.21	J
EW-9D**	Tissue	04/05/2016	3.4	UJ	1.7	UJ	1,200		3.9		191	J	11.7		0.086	J	0.41	J
EW-E	Tissue	04/05/2016	4.4	UJ	3		632		11		235	J	18.6		0.043	J	0.66	J
EW-F	Tissue	04/05/2016	4	U	2	UJ	431		16		181	J	14		0.046	J	0.29	J
EW-G	Tissue	04/05/2016	4.6	UJ	2.3	UJ	850		71		217	J	14.9		0.059	J	0.64	J
EW-H	Tissue	04/05/2016	4.9	U	7.3		1,420		66		265	J	15.2		0.072	J	1.2	J
EW-I	Tissue	04/05/2016	4.8	UJ	9.7		1,180		112		176	J	16.6		0.17		0.89	J
EW-J	Tissue	04/05/2016	5	U	5.7		311	J	656		182	J	19.2	J	0.097	J	0.45	J

Notes

*	Duplicate of ES-D
**	Duplicate of EW-D
J	estimated value
mg/kg	milligram per kilogram
U	non-detect
UJ	non-detect, estimated value

Table 3-1
Soil and Biota Analytical Results
Matteo Sons, Inc. Site
Thorofare, New Jersey

Sample Information			Sample Results (mg/kg)															
Sample Name	Sample Type	Sample Date	Potassium		Selenium		Silver		Sodium		Thallium		Vanadium		Zinc	
ES-A	Soil	04/05/2016	260		2	U	0.51	U	100	U	2	U	8.7		25	
ES-B	Soil	04/05/2016	320		2.2	U	0.98		110	U	2.2	U	14		460	
ES-C	Soil	04/05/2016	230		2.2	U	0.55	U	110	U	2.2	U	6.7		25	
ES-D	Soil	04/05/2016	340		2.2	U	0.55	U	110	U	2.2	U	13		17	
ES-9D*	Soil	04/05/2016	470		2.1	U	0.52	U	100	U	2.1	U	17		22	
ES-E	Soil	04/05/2016	190		2.2	U	0.54	U	110	U	2.2	U	8		55	
ES-F	Soil	04/05/2016	270		2.2	U	0.56	U	110	U	2.2	U	7.7		24	
ES-G	Soil	04/05/2016	370		2.1	U	0.53	U	110	U	2.1	U	10		71	
ES-H	Soil	04/05/2016	560		2.2	U	0.76		110	U	2.2	U	15		140	
ES-I	Soil	04/05/2016	380		3.8	U	4.8		190	U	3.8	U	19		1,700	
ES-J	Soil	04/05/2016	830		4.7	UJ	2.8		230		4.7	U	41		510	
EW-A	Tissue	04/05/2016	1,490		3.2	UJ	0.039	J	675		2.3	U	0.89	J	89.1	
EW-B	Tissue	04/05/2016	1,520		3.2	UJ	0.04	J	706		2.3	U	0.62	J	197	
EW-C	Tissue	04/05/2016	1,540		3.2	UJ	0.043	J	657		2.3	U	0.67	J	101	
EW-D	Tissue	04/05/2016	1,430		3.1	UJ	0.065	J	642		2.2	U	1.1	J	78.7	
EW-9D**	Tissue	04/05/2016	1,330		2.4	UJ	0.082		604		1.7	U	2.2	J	96	
EW-E	Tissue	04/05/2016	1,370		3.1	UJ	0.089	J	679		2.2	U	0.92	J	146	
EW-F	Tissue	04/05/2016	1,410		2.8	UJ	0.074	J	644		2	U	0.67	J	114	
EW-G	Tissue	04/05/2016	1,300		3.2	UJ	0.077	J	613		2.3	U	1.4	J	95	
EW-H	Tissue	04/05/2016	1,470		3.4	UJ	0.11	J	631		2.5	U	2.1	J	79.6	
EW-I	Tissue	04/05/2016	1,600		3.3	UJ	0.19	J	694		2.4	U	0.74	J	88.7	
EW-J	Tissue	04/05/2016	1,370		3.5	UJ	0.24	J	900		2.5	U	0.34	J	118	

Notes

*	Duplicate of ES-D
**	Duplicate of EW-D
J	estimated value
mg/kg	milligram per kilogram
U	non-detect
UJ	non-detect, estimated value

Table 3-2
BAFs and PRGs for Lead and Zinc based on Soil and Earthworm Results and the Food Chain Model for the American Robin
Matteo Sons, Inc. Site
Thorofare, New Jersey

Location ID		Lead					Zinc				
		Concentration (mg/kg)		Bioaccumulation Factor	LOAEL-Based Preliminary Remedial Goal (mg/kg)		Concentration (mg/kg)		Bioaccumulation Factor	LOAEL-Based Preliminary Remedial Goal (mg/kg)	
Soil	Earthworm	Soil	Earthworm		SFF of 1	SFF of 0.58	Soil	Earthworm		SFF of 1	SFF of 0.58
ES-A	EW-A	33	3.8	0.12	49	84	25	89.1	3.56	34	58
ES-B	EW-B	1,000	19.2	0.02	88	151	460	197	0.43	232	400
ES-C	EW-C	53	22.4	0.42	20	35	25	101	4.04	30	51
ES-D	EW-D	14	1.5	0.11	51	88	17	78.7	4.63	26	45
ES-E	EW-E	83	10.8	0.13	46	79	55	146	2.65	45	77
ES-F	EW-F	56	16.3	0.29	27	47	24	114	4.75	25	44
ES-G	EW-G	450	71.3	0.16	41	70	71	95	1.34	86	147
ES-H	EW-H	380	66	0.17	39	66	140	79.6	0.57	184	317
ES-I	EW-I	2,100	112	0.05	68	118	1,700	88.7	0.05	799	1,377
ES-J	EW-J	7,000	656	0.09	54	94	510	118	0.23	369	637
Calculated Results			average	0.16	48	83		average	2.23	183	315
			95% UCL	**0.23**	**32**	**55**		**95% UCL**	**3.33**	**36**	**62**
		Step 3a Report Results[2]		0.03	80	139	Step 3a Report Results[2]		0.56	186	321

Notes:

1 - Food chain model parameters and calculations are presented in Tables 2-6, 7-2 and 7-3 of the Final Step3A ERA.

PRGs calculated using the following equation:

PRG = ((HQ x BW x TRV)/(SFF x (IR-S + BAF x %D x IR-food)))/(1-Moisture)

2 - Results from intial modeling presented in the Step 3a report dated April 2016

Acronyms:

kg/day - kilograms per day

LOAEL - lowest-observed-adverse-effect-level

mg/kg - milligrams per kilogram

mg/kg-day - milligrams per kilogram per day

PRG - preliminary remediation goal

SFF - site foraging factor

TRV - toxicity reference value

UCL - upper confidence limit

Figures

Samples from 0 to 2 feet bgs

HESSIAN RUN

WOODBURY CREEK

Index Area	Expected Lead Concentration	Soil Type	Notes
A	<50 ppm	native	Open field area
B	50-60 ppm	Fill along shore	Shoreline of SY area
C	100 ppm	Native/Fill	Edge of open field area
D	120 ppm	Native	Open field area
E	150 ppm	Native/Fill	Edge of open field area
F	200-250 ppm	Native	Open field area
G	300-400 ppm	Native/Fill	Edge of open field area adjacent to Willow Woods
H	400-500 ppm	Fill	Edge of open field area
I	700-800 ppm	Mixed Waste	Waste disposal area
J	>1,000 ppm	Battery casing waste	Waste disposal area

RI Lead Concentrations
mg/kg
- <100
- 100-200
- 200-300
- 300-400
- 400-600
- 600-800
- >800

NJDEP Lead Concentrations
mg/kg
- <100
- 100-200
- 200-300
- 300-400
- 400-600
- 600-800
- >800

Site Areas
- Matteo Property
- Scrapyard Area
- Open Field/Waste Disposal Area
- Rental Home Area
- Willow Woods Property

Delineated Waste Disposal Areas
- Batteries and Waste
- Batteries
- Waste

Notes
1. Soil sampling results are presented for both the CDM Smith RI (2012,2015) and NJDEP RI (2005) sampling.
2. A removal action was performed on the Willow Woods property, the pre-removal results have not been incorporated.
3. Historic sample depths may not be representative of current conditions, particularly in the Scrapyard area where 2-3 feet of clean gravel have been added.

N

0 150 300 600 Feet

1 inch = 300 feet

Figure 2-1
Biota Sampling Index Areas
Matteo & Sons, Inc. Site
Thorofare, NJ

CDM Smith

Appendix B

Appendix B

Food Chain Exposure Models

Table B-1
Food Chain Exposure Model for the Bald Eagle
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Chemical	Sediment			Fish			Food		Water			SSF	BW	Dose	LOAEL	
	Concentration	IR	Total Ingested Chemical	BSAF	Concentration	Percent of Diet	IR	Total Ingested Chemical	Concentration	IR	Total Ingested Chemical				Value	Hazard Quotient
	mg/kg	kg/day	mg/day		mg/kg		kg/day	mg/day	mg/L	L/day	mg/day		kg	mg/kg/day	mg/kg/day	
Lead	349	0.0038	1.3	0.18	62.8	100%	0.377	23.7	0.133	0.135	0.0180	1	3.75	6.7	11.3	0.59
Zinc	236	0.0038	0.9	1.8	424.8	100%	0.377	160.1	0.449	0.135	0.0606	1	3.75	43.0	131	0.33

Notes:
BSAF - biota-sediment accumulation factor
BW - body weight
IR - ingestion rate
LOAEL - lowest observed adverse effect level
SSF - site foraging factor
kg - kilogram
kg/day - kilogram per day
mg/kg - milligram per kilogram
mg/kg/day - milligram per kilogram per day
mg/L - milligrams per liter
L/day - liters per day
sediment concentrations converted to wet weight as per the following:
sediment concentration in dry weight x (1-average mositure content [53.7%])

Table B-2
Food Chain Exposure Model for the Great Blue Heron
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Chemical	Sediment			Fish			Food		Water			SSF	BW	Dose	LOAEL	
	Concentration	IR	Total Ingested Chemical	BSAF	Concentration	Percent of Diet	IR	Total Ingested Chemical	Concentration	IR	Total Ingested Chemical				Value	Hazard Quotient
	mg/kg	kg/day	mg/day		mg/kg		kg/day	mg/day	mg/L	L/day	mg/day		kg	mg/kg/day	mg/kg/day	
Lead	349	0.014	4.9	0.18	62.8	100%	0.421	26.4	0.133	0.105	0.0140	1	2.34	13.4	11.3	**1.2**
Selenium	1.1	0.014	0.015	1.0	1.1	100%	0.421	0.5	0.0009	0.105	0.0001	1	2.34	0.205	1.0	0.20
Zinc	236	0.014	3.3	1.8	424.8	100%	0.421	178.8	0.449	0.105	0.0471	1	2.34	77.9	131	0.59

Notes:
BSAF - biota-sediment accumulation factor
BW - body weight
IR - ingestion rate
LOAEL - lowest observed adverse effect level
SSF - site foraging factor
kg - kilogram
kg/day - kilogram per day
mg/kg - milligram per kilogram
mg/kg/day - milligram per kilogram per day
mg/L - milligrams per liter
L/day - liters per day
sediment concentrations converted to wet weight as per the following:
sediment concentration in dry weight x (1-average mositure content [53.7%])
Bold - indicates hazard quotient greater than or equal to 1.0

Table B-3
Food Chain Exposure Model for the Mink
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Chemical	Sediment			Fish			Food		Water			SSF	BW	Dose	LOAEL	
	Concentration	IR	Total Ingested Chemical	BSAF	Concentration	Percent of Diet	IR	Total Ingested Chemical	Concentration	IR	Total Ingested Chemical				Value	Hazard Quotient
	mg/kg	kg/day	mg/day		mg/kg		kg/day	mg/day	mg/L	L/day	mg/day		kg	mg/kg/day	mg/kg/day	
Arsenic	8.0	0.015	0.120	0.12	1.0	100%	0.161	0.155	0.013	0.107	0.0014	1	1.02	0.271	0.524	0.52
Copper	44	0.015	0.7	1.0	44.0	100%	0.161	7.1	0.032	0.107	0.0034	1	1.02	7.6	15.4	0.49
Lead	349	0.015	5.2	0.18	62.8	100%	0.161	10.1	0.133	0.107	0.0142	1	1.02	15.1	61.53	0.24
Selenium	1.1	0.015	0.017	1.0	1.1	100%	0.161	0.177	0.0009	0.107	0.0001	1	1.02	0.190	0.254	0.75
Zinc	236	0.015	3.5	1.8	424.8	100%	0.161	68.4	0.449	0.107	0.0480	1	1.02	70.6	246.1	0.29
Aroclor 1248	0.019	0.015	0.000	2.3	0.044	100%	0.161	0.007	ND	0.107	0.0000	1	1.02	0.007	0.15	0.05
Total PCB Congeners[1]	1.0	0.015	0.015	4.2	4.200	100%	0.161	0.676	ND	0.107	0.0000	1	1.02	0.678	0.69	0.98
Total 2,3,7,8-TCDD TEQs[2]	0.0000059	0.015	0.00000009	0.2	0.0000012	100%	0.161	0.0000002	ND	0.107	0.0000	1	1.02	0.00000027	0.00000224	0.12

Notes:
1 - Total sum of PCB congeners excludes those with dioxin-like effects which are evaluated along with dioxins/furans
2 - Includes the total sum of dioxin/furan and dioxin-like PCB congeners toxic equivalents
BSAF - biota-sediment accumulation factor
BW - body weight
IR - ingestion rate
LOAEL - lowest observed adverse effect level
SSF - site foraging factor
kg - kilogram
kg/day - kilogram per day
mg/kg - milligram per kilogram
mg/kg/day - milligram per kilogram per day
mg/L - milligrams per liter
L/day - liters per day
sediment concentrations converted to wet weight as per the following:
sediment concentration in dry weight x (1-average mositure content [53.7%])
Bold - indicates hazard quotient greater than or equal to 1.0

Table B-4
Food Chain Exposure Model for the Muskrat
Matteo & Sons, Inc Site
Thorofare, New Jersey

Chemcial	Sediment			Plants			Food		Water			SSF	BW	Dose	LOAEL	
	Concentration	IR	Total Ingested Chemical	BSAF	Concentration	Percent of Diet	IR	Total Ingested Chemical	Concentration	IR	Total Ingested Chemical				Value	Hazard Quotient
	mg/kg	kg/day	mg/day		mg/kg		kg/day	mg/day	mg/L	L/day	mg/day		kg	mg/kg/day	mg/kg/day	
Arsenic	8.0	0.033	0.26	0.036	0.288	100%	0.351	0.101	0.013	0.114	0.0015	1	1.17	0.313	0.524	0.60
Lead	349	0.033	11.5	0.045	15.7	100%	0.351	5.5	0.133	0.114	0.0152	1	1.17	14.6	61.53	0.24

Notes:
BSAF - biota-sediment accumulation factor
BW - body weight
IR - ingestion rate
LOAEL - lowest observed adverse effect level
SSF - site foraging factor
kg - kilogram
kg/day - kilogram per day
mg/kg - milligram per kilogram
mg/kg/day - milligram per kilogram per day
mg/L - milligrams per liter
L/day - liters per day
sediment concentrations converted to wet weight as per the following:
sediment concentration in dry weight x (1-average mositure content [53.7%])

Table B-5
Food Chain Exposure Model for the Wood Duck
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Chemical	Sediment			Mollusks			Plants			Food		Water			SSF	Body Weight	Dose	LOAEL	
	Concentration	IR	Total Ingested Chemical	BSAF	Concentration	Percent of Diet	BAF	Concentration	Percent of Diet	IR	Total Ingested Chemical	Concentration	IR	Total Ingested Chemical				Value	Hazard Quotient
	mg/kg	kg/day	mg/day		mg/kg			mg/kg		kg/day	mg/day	mg/L	L/day	mg/day		kg	mg/kg/day	mg/kg/day	
Lead	349	0.00488	1.703	0.0046	1.6	50%	0.045	15.7	50%	0.044	0.4	0.133	0.045	0.0060	1	0.658	3.2	11.3	0.28
Zinc	236	0.00488	1.152	1.1	259.6	50%	0.0000000000012	0.0000000003	50%	0.044	5.7	0.449	0.045	0.0202	1	0.658	10.5	131	0.08

Notes:
BAF - bioaccumulation factor
BSAF - biota-sediment accumulation factor
BW - body weight
IR - ingestion rate
LOAEL - lowest observed adverse effect level
SSF - site foraging factor
kg - kilogram
kg/day - kilogram per day
mg/kg - milligram per kilogram
mg/kg/day - milligram per kilogram per day
mg/L - milligrams per liter
L/day - liters per day
sediment concentrations converted to wet weight as per the following:
sediment concentration in dry weight x (1-average mositure content [53.7%])

Table B-6
Food Chain Exposure Model for the Raccoon
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Chemical	Sediment			Mollusks			Plants			Food		Water			SSF	BW	Dose	LOAEL	
	Concentration	IR	Total Ingested Chemical	BSAF	Concentration	Percent of Diet	BAF	Concentration	Percent of Diet	IR	Total Ingested Chemical	Concentration	IR	Total Ingested Chemical				Value	Hazard Quotient
	mg/kg	kg/day	mg/day		mg/kg			mg/kg w.w.		kg/day	mg/day	mg/L	L/day	mg/day		kg	mg/kg/day	mg/kg/day	
Arsenic	8.0	0.0273	0.22	0.029	0.23	50%	0.036	0.288	50%	0.291	0.076	0.013	0.0477	0.001	1	5.78	0.051	0.524	0.10
Lead	349	0.0273	9.5	0.0046	1.6	50%	0.045	15.7	50%	0.291	2.5	0.133	0.0477	0.006	1	5.78	2.1	61.53	0.03
Aroclor 1248	0.019	0.0273	0.00052	0.0046	0.000087	50%	0.045	0.00086	50%	0.291	0.00014	0.133	0.0477	0.006	1	5.78	0.001	61.53	0.00002

Notes:
BAF - bioaccumulation factor
BSAF - biota-sediment accumulation factor
BW - body weight
HQ - hazard quotient
IR - ingestion rate
LOAEL - lowest observed adverse effect level
SSF - site foraging factor
kg - kilogram
kg/day - kilogram per day
mg/kg - milligram per kilogram
mg/kg/day - milligram per kilogram per day
mg/L - milligrams per liter
L/day - liters per day
sediment concentrations converted to wet weight as per the following:
sediment concentration in dry weight x (1-average mositure content [53.7%])

Table B-7
Food Chain Exposure Model for the Short-tailed Shrew
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Chemical	Soil			Invertebrates			Food		Water			SFF	Body Weight	Dose	LOAEL	
	Concentration	Ingestion Rate	Total Ingested Chemical	Bioaccumulation Factor[1]	Concentration	Percent of Diet	Ingestion Rate	Total Ingested Chemical	Concentration	Ingestion Rate	Total Ingested Chemical				Value	Hazard Quotient
	mg/kg w.w.	kg/day	mg/day		mg/kg w.w.		kg/day	mg/day	mg/L	L/day	mg/day		kg	mg/kg/day	mg/kg/day	
Arsenic	3.7	0.00049	0.0018	0.11	0.407	100%	0.0094	0.0038	0.0466	0.0038	0.0002	1	0.017	0.342	1.498	0.23
Cadmium	1.6	0.00049	0.0008	0.96	1.5	100%	0.0094	0.0144	0.0127	0.0038	0.0000	1	0.017	0.9	21.2	0.04
Lead	6862	0.00049	3.4	0.03	205.9	100%	0.0094	1.9	0.654	0.0038	0.0025	1	0.017	311.8	175.83	**1.8**
Zinc	6875	0.00049	3.4	0.56	3850.0	100%	0.0094	36.2	2.21	0.0038	0.0084	1	0.017	2327.5	703.3	**3.3**
Benzo(a)anthracene	1.144	0.00049	0.0006	1.59	1.819	100%	0.0094	0.0171	0.00018	0.0038	0.000001	1	0.017	1.039	6.15	0.17
Benzo(b)fluoranthene	0.880	0.00049	0.0004	2.6	2.288	100%	0.0094	0.0215	0.00038	0.0038	0.000001	1	0.017	1.291	6.15	0.21
Benzo(k)fluoranthene	0.616	0.00049	0.0003	2.60	1.602	100%	0.0094	0.0151	0.00015	0.0038	0.0000006	1	0.017	0.903	6.15	0.15
Chrysene	0.862	0.00049	0.0004	2.29	1.975	100%	0.0094	0.0186	0.00032	0.0038	0.000001	1	0.017	1.117	6.15	0.18
gamma-chlordane	0.048	0.00049	0.00002	7,925.7	376.63	100%	0.0094	3.5403	0.000027	0.0038	0.00000010	1	0.017	208.3	10.9	**19**
Dieldrin	0.027	0.00049	0.00001	14.7	0.40	100%	0.0094	0.0037	ND	0.0038	0	1	0.017	0.2	0.44	0.5
Endrin	0.010	0.00049	0.000005	1,296.6	13.07	100%	0.0094	0.1229	ND	0.0038	0	1	0.017	7.2	1.094	**6.6**
Aroclor 1248	2.856	0.00049	0.0014	1.1	3.23	100%	0.0094	0.0303	ND	0.0038	0	1	0.017	1.9	0.43	**4**
Aroclor 1254	0.2	0.00049	0.0001	1.13	0.2	100%	0.0094	0.0022	ND	0.0038	0	1	0.017	0.1	0.668	0.2
Aroclor 1260	0.715	0.00049	0.000	1.13	0.808	100%	0.0094	0.0076	ND	0.0038	0	1	0.017	0.467	0.668	0.7
Total 2,3,7,8-TCDD TEQs	0.000029	0.00049	0.00000001	1.59	0.00005	100%	0.0094	0.0000004	ND	0.0038	0	1	0.017	0.00003	0.000022	**1.2**

Notes:
1 - bioaccumulation factors are presented in Table 2-9
NOAEL - no observed adverse effect level
LOAEL - lowest observed adverse effect level
NA - Input variable not located
NC - Not calculated
ND - Not detected
SFF - site foraging factor
kg - kilogram
kg/day - kilogram per day
mg/kg w.w. - milligram per kilogram wet weight
mg/kg/day - milligram per kilogram per day
mg/L - milligrams per liter
L/day - liters per day
Bold - indicates hazard quotient greater than threshold of one
wet weight concentrations converted as follow: ww = Cs x (1 - % moisture)
where:
ww - wet weight concentration
Cs - dry weight concentration in soil
% moisture - percent moisture
For example, dry weight concentration and % moisture for arsenic were 8 mg/kg and 17.9%, respectively.
ww = 8 x (1 - .179)
ww = 6.6 mg/kg

Table B-8
Food Chain Exposure Model for the American Robin
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Chemical	Soil			Invertebrates			Food		Water			SFF	Body Weight	Dose	LOAEL	
	Concentration	Ingestion Rate	Total Ingested Chemical	Bioaccumulation Factor[1]	Concentration	Percent of Diet	Ingestion Rate	Total Ingested Chemical	Concentration	Ingestion Rate	Total Ingested Chemical				Value	Hazard Quotient
	mg/kg w.w.	kg/day	mg/day		mg/kg w.w.		kg/day	mg/day	mg/L	L/day	mg/day		kg	mg/kg/day	mg/kg/day	
Cadmium	1.6	0.010	0.0160	0.96	1.5	100%	0.098	0.151	0.0127	0.011	0.0001	0.58	0.081	1.2	20	0.06
Copper	99	0.010	1.0	0.04	4.0	100%	0.098	0.4	0.15	0.011	0.0017	0.58	0.081	9.9	61.7	0.2
Lead	6862	0.010	68.6	0.03	205.9	100%	0.098	20.2	0.654	0.011	0.0072	0.58	0.081	636	11.3	**56**
Zinc	6875	0.010	68.8	0.56	3850.0	100%	0.098	377.3	2.21	0.011	0.0243	0.58	0.081	3194	131	**24**
Benzo(a)anthracene	1.144	0.010	0.0114	1.59	1.819	100%	0.098	0.178	0.00018	0.011	0.0000020	0.58	0.081	1.4	20	0.1
Benzo(b)fluoranthene	0.880	0.010	0.0088	2.6	2.288	100%	0.098	0.224	0.00038	0.011	0.0000042	0.58	0.081	1.7	20	0.1
Benzo(k)fluoranthene	0.616	0.010	0.0062	2.60	1.602	100%	0.098	0.157	0.00015	0.011	0.0000017	0.58	0.081	1.2	20	0.1
Chrysene	0.862	0.010	0.0086	2.29	1.975	100%	0.098	0.194	0.00032	0.011	0.000004	0.58	0.081	1.4	20	0.1
4,4'-DDE	0.035	0.010	0.0004	1.26	0.044	100%	0.098	0.00	ND	0.011	0	0.58	0.081	0.03	0.028	**1.2**
4,4'-DDT	0.210	0.010	0.0021	1.26	0.265	100%	0.098	0.03	ND	0.011	0	0.58	0.081	0.2	0.028	**7**
delta-BHC	0.060	0.010	0.0006	6.34	0.4	100%	0.098	0.04	ND	0.011	0	0.58	0.081	0.3	2.25	0.1
gamma-chlordane	0.048	0.010	0.0005	7,925.7	377	100%	0.098	36.91	0.000027	0.011	0.0000003	0.58	0.081	264.3	10.7	**25**
Dieldrin	0.027	0.010	0.0003	14.7	0.4	100%	0.098	0.04	ND	0.011	0	0.58	0.081	0.3	0.77	0.4
Endrin	0.010	0.010	0.0001	1,296.6	13.1	100%	0.098	1.28	ND	0.011	0	0.58	0.081	9.2	0.1	**92**
Aroclor 1248	2.856	0.010	0.0286	1.1	3.2	100%	0.098	0.3	ND	0.011	0	0.58	0.081	2.5	1.8	**1.4**
Aroclor 1254	0.205	0.010	0.0021	1.13	0.2	100%	0.098	0.023	ND	0.011	0	0.58	0.081	0.2	1.8	0.1
Aroclor 1260	0.715	0.010	0.0072	1.13	0.808	100%	0.098	0.079	ND	0.011	0	0.58	0.081	0.6	1.8	0.3
Total 2,3,7,8-TCDD TEQs	0.0000230	0.010	0.0000002	1.59	0.00004	100%	0.098	0.0000036	ND	0.0110	0	0.58	0.081	0.00003	0.00014	0.2

Notes:
1 - bioaccumulation factors are presented in Table 2-9
NOAEL - no observed adverse effect level
LOAEL - lowest observed adverse effect level
NA - Input variable not located
NC - Not calculated
ND - Not detected
SFF - site foraging factor
kg - kilogram
kg/day - kilogram per day
mg/kg w.w. - milligram per kilogram wet weight
mg/kg/day - milligram per kilogram per day
mg/L - milligrams per liter
L/day - liters per day
Bold - indicates hazard quotient greater than threshold of one
wet weight concentrations converted as follow: ww = Cs x (1 - % moisture)
where:
ww - wet weight concentration
Cs - dry weight concentration in soil
% moisture - percent moisture
For example, dry weight concentration and % moisture for arsenic were 8 mg/kg and 17.9%, respectively.
ww = 8 x (1 - .179)
ww = 6.6 mg/kg

Table B-9
Food Chain Exposure Model for the Red-tailed Hawk
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Chemical	Soil			Small Mammals			Food		Water			SFF	Body Weight	Dose	LOAEL	
	Concentration	Ingestion Rate	Total Ingested Chemical	Bioaccumulation Factor[1]	Concentration[2]	Percent of Diet	Ingestion Rate	Total Ingested Chemical	Concentration	Ingestion Rate	Total Ingested Chemical				Value	Hazard Quotient
	mg/kg w.w.	kg/day	mg/day		mg/kg w.w.		kg/day	mg/day	mg/L	L/day	mg/day		kg	mg/kg/day	mg/kg/day	
Lead	6862	0.001	6.9	NA	57	100%	0.11	6.27	0.133	0.064	0.0085	1	1.13	11.6	11.3	**1.0**
Zinc	6875	0.001	6.9	NA	148	100%	0.11	16.28	0.449	0.064	0.0287	1	1.13	20.5	131	0.16
4,4'-DDE	0.035	0.001	0.00004	4.9	0.1729	100%	0.11	0.02	ND	0.064	0	1	1.13	0.0169	0.028	0.60
4,4'-DDT	0.21	0.001	0.0002	4.9	1.0290	100%	0.11	0.11	ND	0.064	0	1	1.13	0.1004	0.028	**3.6**
Aroclor 1248	2.856	0.001	0.00286	1.0	2.8560	100%	0.11	0.31	ND	0.064	0	1	1.13	0.2805	1.8	0.16
Aroclor 1260	0.715	0.001	0.0007	1.0	0.7150	100%	0.11	0.08	ND	0.064	0	1	1.13	0.0702	1.8	0.04

Notes:
1 - bioaccumulation factors are presented in Table 2-9
2 - No bioaccumulation factors for soil to small mammals available for arsenic, cadmium, copper, lead, nickel, silver, and zinc; concentrations in smal mammals estimated using regression equation per Table 4a in Attachment 4-1, Guidance for Developing Ecological Soil Screening Levels (EPA
NOAEL - no observed adverse effect level
LOAEL - lowest observed adverse effect level
NA - Input variable not located
NC - Not calculated
ND - Not detected
SFF - site foraging factor
kg - kilogram
kg/day - kilogram per day
mg/kg w.w. - milligram per kilogram wet weight
mg/kg/day - milligram per kilogram per day
mg/L - milligrams per liter
L/day - liters per day
Bold - indicates hazard quotient greater than threshold of one
wet weight concentrations converted as follow: ww = Cs x (1 - % moisture)
where:
ww - wet weight concentration
Cs - dry weight concentration in soil
% moisture - percent moisture
For example, dry weight concentration and % moisture for arsenic were 8 mg/kg and 17.9%, respectively.
ww = 8 x (1 - .179)
ww = 6.6 mg/kg

Table B-10
Food Chain Exposure Model for the Red Fox
Matteo & Sons, Inc. Site
Thorofare, New Jersey

Chemical	Soil			Small Mammals			Food		Water			SFF	Body Weight	Dose	LOAEL	
	Concentration	Ingestion Rate	Total Ingested Chemical	Bioaccumulation Factor[1]	Concentration[2]	Percent of Diet	Ingestion Rate	Total Ingested Chemical	Concentration	Ingestion Rate	Total Ingested Chemical				Value	Hazard Quotient
	mg/kg w.w.	kg/day	mg/day		mg/kg w.w.		kg/day	mg/day	mg/L	L/day	mg/day		kg	mg/kg/day	mg/kg/day	
Arsenic	3.7	0.014	0.0518	NA	0.03	100%	0.51	0.015	0.013	0.386	0.0050	1	4.54	0.016	0.36	0.04
Lead	6862	0.014	96.1	NA	57	100%	0.51	29.1	0.133	0.386	0.0513	1	4.54	27.6	42.25	0.65
Dieldrin	0.027	0.014	0.00038	14.4	0.3871	100%	0.51	0.1974	ND	0.386	0	1	4.54	0.044	0.106	0.4
Aroclor 1248	2.856	0.014	0.03998	1.0	2.8560	100%	0.51	1.4566	ND	0.386	0	1	4.54	0.330	0.103	**3.2**
Aroclor 1254	0.2	0.014	0.0029	1.0	0.2050	100%	0.51	0.1046	ND	0.386	0	1	4.54	0.024	0.474	0.05
Aroclor 1260	0.715	0.014	0.0100	1.0	0.7150	100%	0.51	0.3647	ND	0.386	0	1	4.54	0.083	0.474	0.17
Total 2,3,7,8-TCDD TEQs	0.000029	0.014	0.0000004	1.0	0.00003	100%	0.51	0.00001	ND	0.386	0	1	4.54	0.000003	0.0000053	0.63

Notes:
1 - bioaccumulation factors are presented in Table 2-9
2 - No bioaccumulation factors for soil to small mammals available for arsenic, cadmium, copper, lead, nickel, silver, and zinc; concentrations in small mammals estimated using regression equation per Table 4a in Attachment 4-1, Guidance for Developing Ecological Soil Screening Levels (EPA 2005).
NOAEL - no observed adverse effect level
LOAEL - lowest observed adverse effect level
NA - Input variable not located
NC - Not calculated
ND - Not detected
SFF - site foraging factor
kg - kilogram
kg/day - kilogram per day
mg/kg w.w. - milligram per kilogram wet weight
mg/kg/day - milligram per kilogram per day
mg/L - milligrams per liter
L/day - liters per day
Bold - indicates hazard quotient greater than threshold of one
wet weight concentrations converted as follow: ww = Cs x (1 - % moisture)
where:
ww - wet weight concentration
Cs - dry weight concentration in soil
% moisture - percent moisture
For example, dry weight concentration and % moisture for arsenic were 8 mg/kg and 17.9%, respectively.
ww = 8 x (1 - .179)
ww = 6.6 mg/kg