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# APPENDIX I

GREAT BLUE HERON FOOD WEB ASSESSMENT

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# APPENDIX I

# GREAT BLUE HERON FOOD WEB ASSESSMENT

## 1.00 INTRODUCTION

This report describes the methods used to estimate potential risks to wildlife associated with exposure to sediment and surface water contaminants within Upper and Lower Simmons Reservoirs, the Quarry Stream and Cedar Swamp Brook, and Sedimentation Ponds 2, 3 and 4 within the active portion of the Central Landfill property. The risk estimate for wildlife exposure is based on assessment of risk to the great blue heron (*Ardea herodias*), a largely piscivorous wading bird expected to utilize these exposure points as foraging habitat. An exposure model which incorporates the feeding and foraging habits of the heron was used to estimate the heron's exposure to contaminants in sediment, surface water and in representative prey organisms. Concentrations of organic contaminants in prey organisms were estimated using a widely accepted model (Gobas, 1993) which predicts the bioaccumulation of organic contaminants through an aquatic food-web. Assumptions used in this model were intended to conservatively represent the trophic relationships of aquatic species within the CLF Drainage Area (defined as Sedimentation Pond 4, Sedimentation Ponds 2&3 and Channels, the Upper Simmons Reservoir, and the Lower Simmons Reservoir). Bioconcentration factors presented in recently published regulatory and scientific literature were used to estimate concentrations of inorganic contaminants in aquatic/semi-aquatic species likely to be preyed upon by the heron. The exposure levels (doses) calculated for the heron were compared to toxicological reference doses obtained from current literature to assess the potential for adverse health effects. The following sections describe the exposure model for the heron, the aquatic bioaccumulation models, input assumptions for the models, the toxicological reference doses (RfDs), and the results of this preliminary risk assessment for the great blue heron.

The selection of Contaminants of Potential Ecological Concern (COPECs) for the sub-areas within the CLF Drainage Area was based on comparisons of OU2 contaminant concentrations to background and toxicological benchmark concentrations. COPEC selection is presented in Section 9.14 of the main RI report. CLF Drainage Area COPECs include VOCs, SVOCs, PCB/Pesticides, and inorganic contaminants.

## 2.00 FOOD WEB EXPOSURE MODEL FOR THE GREAT BLUE HERON

The food chain model used for this evaluation estimates exposure of the indicator species to COPECs within prey organisms, due to water consumption and incidental ingestion of sediment. The model takes into consideration the daily food ingestion rate of the heron, the proportions of diet made up by different types of affected prey organisms, and the proportion of the feeding area which is comprised by the different exposure points being evaluated.

Exposure of receptors to site contaminants was estimated using the following formula:

$$ADD_{mg/kg/day} = \left(\left\{\left[\Sigma_{1...n}(OHM_{inverts} \times Wgt_{FA}) \times Ing_{inverts}\right] + \left[\Sigma_{1...n}(OHM_{amphib} \times Wgt_{FA}) \times Ing_{amphib}\right] + \left[\Sigma_{1...n}(OHM_{fish} \times Wgt_{FA}) \times Ing_{fish}\right] + \left[\Sigma_{1...n}(OHM_{sed} \times Wgt_{FA}) \times Ing_{sed}\right]\right\} \times (IR_{total}) + \left[\Sigma_{1...n} OHM_{water} \times Wgt_{FA} \times Ing_{water}\right]\right) \times (FA)$$

where:

| | | |
|---|---|---|
| $ADD_{mg/kg/day}$ | = | Average Daily Dose of contaminant to the receptor based on mg/kg of body weight/day. |
| $Wgt_{FA}$ | = | Foraging area weighting assignment for exposure point 1 through n, used to normalize the overall exposure point concentration based on the size of the individual exposure points when multiple exposure points are being considered in the particular run of the model. |
| $OHM_{inverts}$ | = | Average concentration of contaminant in invertebrates within exposure point 1 through n; for organic contaminants this value was the average among chironimidae, oligochaeta, and crayfish. |
| $Ing_{inverts}$ | = | Fraction of receptors diet that is comprised of invertebrates. |
| $OHM_{amphib}$ | = | Average concentration of contaminant in amphibians within exposure point 1 through n. |
| $Ing_{amphib}$ | = | Fraction of receptors diet that is comprised of amphibians. |
| $OHM_{fish}$ | = | Average concentration of contaminant in fish within exposure point 1 through n; for organic contaminants this was the average among the pumpkinseed and largemouth bass. |
| $Ing_{fish}$ | = | Fraction of receptors diet that is comprised of fish. |
| $OHM_{sed}$ | = | Average concentration of contaminant in sediment within exposure point 1 through n. |
| $Ing_{sed}$ | = | Fraction of receptors diet that is comprised of sediment. |
| $OHM_{water}$ | = | Average concentration of contaminant in surface water within exposure point 1 through n. |
| $Ing_{water}$ | = | The daily rate of water ingestion expressed as a fraction of the receptor's body weight. FA = The fraction of the herons foraging area comprised by all exposure points being considered for the particular run of the food web model. For this assessment, the exposure points being considered were always assumed to comprise the entire foraging area of the heron, thus FA always equals 1. |
| $IR_{total}$ | = | The daily rate of food ingestion expressed as a fraction of the receptor's body weight. |

## 2.10 GREAT BLUE HERON EXPOSURE ASSUMPTIONS

The following sections describe assumptions made regarding great blue heron feeding habits, exposure durations, and present methods used to estimate the concentrations of contaminants in the prey organisms of the heron.

### 2.11 Exposure Duration and Feeding Habits

Information regarding the habitat and foraging requirements of the great blue heron were obtained from EPA (1993a&b) and from DeGraaf and Rudis (1987). The following paragraphs summarize information used to develop an exposure model for the heron.

The heron is a migratory species, and is likely to arrive in the vicinity of the Site in the spring (coincident with the ice-melt) and likely flies south by October or November (EPA, 1993a). Seasonal migration reduces the average daily exposure of the heron when factored over the course of a year or more, however, this was not taken into account in the model used for this evaluation. The reason for this is that the durations of the majority of the toxicity tests used to derive benchmark doses were less than the length of time herons are likely to spend on the site. Therefore, we assumed that if effects were to occur to the heron they would occur over the course of the breeding season when the heron (or similar bird species) may be expected to be at the Site. However, this assumption may be conservative for some contaminants; the durations of the toxicity test used to derive benchmark doses for Aroclor 1242, DDT and its degradation products, and mercury were longer than the period over which the herons are expected to be at the site each year.

The aquatic foraging habitats of the great blue heron include shallow standing and flowing waters up to 0.5 meters deep with firm substrate (EPA, 1993a). Studies which document the foraging domains of great blue herons present results in units of linear measurement (e.g., kilometers of shoreline), reflecting the dependence of the heron on shallow water. The linear extent of defended foraging territory for individual herons ranges from 0.129 km to 0.98 km (EPA, 1993b). The daily food ingestion rates for the heron has been estimated at 0.18 grams of food per gram body weight per day. The composition of the heron's diet, estimated by averaging values for habitats similar to the Site reported in EPA (1993b), includes approximately 81 percent fish, 3 percent amphibians, and 10 percent macroinvertebrates. The remainder of the heron's diet includes plants and non-aquatic animals. Fish in the heron diet are reported to be 20 cm or shorter in length. EPA (1993a) provides an estimated water ingestion rate for the heron of 0.045 grams/gram body weight per day.

An incidental sediment ingestion rate for herons was estimated based on reported ingestion rates for the semipalmated sandpiper. The semipalmated sandpiper feeds almost exclusively on mud-dwelling invertebrates. We conservatively assumed that all of the heron's macroinvertebrate and amphibian foraging activities result in incidental ingestion of sediment. The maximum reported sediment ingestion rate for the sandpiper, 30 percent (1993b), was multiplied by the fraction of the diet comprised by amphibian and macroinvertebrate portions of the heron's diet (i.e., 0.13). The resulting incidental sediment

ingestion rate of 3.9 percent was used in the exposure model for the heron. This is likely conservative because macroinvertebrates ingested by herons are likely to be mainly epiphytic rather than infaunal.

### 2.12 Exposure Points Evaluated

Surface water bodies evaluated in this assessment included the Upper Simmons Reservoir (USR), Lower Simmons Reservoir (LSR), Sedimentation Ponds 2, 3, and 4, Cedar Swamp Brook and the Quarry Stream. These are the waterbodies to which all of the surface water from the landfill drains, and to which most of the groundwater drains. Therefore, these water bodies have the greatest potential for impacts from the landfill. These exposure points are referred to collectively as the Central Landfill Drainage Area (CLF Drainage Area). Based on their topographic positions and contaminant concentrations, data from Cedar Swamp Brook and Quarry Stream were combined with those for Sedimentation Ponds 2 and 3 (referred to as Sed Ponds 2&3 and Channels) to represent one exposure point. Because sediment containment booms are present between the northern and southern basins of the USR, the northern basin was also treated as an individual exposure point.

Several different runs of the food web model were performed. One run assumed that an individual heron feeds throughout the CLF Drainage, thus data from all the sub-areas within the CLF Drainage Area were incorporated in the body burden estimates for heron prey items. For each of the remaining food web model runs we assumed that an individual heron feeds exclusively within one of the CLF Drainage Area sub-areas, and data from only that sub-area were incorporated into the body burden estimates. Assumptions regarding the foraging area for each run of the model were as follows:

- The entire CLF Drainage Area was assumed to comprise 100% of the foraging area of the heron. Exposure Point Concentrations (EPC) within each exposure point (i.e., USR, LSR, Sed Ponds 2&3 and Channels, and Sed Pond 4) were weighted based on the size of the exposure point, relative to the entire CLF Drainage Area, to develop Feeding Area Normalized EPCs for the entire CLF Drainage Area. The surface area of water within each exposure point was used as a rough estimate of the relative amount of foraging area within that exposure point. Thus, the EPCs within exposure point X were weighted by multiplying by:

  $$\frac{\text{Surface Water Area at Exposure Point X}}{\text{Total Surface Water Area Within the CLF Drainage Area}}$$

  Then, the Feeding Area Normalized EPCs were calculated by summing the weighted EPCs from each exposure point. Table I-22 presents a summary of the weighting factors calculated for each exposure point.

- Sed Pond 4 was assumed to comprise 100 percent of the heron's foraging area.
- Sed Ponds 2&3 and Channels (which includes Cedar Swamp Brook and the Quarry Stream) were assumed to comprise 100 percent of the heron's foraging area.

- The Upper Simmons Reservoir was assumed to comprise 100 percent of the heron's foraging area.
- The Lower Simmons Reservoir was assumed to comprise 100 percent of the heron's foraging area.
- The North Basin of USR still contains significant amounts of potentially landfill-derived sediments, which generally have higher concentrations than the naturally deposited "original" sediments exposed in the main body of USR after dredging. For this reason, and at the request of EPA, the North Basin of the USR (including Cedar Swamp Brook delta within Upper Simmons Reservoir) was assumed to comprise 100 percent of the heron's foraging area.

Within each of these different exposure points, average concentrations within surface water and sediment were used as the basis for estimating the exposure of herons to site contaminants. Maximum concentrations were not used to estimate heron exposure to COPECs because this would have produced an overly conservative assessment. The herons feeding range (approximately 0.129 to 0.98 kilometers of shoreline) is large relative to the habitat size provided by the different exposure points. Also, a fairly large numbers of surface water and sediment samples (27 surface water sampling locations, and 36 sediment samples) were used to represent the CLF Drainage area. Therefore, it is highly unlikely that any individual heron would be exposed exclusively to an area with concentrations of COPECs comparable to the maximum concentrations. In addition, because the CLF Drainage Area was broken up into several smaller areas, if there were significant areas with COPEC concentrations consistently higher than the rest of the CLF Drainage Area, these conditions would be adequately represented by the average concentration for that exposure point.

However, in order to get an idea of the magnitude of difference between risk estimates calculated using the averages, and risk estimates using the maximum COPEC concentrations, the food web model for the Upper Simmons Reservoir was rerun using the maximum concentrations. The results of the average-based and maximum-based risk estimates for the Upper Simmons Reservoir are compared below.

### 2.13 Exposure Assumption Summary

The following assumptions were used as input parameters for the heron food web model:

| | | |
|---|---|---|
| Contaminated Fraction of Feeding Area = | 1 | |
| Total Daily Food Intake (kg/kg-day) = | 0.18 | (EPA, 1993) |
| Total Daily Water Intake (kg/kg-day) = | 0.045 | (EPA, 1993) |
| Fraction Composed of Fish = | 0.81 | (EPA, 1993) |
| Fraction Composed of Amphibians = | 0.03 | (EPA, 1993) |
| Fraction Composed of Invertebrates = | 0.1 | (EPA, 1993) |
| Fraction Incidentally Ingested Sediment = | 0.039 | (EPA, 1993) |

## 2.20 BODY BURDEN ESTIMATES FOR PREY ORGANISM

As discussed above, estimates of COPEC body burdens within heron prey organisms (and by extension, heron exposure to COPECs) were based on average COPEC concentrations in surface water and sediment of each exposure point. The use of maximum concentrations was considered to be overly conservative, however, the magnitude of difference between risk estimates based on average concentrations and those based on maximum concentrations is discussed in Section 4.00.

### 2.21 Gobas Model for Organic Contaminant Uptake

In order to conservatively predict tissue concentrations of organic COPECs in aquatic organisms inhabiting the surface waters adjacent to the Site, we applied the food-web bioaccumulation model of Gobas (1993). We obtained a copy of the food-web computer model from Gobas in 1995 ("A Bioaccumulation and Trophic Transfer Model for Contaminants in Aquatic Food Webs - Version 1.00, May, 1994"). This model has been used to produce the generic Food Chain Multipliers presented in the Great Lakes Water Quality Guidance, and in EPA's "Ambient Water Quality Criteria Derivation Methodology Human Health Technical Support Document - Final Draft" (EPA, 1998). Each of these documents provides detailed descriptions of the Gobas model.

The Gobas model allows estimation of bioavailable surface water contaminant concentrations, tissue concentrations, lipid concentrations, bioconcentration factors (BCFs), bioaccumulation factors (BAFs), fugacities, and uptake/elimination factors using site-specific descriptions of sediment/water chemistry and trophic relationships. Input parameters required include:

1. Molecular Weight (MW) for each COPEC
2. Henry's Law Constant for each COPEC
3. Octanol-water partition coefficient (log Kow) for each COPEC
4. Dissociation constant (for ionizing substances only)
5. Concentration of suspended solids
6. Concentration of COPEC in suspended solids
7. Concentration of COPEC in sediment
8. Concentration of COPEC in surface water
9. Organic carbon content of sediment and suspended solids
10. Organism weight
11. Organism lipid content
12. pH
13. Water temperature (Celsius)
14. Feeding Preferences (or trophic interactions)

Figure 1 depicts trophic relationship assumptions used in the Gobas model. Tables I-1 through I-12 list chemical, physical and biological input parameters used to run the model. Of the input parameters listed above, measured site-specific values were available for concentrations of suspended solids, concentrations of organic COPECs in sediment,

concentrations of organic COPECs in surface water, organic carbon contents of sediment, and pH. We assumed that the organic carbon and organic COPEC content of suspended solids equaled that of bottom sediment. Water temperature was assumed to be 18 degrees C (+/- 5 degrees). With the exception of Aroclor 1242, all physical constants for organic COPECs were obtained from EPA Guidance documents (i.e. EPA, 1986 and EPA, 1998). Whenever possible, lipid contents of species included in the food-web were obtained from EPA (1997). Other lipid content assumptions were based on values reported in current scientific literature. Reasonably conservative assumptions regarding organism feeding preferences were based on information presented in EPA (1993a&b) and in Carlander (1977).

Based on a review of limnological literature, our assumption that the total organic carbon (TOC) content of suspended solids is justifiable and conservative because the organic content of resuspended matter may exceed the organic content of bottom sediment (Kawana and Tanimoto, 1984). Other researchers (e.g. Meyers *et al.*, (1984)) have shown that the organic content of particulate matter within the top 1 meter of surface water is largely composed of terrigenous lipid matter which is degraded slower than the lipid matter of aquatic origin which dominates the suspended solids of deeper waters. Prey items of the great blue heron are likely to spend the majority of the year in shallow water where organic carbon content of suspended solids is higher, thus, bioavailability of organic contaminants in these areas may be lower compared to deeper water. A data set for Lake Ontario summarized by Campfens and Mackay (1997) documents the organic carbon fraction of sediment as 0.02 and the organic carbon fraction of suspended particles as 0.2, supporting the conservative nature of our assumption. Because the relationship between the organic content of the suspended solids and the predicted body burdens of aquatic organisms is roughly linear, this conservative assumption may result in an approximately 3x to 10x overestimation of body burdens (see Section 6.00).

The Gobas model requires input of surface water and sediment concentrations for each contaminant being evaluated. If an organic contaminant was not detected in surface water (and therefore was not a surface water COPEC for that exposure point) we input a concentration of $1 \times 10^{-7}$ mg/l, which is essentially a "zero" concentration. This value was used because, based on trial runs with DDT, $1 \times 10^{-7}$ is the point at which surface water concentrations no longer have a significant influence on the estimated body burdens.

In a few cases (e.g., aldrin and DDT in the Lower Simmons Reservoir), organic contaminants were detected in surface water but not sediment. With the exception of VOCs, it is expected that contaminants found in surface water are also found in sediment, and that the reason they were not detected is likely due to small sample size or high detection limits. Therefore, in these cases, the sediment concentration was assumed to be one-half of the average sediment MDL for that data set.

#### 2.21.1 Gobas Biological Uptake Model Results

Tables I-13 through I-17 present the body burdens and bioavailable surface water concentrations calculated by the model. The sections below provide a brief overview

of the formulas used in the model. More detailed descriptions of these formulas are presented in Gobas (1993).

Freely Dissolved Surface Water Concentrations of COPECs

The Gobas model predicts the bioavailable (or "freely dissolved") fraction of a COPEC in surface water (Bioavailable Solute Fraction [BSF]), using the formula:

$$BSF = 1/(1 + (K_{OW} \times [OM]/dOM))$$

where [OM] is the concentration (kg/L) of organic matter in the water, $K_{OW}$ is the octanol/water partitioning coefficient of the COPEC, and dOM is the density of the organic matter (kg/L). The model uses the calculated BSF to predict body burdens of organisms in the hypothetical food web.

COPEC Concentrations in Benthic Invertebrates

The Gobas model predicts COPEC concentrations in benthic invertebrates using the relationship:

$$CB \times dL/LB = CS \times dOC/OC = KLW \times CP$$

where CB is the chemical concentrations in the benthic invertebrate (μg/kg wet weight), CS is the concentration in the sediments (μg/kg dry weight), CP is the truly dissolved chemical concentration in the pore water (μg/L water); LB is the lipid fraction of the benthic organisms (kg lipid/kg organism), dL is the density of the lipids of the benthic organisms (kg/L), OC is the organic carbon fraction of the sediments (kg organic carbon/kg sediment), dOC is the density of the organic carbon fraction of the sediments (kg/L) and KLW is the dimensionless lipid water partition coefficient. Since dL and dOC are approximately the same, CB/CS should be approximately similar for organic chemicals, namely, LB x dOC/OC x dL, or simply LB/OC. Thus, uptake by benthic invertebrates is seen as being primarily dependent upon the relationship between sediment organic carbon and the lipid fraction of the organism.

COPEC Concentrations in Fish and Amphibians

The Gobas model predicts COPEC concentrations in fish using estimates of compound and species specific gill uptake rate constants, gill elimination rate constants, metabolic transformation rate constants, dietary uptake rate constants, fecal egestion rate constants, growth dilution, and feeding preferences. For the purposes of this risk assessment, we assumed that bullfrog tadpoles would exhibit the same bioaccumulation tendencies as fish. Bullfrog tadpoles are gilled and can spend as much as 3 years in the water before metamorphosing into adults (EPA, 1993a).

## 2.22 Inorganic Body Burden Estimates

### 2.22.1 Benthic Macroinvertebrate Tissue

For exposure points in which an inorganic COPEC had been detected in surface water, we estimated benthic invertebrate body burdens by multiplying the arithmetic mean total surface water concentration of the COPEC by bioconcentration factors (BCFs) for fish presented in EPA (1998b). If the COPEC was detected in sediment but not in surface water, we estimated body burdens by multiplying the arithmetic mean sediment concentration by the Invertebrate Accumulation Factors (IAFs) presented on Table I-18. The IAFs for inorganics were calculated by dividing the COPEC-specific fish BCF from EPA (1998b) by the $Kd_{bw}$ (bed-sediment to pore water partition coefficient) presented in EPA (1998b).

### 2.22.2 Amphibian Tissue

Body burdens for amphibians were estimated by multiplying mean total surface water concentrations by BCFs for fish presented in EPA (1998b). If an inorganic COPEC was not detected in surface water but was present in sediments, amphibian body burdens were calculated using the same method described above for invertebrates. In the case of mercury, the sediment/amphibian BCF presented on Table I-19 was used.

### 2.22.3 Fish Tissue

Fish tissue samples (filets) were collected for inorganic analyses from the Upper and Lower Simmons Reservoirs by Environmental Science Services (ESS) in 1993 and 1994. Reports produced by ESS are presented in Appendix K. Fish tissue analytes consisted of cadmium, chromium, copper, lead, mercury, and zinc. With the exception of zinc and mercury, none of the other inorganic contaminants were detected. Mercury was detected in one tissue sample; 0.4 mg/kg wet weight (or about 2 mg/kg dry weight assuming a fish tissue percent solid value of 20 percent) of mercury was detected in a sample from the Upper Simmons Reservoir. Zinc was detected in all fish tissue samples; concentrations detected ranged from 4.2 to 6.0 mg/kg wet weight (about 21 to 30 mg/kg dry weight) in the Upper Simmons Reservoir, and from 2.1 to 8.6 mg/kg (about 11 to 43 percent dry weight) in the Lower Simmons. Average concentrations of zinc were 5.0 and 4.9 mg/kg wet weight (about 25 to and 24.5 mg/kg dry weight) in the Upper and Lower Simmons Reservoirs, respectively.

One potential option for estimating fish tissue concentrations for the metals analyzed but not detected by ESS was to use one-half the method detection limit as the body burden value. However, MDLs for data collected by ESS were quite high, and had we used those MDLs, this analytical artifact would have driven the results of our exposure estimate for these metals. Therefore, with the exception of zinc (which was positively detected in each fish sample), we estimated fish tissue concentrations for these, and other inorganic COPECs using BCFs obtained from EPA (1998c) (Table I-20). The average concentration of zinc detected in fish tissue samples from the Upper Simmons was used to represent fish tissue EPCs for the Upper Simmons, and the average concentration of zinc in fish samples from the

Lower Simmons was used to estimate fish tissue concentration in that waterbody. ESS reported fish tissue concentrations on an "as is" basis, which we took to mean on a wet weight basis. Therefore, these values were used as reported to estimate daily doses to the heron. Average fish tissue zinc concentrations for the Upper and Lower Simmons Reservoirs are presented in Table 23.

If an inorganic COPEC was detected in surface water, the fish tissue concentration was estimated by multiplying the arithmetic mean total surface water concentration by the published BCF. If a contaminant was detected in sediment but not in surface water, we estimated the fish tissue contaminant concentration by multiplying the average sediment concentration by the sediment to fish BCFs presented on Table I-21, and by the fraction of solid content in fish to calculate the fish body burden on a wet weight basis. Fish species similar to species present in the reservoirs collected in a different study was measured to have approximately 20 percent solids. Thus, we used 0.2 as the fraction of solid content in fish.

## 3.00 REFERENCE DOSES FOR THE GREAT BLUE HERON

With the exception of the reference dose (RFD) for methoxychlor, RfDs for the great blue heron were obtained from Sample *et al.* (1996). The RFD for methoxychlor was obtained from EXTOXNET (1996). Tables I-33 through I-38 present RfDs for COPECs. Whenever possible, we used both No Observed Adverse Effects Levels (NOAELs) and Lowest Observed Adverse Effects Levels (LOAELs) in our risk evaluation. The following paragraphs summarize the test endpoints upon which each RFD was based.

### 3.10 ORGANIC CONTAMINANTS

#### Acetone

Toxicological information regarding the effects of acetone on birds was not identified in Sample *et al.*, 1996. However, acetone toxicity data was available for rats, and thus we used the LOAEL and NOAEL reported for the rat as our benchmarks for the Great Blue Heron. Sample *et al.*, 1996 discussed a subchronic (90 days) study of the effects of acetone applied orally in three doses (100, 500, and 2,500 mg/kg/d) to rats weighing approximately 0.35 kg and consuming 0.028 kg of food per day. Doses of 500 and 2,500 mg/kg/d lead to significant kidney damage and increased kidney weights, but no differences were observed at the lowest dose. Because the exposure duration did not include the rat's reproductive lifestage, 100 and 500 mg/kg/d were considered to be subchronic doses, and were each divided by an uncertainty factor of 0.1 to estimate the chronic NOAEL and LOAEL of 10 and 50 mg/kg/d, respectively.

Chloromethane

Avian wildlife toxicity data for chloromethane (synonym: methyl chloride) was not available in Sample *et al.*, 1996. However, NOAELs and LOAELs for mammals were available, and we used the benchmarks identified in a chronic study (two years) of chloromethane toxicity to rats. Four doses of chloromethane (5.85, 50, 125, and 250 mg/kg/d) were administered orally to rats of approximately 0.35 kg in body weight. No effects were observed at the lowest dose, but changes in liver tissue were observed at 50/mg/kg/d. The chronic NOAEL and LOAEL were considered to be 5.85 and 50 mg/kg/d, respectively.

Chlorobenzene

There was no toxicological information for chlorobenzene available for avian or terrestrial wildlife in Sample *et al.*, 1996. However, toxicity studies for chlorobenzene were described in the Agency for Toxic Substances and Disease Registry (ATSDR) toxicity profile for chlorobenzene (1999). In a chronic study of rats orally exposed to chlorobenzene, altered kidney weights were observed at the dose of 120 mg/kg/d. No effects were observed at 60 mg/kg/d. These doses were the lowest LOAEL and NOAEL reported in the ATSDR profile. We divided these values by an uncertainty factor of 10 to estimate the LOAEL and NOAEL for the great blue heron.

1,2-Dichlorobenzene and 1,4-Dichlorobenzene

There was no available toxicity information about the effects of 1,2- and 1,4-dichlorobenzene on avian or terrestrial wildlife in Sample *et al.*, 1996. However, toxicological data for 1,4-dichlorobenzene was available in the ATSDR toxicity profile for 1,4-dichlorobenzene (1999). Moderate kidney damage was observed in male rats exposed to 150 mg/kg/d by gavage for 2 years in a chronic (2 years) study of the effects of 1,4-dichlorobenzene on rats. This dose was the lowest reported chronic value in the ATSDR toxicological profile. We divided this value by an uncertainty factor of 10 to estimate the LOAELs for 1,2- and 1,4-dichlorobenzene. Because a NOAEL for this particular effect was not estimated and NOAELs for other effects were higher than 150 mg/kg/d in the studies described in the ATSDR toxicological profile, we used the NOAEL reported for chlorobenzene described above.

Butylbenzylphthalate

There were no data regarding the toxicity of butylbenzylphthalate to wildlife. However, toxicological information about the similar compound di-n-butylphthalate was identified in Sample *et al.*, 1996, and we used the identified LOAEL and NOAEL for di-n-butyl phthalate as surrogate benchmarks for butylbenzylphthalate. One dose of 10 mg of di-n-butylphthalate per kg of food administered via diet to ringed doves during a four-week period reduced eggshell thickness and water permeability of the shell. A LOAEL of 1.1 /kg/d was calculated based on the dose applied, and the body weight (0.155 kg) and food consumption rate (0.01727 kg/d) of ringed doves. Because the exposure period included the critical

reproduction lifestage, this value was considered to be the chronic LOAEL, and the chronic NOAEL was estimated by multiplying the chronic LOAEL by the uncertainty factor of 0.1.

Benzo(a)pyrene and Other PAHs

Toxicity studies of benzo(a)pyrene, benzo(a)anthracene, and benzo(b)fluoranthene to avian wildlife were not available. However, there was information regarding the toxicity of benzo(a)pyrene to mammals in Sample *et al.*, 1996, and we used the test species LOAEL and NOAEL each divided by an uncertainty factor of 10 for the purpose of this food web. Three doses of benzo(a)pyrene (10, 40, and 160 mg/kd/d) was administered orally to mice. The dose of 10 mg/kg/d induced reduction of weight and fertility impairment among offspring. Because the exposure period included the reproduction lifestage, 10 mg/kg/d was considered to be the chronic LOAEL, and the chronic NOAEL of 1 mg/kg/d was estimated by multiplying the LOAEL by an uncertainty factor of 0.1.

Aldrin

Toxicological information regarding the effects of aldrin on avian wildlife were not identified. However, because aldrin quickly breaks down to dieldrin in the body and in the environment (ATSDR, 1989) we used the RfDs for dieldrin presented in Sample *et al.* (1996). Sample *et al.* summarized a study of the effects of orally administered dieldrin to the Barn owl. The single dose applied, 0.58 mg/kg, reduced eggshell thickness but did not have a significant effect on the number of eggs laid, the number of eggs hatched, the percent of eggs broken, or embryo or nestling mortality. Sample *et al.* considered this exposure level to be a No Observed Effects Level (NOAEL) and converted it to a RFD of 0.077 mg/kg/day using a literature derived body weight and food consumption rate.

Benzene Hexachloride (BHC)

Sample *et al.* (1996) reviewed the wildlife toxicity of mixed isomers of Benzene hexachloride (BHC). When exposed to 20 mg BHC/ kg food over a 90 day period, Japanese quail experienced reduced egg hatchability and egg volume. No significant effects were observed at dietary levels of 1 or 5 mg/kg. Sample *et al.* calculated a NOAEL and a Lowest Observed Effects Level (LOAEL) for birds of 0.563 mg/kg/day and 2.25 mg/kg/day from the 5 mg/kg and 20 mg/kg exposure levels, respectively. These calculations were conducted using quail body weights reported in the original study and food consumption rates estimated using an allometric equation.

Polychlorinated Biphenyls (PCBs)

Sample *et al.* (1996) reviewed the wildlife toxicity of mixed isomers of Aroclor 1242. Neither fertility or hatching success were significantly reduced when Screech owls were exposed to 3 mg/kg in diet over a period of two generations. Sample *et al.* considered this exposure level to be a NOAEL for birds and calculated a NOAEL RFD of 0.41 mg/kg/day using literature derived body weights and food consumption rates for the owl.

Sample *et al.* (1996) also summarize a 17-week study of Ring-necked pheasant exposure to Aroclor 1254 via weekly oral doses in gelatin capsules. The lowest test dose, 12.5 mg/bird/week, significantly reduced egg hatchability and was considered to be a LOAEL. Sample *et al.* (1996) calculated a LOAEL dose of 1.8 mg/kg/day using a literature derived body weight and assuming that the weekly dose could be divided by 7 to estimate a daily dose.

Because RfDs for Aroclor 1232 could not be identified, we applied the RfDs for Aroclor 1254. This should be a conservative assumption because of the higher chlorine content of Aroclor 1254 and the perceived relationship between PCB chlorine content and wildlife toxicity.

DDT and Metabolites (DDD and DDE)

Sample *et al.* (1996) summarized a study that documented the reproductive success of pelicans exposed to DDT over a 5 year period. The pelicans were exposed to DDT via consumption of anchovies, which were monitored for DDT concentrations over the course of the study. The lowest anchovy DDT concentration documented, 0.015 mg/kg (wet weight), was coincident with a reproductive success rate 30 percent below that required to maintain a stable population. Both Sample *et al.* and EPA (as cited in Sample *et al.*) have considered this exposure level to be a chronic LOAEL. Sample *et al.* estimated a chronic NOAEL by multiplying the LOAEL by an uncertainty factor of 0.1. These exposure levels were converted to NOAEL and LOAEL RfDs of 0.0028 mg/kg/day and 0.028 mg/kg/day using literature derived pelican body weights and food consumption rates. It should be noted that although DDD and DDE were not mentioned in the summary of this study provided by Sample *et al.* (1996). These compounds would be expected to occur along with DDT in the anchovy tissue, and would likely have contributed to the observed toxicity to pelicans. Therefore, the RfDs based on this study were applied to each DDT residue individually, but were also considered to be applicable to the summed total of DDT residues (DDTR).

Total Chlordanes

Sample *et al.* (1996) summarized a study that documented adverse impacts to red-winged blackbirds exposed to three dietary levels of chlordane. The study documented a 26 percent mortality in test animals over a 10 week exposure period at an exposure level of 50 mg/kg. No adverse effects were observed in test animals at an exposure level of 10 mg/kg. Sample *et al.* considered the 10 mg/kg exposure to be a NOAEL and the 50 mg/kg exposure to be a LOAEL. These values were converted to NOAEL and LOAEL RfDs of 2.14 mg/kg/day and 10.7 mg/kg/day using the body weight of the birds reported in the original study and an allometric equation to estimate a food consumption rate.

Total Endosulfans

Sample *et al.* (1996) summarized a study that failed to document adverse impacts to gray partridge exposed to three dietary levels (5, 25, and 125 ppm) of Endosulfan for 4 weeks during a life stage critical to reproduction. The maximum dose applied was considered to be

a chronic LOAEL, and was converted to a RfD of 10 mg/kg/day using the body weight of the birds reported in the original study and an allometric equation to estimate a food consumption rate.

Methoxychlor

EXTOXNET (1996) cites a study which reported that dietary levels of methoxychlor as high as about 145 mg/kg/day had no effects on reproductive function of male and female chickens over 8 to 16 weeks. We conservatively divided this value by an uncertainty factor of 10 to estimate a NOAEL of 14.5 mg/kg/day.

## 3.20 INORGANIC CONTAMINANTS

Aluminum

A chronic ( four month critical lifestage) study of silver exposed ringed doves was described in Sample *et al.*, 1996. A single dose of 1000 ppm of aluminum was administered orally to ring doves via diet, and no effects were observed. Based on the food consumption rate (0.017 kg/d) and body weight (0.155 kg), a chronic NOAEL was estimated to be 109.7 mg/kg/d.

Arsenic

Sample *et al.* (1996) summarized a chronic (7 months) study of cowbirds exposed to arsenic in the form of copper acetoarsenite (approximately 44% arsenic). Four doses (25, 75, 225, and 675 ppm) were administered orally via the diet to cowbirds. Twenty percent mortality was observed in the cowbird group exposed to 75 ppm, and no observed effects were observed at 25 ppm. Based on body weight (0.049 kg) and food consumption rate (0.01087 kg/d), the chronic LOAEL and NOAEL were calculated at 7.38 mg/kg/d and 2.46 mg/kg/d, respectively.

Barium

Sample *et al.* (1996) described a subchronic study of 1-day old chicks exposed to eight doses (250, 500, 100, 200, 4000, 8000, 16,000, and 32,000 ppm) of barium hydroxide. Five percent mortality was observed in the group exposed to 4000 ppm, and barium exposures up to 2000 ppm lead to no significant effects. Based on body weight (0.121 kg) and food consumption rate (0.0126 kg/d), subchronic LOAEL and NOAEL were calculated at 416.53 and 208.26 mg/kg/d, respectively. Chronic LOAEL of 41.7 mg/kg/d and chronic NOAEL of 20.8 mg/kg/d were estimated by dividing the subchronic benchmarks by an uncertainty factor of 0.1.

Beryllium

Information regarding toxicity of beryllium to avian wildlife was not available in Sample *et al.*, 1996. However, beryllium toxicity to rats was described in Sample *et al.* (1996) and chronic NOAEL presented in this study were divided by an uncertainty factor of 10 to calculate this benchmark for the great blue heron. One dose of 5 ppm beryllium sulfate was administered to rats orally in water, and produced no significant effects. Because the study duration was greater than one year, this dose was considered to be the chronic NOAEL.

Cadmium

Sample *et al.* (1996) cited a chronic (90 day critical life stage) study which evaluated reproductive harm to mallard ducks exposed to cadmium chloride via diet. Body weights and food consumption rates were obtained from the original study. The LOAEL dose (210 mg/kg diet or 20.03 mg/kg/day) resulted in a significant reduction in egg-laying, while the NOAEL dose (15.2 mg/kg diet or 1.45 mg/kg/day) had no effect. Scheuhammer (1991) mentions a study that documented decreased egg production and eggshell thinning in chickens fed a diet containing 48 mg/kg cadmium.

Although the large interval between the NOAEL and LOAEL introduces some uncertainty, the study documented an ecologically relevant effect over a substantial exposure period. Based on these uncertainties, our confidence in these benchmark doses is moderate. It is reasonable to expect that exceedance of the LOAEL would elicit some effect on the local population of herons, and that doses below the NOAEL would have no effect.

Chromium

Sample *et al.* (1996) described a chronic study (ten months) of black ducks exposed to two doses (10 and 50 ppm) of trivalent copper in the diet. At 50 ppm, duckling survival was reduced, but no effects were observed at 10 ppm. Based on the body weight (1.25 kg) and food consumption rate (125 g food /day) of black ducks, and chronic LOAEL and NOAEL were calculated to be 5 mg/kg/d and 1mg/kg/d, respectively.

Manganese

Sample *et al.* (1996) summarized a chronic study (75 days) of manganese toxicity to 20 day old Japanese quails. One dose of 5000 ppm manganese was administered to the birds through the diet. Manganese consumption estimated at 977 mg/kg/d resulted in no significant adverse effects. Thus, this dose was considered to be the chronic NOAEL.

Mercury

For the purposes of this risk assessment, we assumed that all of the mercury ingested by the heron, including mercury associated with incidentally ingested sediment, would be in the form of methylmercury. Methylmercury is substantially more toxic and bioaccumulative than inorganic forms. Although nearly all (95-100%) of the mercury present in fish is

methylmercury, obtained mostly from the diet, total concentrations of mercury in sediment, water, and biota in lower trophic levels (below fish) are not reliable predictors of methylmercury concentrations in fish (USGS, 1996). Generally the vast majority of mercury in an aquatic ecosystem is in the inorganic form (about 95 to 99%), and the vast majority of mercury in an aquatic ecosystem is found in the sediments (USGS, 1996).

Sample *et al.* (1996) summarized a study that documented reproductive impairment in mallard ducks exposed to 0.5 mg/kg methylmercury dicyandiamide in diet over three successive generations. Sample *et al.* considered this exposure level to be a LOAEL and derived a NOAEL by multiplying by an uncertainty factor of 0.1. Sample *et al.* converted these values to NOAEL and LOAEL RfDs of 0.0064 mg/kg/day and 0.064 mg/kg/day using a literature derived body weight and the food consumption rate reported in the original study.

Nickel

Sample *et al.* (1996) summarized a study that documented the effects of dietary nickel on Mallard ducklings exposed to three exposure levels for 90 days. Ducklings exposed to 1,069 mg/kg nickel experienced reduced growth and 70 percent mortality, while those exposed to 774 mg/kg did not experience adverse effects. Sample *et al.* considered the 1,069 exposure to be a LOAEL and the 774 mg/kg exposure to be a NOAEL. These values were converted to NOAEL and LOAEL RfDs of 77.4 mg/kg/day and 107 mg/kg/day using body weights reported in the original study and a literature derived food consumption rate.

Selenium

Sample *et al.* summarized several studies that documented adverse effects to avian receptors exposed to dietary selenium. We conservatively applied RfDs derived from the study that reported the lowest measured effects levels. This study reported a reduction in mallard duckling survival after exposure to 8 mg/kg dietary selenium over 100 days, with no adverse effects reported at a level of 4 mg/kg. Sample *et al.* considered 8 mg/kg to be a LOAEL and 4 mg/kg to be a NOAEL. These values were converted to NOAEL and LOAEL RfDs of 0.4 mg/kg/day and 0.8 mg/kg/day using body weights and food consumption rates reported in the original study.

Silver

There was no available information regarding silver toxicity to avian or terrestrial wildlife in Sample *et al.* (1996). However, in a review paper of silver toxicity and bioaccumulation by Ratte, 1999, silver toxicity to mammals was described. No observed adverse effects were observed to mice orally exposed to silver in the form of silver chloride at the dose of 18.1 mg/kg/d. This dose was the lowest NOAEL reported in Ratte (1999). Therefore, we divided the NOAEL for mice by an uncertainty factor of 10 to estimate to NOAEL for the great blue heron.

Thallium

Toxicological information regarding thallium exposure to avian wildlife was not available in Sample *et al.* (1996), but a subchronic (60 days) thallium exposure study to mammalian wildlife was described. One dose of 10 ppm thallium administered orally to rats resulted in reduced sperm motility. The mean daily intake of thallium was estimated to be 0.74 mg/kg/d, and this dose was considered to be the subchronic LOAEL. The chronic LOAEL of 0.074 mg/kg/d was estimated by multiplying the value by an uncertainty factor of 0.1, and the chronic NOAEL of 0.0074 mg/kg/d was estimated by multiplying the chronic LOAEL by 0.1.

Vanadium

A chronic (12 week) study of mallard ducks exposed to three doses (2.84, 10.36, 110 ppm) of vanadium in the diet was described by Sample *et al.* (1996). No adverse effects were observed at 110 ppm. Based on body weight (1.17 kg) and food consumption weight (0.121 kg/d), the chronic NOAEL was calculated to be 11.38 mg/kg/d.

Zinc

Sample *et al.* (1996) summarized a chronic study (44 weeks) of white leghorn hens exposed to three doses (20, 200, 2000 ppm) of supplemental zinc plus 28 ppm of zinc in the diet. Reduced egg hatchability was observed at 2028 ppm, but no adverse effects were observed at 48 and 228 ppm. Based on body weight and food consumption rate (1.935 kg and 123 g/d, respectively in the 228 ppm dose group, and 1.766 kg and 114 g/d, respectively in the 2028 dose group) the chronic NOAEL and LOAEL were calculated to be 14.5 mg/kg/d and 131 mg/kg/d, respectively.

## 4.00 RISK ESTIMATES FOR THE GREAT BLUE HERON

EPCs were converted to estimated daily doses using the exposure assumptions described in Section 2.00. Weighted EPCs are presented on Table I-24, I-25, and I-26. These estimated doses are presented on Tables I-27 through I-32. Estimated daily doses were compared to the toxicological RfDs (LOAELs and NOAELS) described above, and comparisons are presented on Tables I-33 through I-38. Comparisons are presented as Toxicity Quotients (TQs), which are simply the estimated dose divided by the RfD. TQs have been summed to yield Hazard Quotients (HQs); HQs were calculated separately for the organic contaminants and the inorganic contaminants, and also as a total HQ for the exposure point. Table I-39 presents a summary of contaminants which exceeded their LOAELs or NOAELs, and presents those HIs which are greater than 1.

In evaluating exceedances of the RfDs, emphasis is given to exceedances of the LOAELs. LOAEL-based TQs greater than 1 indicate that the estimated dose exceeded a dose which has been shown to cause adverse effects to a test organism. Exceedance of a NOAEL, on the

other hand, indicates that the predicted exposure level is greater than the highest known "safe" level of exposure, but does not necessarily indicate that there is a significant level of risk. There are often great discrepancies and wide intervals between literature reported NOAELs and LOAELs. For instance, the LOAEL for heron exposure to cadmium (20.03 mg/kg/day) is nearly 14 times greater than the NOAEL of 1.45 mg/kg/day. Conversely, the LOAEL for heron exposure to nickel, 107 mg/kg/day, is only slightly higher than the NOAEL of 77.4 mg/kg/day. Our assessment places a higher degree of confidence in NOAELs which do not differ greatly from the original study's LOAEL.

Table I-33 summarizes TQs for the CLF Drainage Area. Butylbenzylphthalate slightly exceeded the NOAEL, with a TQ of 1.93, but did not exceed the LOAEL. The pesticide DDT slightly exceeded the LOAEL-based RfD, with a TQ of 3.66. The LOAEL based TQ for total DDTR was 3.75. Beryllium slightly exceeded the NOAEL with a TQ of 1.33; there was no available LOAEL-based RfD for beryllium. The estimated dose of mercury slightly exceeded the NOAEL, with a TQ 4.74, but did not exceed the LOAEL. The estimated dose of thallium exceeded the LOAEL with a TQ of 7.36, and exceeded the NOAEL with a TQ of 73.6. The NOAEL and LOAEL-based total HQs were 122 and 12.4, respectively.

Table I-34 summarizes TQs for the heron based on the assumption that the Upper Simmons Reservoir comprises the entire foraging range of a heron. None of the contaminants exceeded LOAEL RfDs. The LOAEL-based HQs for organic COPECs was less than one. Butylbenzylphthalate slightly exceeded the NOAEL-based RfD with a TQ of 3.57. Beryllium slightly exceeded its NOAEL with a TQ of 1.57. The NOAEL and LOAEL-based total HQs were 0.7 and 8.6, respectively.

To gauge the magnitude of difference the use of maximum sediment and surface water concentrations would make to the risk estimates for the heron, the heron food web model for the Upper Simmons Reservoir was re-run using maximum concentrations. In general, maximum-based TQs for individual COPECs were on the order on 50 percent to 4 times higher than the average-based TQs; the LOAEL-based and NOAEL-based total HIs calculated using maximums were about 2 times greater than those based on average COPEC concentrations. Use of maximum concentrations did not result in LOAEL exceedances by any of the individual COPEC, however the LOAEL-based total HI increased from 0.7 based on average concentrations to 1.8 based on maximum concentrations. Use of the maximum concentrations resulted in additional exceedances of the NOAEL by individual contaminants; these exceedances were by DDT (and DDTR), and thallium, with NOAEL-based TQs of 1.1 (2.0), and 5.8, respectively. The NOAEL-based total HQ increased from 8.6 based on average concentrations, to 21 based on maximum concentrations.

Table I-35 summarizes TQs for the north basin of the Upper Simmons Reservoir. None of the contaminants exceeded LOAEL RfDs. NOAEL-based RfDs were slightly exceeded by butylbenzylphthalate, DDE, total DDTR, and thallium with TQs of 2.82, 1.20, 2.70, and 6.73 respectively. The total NOAEL and LOAEL-based HQs were 16.4 and 1.6, respectively.

Table I-36 presents TQs based on the assumption that the Lower Simmons Reservoir comprises the entire foraging range of a heron. DDT, total DDTR, and thallium exceeded the LOAEL RfDs with TQs of 6.45, 6.54, and 12.8, respectively. Beryllium slightly exceeded its NOAEL with a TQ of 1.19. The NOAEL and LOAEL-based total HQs were 193 and 19.8, respectively.

Table I-37 summarizes TQs for Sed Ponds 2&3 and Channels. Estimated doses of benzo(a)anthracene, benzo(a)pyrene, and mercury exceeded their RfDs with LOAEL TQs of 1.3, 3.1, and 4.01, respectively. The NOAEL and LOAEL-based total HQs were 90 and 8.7, respectively.

Table I-38 summarizes TQs for Sed Pond 4. Butylbenzylphthalate was the only COPEC to exceed its RfDs: the estimated daily dose exceeded the LOAEL dose with a TQ of 1.4, and the NOAEL-TQ was 14.4.

## 5.00 RISK CHARACTERIZATION FOR THE GREAT BLUE HERON

The following paragraphs express the results of the food web analysis for the heron within the context of available toxicological information and contaminant distribution at the site. The intention of this section is to characterize and describe potential risks to receptors, and to provide a technical narrative supporting the risk estimates. Although sources of uncertainty in the risk estimate are mentioned throughout this risk description, more detailed discussions of uncertainties are presented in Section 6.00.

### 5.10 RISKS FROM DDTR

DDT and total DDTR were the only PCB and pesticide COPECs which resulted in estimated doses above their LOAELs. Estimated doses of DDT/DDTR exceeded the LOAEL for the entire CLF Drainage Area, however, this exceedance was the result of a 0.0001 mg/l detection of DDT in a single unfiltered surface water sample (sample SW98-54) from the Lower Simmons Reservoir. Given the highly hydrophobic nature of DDT and the fact that DDT was not detected in Lower Simmons Reservoir sediment, it is likely that the detection was due to suspended matter in the sample. Although suspended solids were not detected in this sample at a MDL of 10 mg/l, if it is assumed that TSS is present at one-half the MDL the concentration of DDT associated with the suspended solids would only need to be 0.00002 mg/kg to account for the 0.0001 mg/l detection. If this outlying surface water data point is not included in the input data set for the Gobas model, none of the sediment EPCs for DDT or DDTR are high enough to result in an exceedance of the LOAEL RfD.

Given the agricultural history of the USR and LSR watershed, and the pattern of detection for DDT, DDE, and DDD it is unlikely that DDTR present in these waterbodies resulted from Central Landfill. Although risks to the heron from ingestion of DDTR cannot be ruled out due to the single detection in sample SW98-54, it is unlikely that the landfill contributed to this risk estimate.

## 5.20 RISKS FROM MERCURY

The risk estimates suggest that herons may be exposed to potentially harmful dietary mercury concentrations while foraging at the sedimentation ponds, where estimated mercury doses exceeded the LOAEL RfD. As described in Section 3.20, the RfDs used for evaluation of heron exposure to mercury were based on a study in which methylmercury dicyandiamide was administered to mallard ducks, resulting in a significant reduction in reproductive success. It should be noted that mallards may possess less capability to detoxify methylmercury than other duck species, and piscivorous birds such as the heron likely possess a greater ability to detoxify methylmercury than do non-piscivorous birds like mallards (EPA, ~~(~~1997 - Volume VI).

The Massachusetts Department of Environmental Protection (MA DEP) recently published a report documenting the sediment, water and fish tissue mercury concentrations found in 24 of the state's "least-impacted" waterbodies (MA DEP, 1997). Sediment mercury concentrations ranged from 0.029 mg/kg to 0.425 mg/kg (average = 0.22 mg/kg). The average fish tissue concentrations were 0.31 mg/kg (yellow perch), 0.40 mg/kg (largemouth bass), and 0.14 mg/kg (brown bullhead). The EPA Mercury Study Report to Congress (EPA, 1997 - Volume III) reported a nationwide mean bass tissue concentration of 0.38 mg/kg.

EPA (1997 - Volume VI) concluded that predatory wildlife, particularly piscivorous (fish-eating) birds and mammals are potentially at risk from consumption of methylmercury in contaminated prey. The risks to wildlife were concluded to be greatest in regions receiving the highest levels of atmospheric mercury deposition, notably the Northeast.

The mean mercury concentrations detected in sediment samples for each of the exposure points evaluated in the heron risk characterization were within the range reported for relatively unimpacted waterbodies, and the fish tissue concentrations calculated for the exposure model are similar to tissue concentrations measured in fish from other freshwater lakes in the region. The risk estimate for heron exposure to mercury in fish is consistent with other risk estimates for piscivorous wildlife (e.g., EPA, 1997). Based on available information regarding regional contamination of waterbodies by atmospherically deposited mercury, it is unlikely that the risks to herons associated with consumption of mercury are related to the landfill.

## 5.30 RISKS FROM BUTYLBENZYLPHTHALATE, THALLIUM, BENZO(A)-ANTHRACENE, AND BENZO(A)PYRENE

Butylbenzylphthalate slightly exceeded its LOAEL in Sedimentation Pond 4 with a TQ of 1.44. However, as discussed in Section 4.0, there were no benchmarks identified for butylbenzylphthalate. Thus, we conservatively used the LOAEL-based RfD for di-n-butylyphthalate, which was the lowest reference dose for a phthalate based compound reported for avian wildlife in Sample *et al.*, 1996. Additionally, results from Sedimentation

Pond 4 were based on a single surface water sample. Because the exceedance of the LOAEL was less than a factor of two, we do not expect the potential for risk to the great blue heron in Sedimentation Pond 4.

The estimated daily dose for thallium exceeded the LOAEL in Lower Simmons Reservoir with a TQ of 12.8. However, there were no available thallium RfDs for avian wildlife. Thus, we used the LOAEL reported for the rat divided by an uncertainty factor of ten. Based on the uncertainty of this benchmark, we do not believe the exceedance of the LOAEL is indicative of potential for risk to the great blue heron in Lower Simmons Reservoir (See Section 6.00). We would not expect the actual LOAEL for avian wildlife to be comparable to the reference dose based on thallium toxicity to the physiologically dissimilar rat.

The RfDs used for both benzo(a)anthracene and benzo(a)pyrene, were based on a LOAEL for rats of 10mg/kg/day divided by an uncertainty factor of 10 to account for the extrapolation from mammals to birds. Estimated daily doses for these PAHs resulted in LOAEL TQs of just 1.3 and 3.1 in the Sed Ponds 2&3 and Stream Channels exposure area. Since the LOAEL TQs are less than 10, the use of mammal RfDs for birds presents a high degree of uncertainty, and the Sed Ponds 2&3 and Stream Channels exposure area consists of engineered waterbodies which are used to manage migration of sediments from the landfill facility, it is our opinion that these PAHs do not present a significant risk of harm to herons or similar birds which may feed within Sed Ponds 2&3 and Stream Channels.

## 6.00 UNCERTAINTIES

As mentioned above, we conservatively assumed that the total organic carbon (TOC) content of suspended solids (TSS) in each of the exposure points equaled the mean TOC content of the bottom sediment. Current scientific literature suggests that this assumption may underestimate the TSS TOC content by an order of magnitude (e.g., Campfens and Mackay, 1997). Table I-40 presents an analysis of the effect of TSS TOC on body burdens predicted by the Gobas model. For this analysis, we used sediment and surface water data from the Upper Simmons Reservoir North Basin, and varied the TSS TOC input from the mean sediment fraction of 0.02065 to a TSS TOC input one order of magnitude higher (0.2065). The analysis was performed for Aroclor 1254, DDT, DDE, and DDD.

Assuming a higher TSS TOC content consistently results in significant decreases in predicted body burden concentrations and freely dissolved surface water concentrations. The decreased concentrations with increased TSS TOC are the result of greater predicted sorption to TSS. The contaminant with the highest log Kow, DDE, showed the greatest change with a change in TSS TOC. Fish tissue concentrations of DDT and its metabolites were approximately 6 to 8 times higher when the sediment TOC was used to estimate TSS TOC. The conservative uncertainty associated with this assumption may have resulted in an overestimation of potential risks to great blue heron populations.

As noted in Section 3.20, total concentrations of mercury in sediment, water, and biota in lower trophic levels (below fish) are not reliable predictors of methylmercury concentrations in fish (USGS, 1996). To reduce the possibility that prediction of tissue concentrations from sediment or water concentrations would underestimate field conditions, we made reasonably conservative assumptions regarding mercury bioconcentration. The predicted tissue concentrations of mercury were generally slightly higher than the detection limits used in the 1993 ESS study of mercury in the USR and LSR (see Appendix K), confirming that the bioconcentration calculations for mercury are unlikely to have underestimated fish tissue concentrations. However, based on available data regarding mercury distribution in the northeastern U.S., it is likely that fish tissue do contain some low level of methylmercury.

There is a high degree of uncertainty in the use of the reference dose based benchmarks for 1,2-dichlorobenzene, 1,4-dichlorobenzene, chlorobenzene, benzo(a)pyrene, benzo(a)-anthracene, benzo(b)fluoranthene, beryllium, and thallium. These benchmarks reported in Sample *et al.* (1996) were derived from studies of toxicological effects to mammals using rat or mice as the test species. Interclass differences in physiological, biochemical, and behavioral factors including uptake, metabolism, and disposition would most likely result in significant differences in the toxicity of these contaminants between avian and mammalian species. Sample *et al.* (1996) stated that interclass extrapolation would carry a high degree of uncertainty, and was not performed for the purpose of deriving benchmarks for avian and mammalian wildlife receptors.

## 7.00 REFERENCES


Agency for Toxic Substances and Disease Registry (ATSDR). 1993. Toxicological profile for aldrin/dieldrin. Atlanta: U.S. Department of Health and Human Services, Public Health Service.

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for chlorobenzene. Atlanta: U.S. Department of Health and Human Services, Public Health Service.

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for 1,4-dichlorobenzene. Atlanta: U.S. Department of Health and Human Services, Public Health Service.

Barak, N.A-E. and C.F. Mason. 1989. Heavy Metals in Water, Sediment, and Invertebrates from Rivers in Eastern England. Chemosphere, Vol. 19, Nos. 10/11, pp 1709-1714. (abstract only)

Burger, J. and J. Snodgrass. 1998. Heavy Metals in Bullfrog (Rana Catesbeiana) Tadpoles: Effects of Depuration Before Analysis. Environmental Toxicology and Chemistry, Vol. 17, No. 11, pp 2203-2209.

Campfens, I. and D. Mackay. 1997. Fugacity-Based Model of PCB Bioaccumulation in Complex Aquatic Food Webs. Environ. Sci. Technol. Vol. 31, pp. 577-583.

Carlander, K.D., 1977. Handbook of Freshwater Fishery Biology. Iowa State University Press, Ames, Iowa. 431 pp.

DeGraaf, R. and D. Rudis, 1987. New England Wildlife: Habitat, Natural History, and Distribution. General Technical Report NE-108.

EPA, 1986. Superfund Public Health Evaluation Manual. US Environmental Protection Agency, Office of Emergency and Remedial Response.. EPA/540/1-86/060.

EPA, 1993a&b. Wildlife Exposure Factors Handbook (Volumes I and II). US Environmental Protection Agency, Office of Research and Development. EPA/600/R-93/187a and b. NTIS No. PB94-174778, and PB94-177789. December.

EPA, 1997. Mercury Study Report to Congress Volume VI: An Ecological Assessment for Anthropogenic Mercury Emissions in the United States. EPA-452/R-97-008, December 1997.

EPA, 1997. Mercury Study Report to Congress Volume III: Fate and Transport of Mercury in the Environment. EPA-452/R-97-005, December 1997.

EPA. 1998a. Ambient Water Quality Criteria Derivation Methodology Human Health Technical Support Document - Final Draft. EPA/822/B-98/005
July 1998

EPA. 1998b. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities - Volume Two [Peer Review Draft]. Office of Solid Waste and Emergency Response. EPA530-D-98-001B.

Environmental Protection Agency, 40 CFR Parts 9, 122, 123, 131, and 132 RIN 2040-AC08

Environmental Science Services (ESS), October, 1993. Central Landfill Fish Sampling and Tissue Analysis. Prepared for Rhode Island Solid Waste Management Corporation, 65 Shun Pike Johnston, Rhode Island.

EXTOXNET. 1996. Extension Toxicology Network. Pesticide Information Profiles. *A Pesticide Information Project of Cooperative Extension Offices of Cornell University, Oregon State University, the University of Idaho, and the University of California at Davis and the Institute for Environmental Toxicology, Michigan State University. EXTOXNET primary files maintained and archived at Oregon State University.* http://ace.orst.edu/info/extoxnet/pips/methoxyc.htm

Gobas, F.A.P.C. 1993. A Model for Predicting the Bioaccumulation of Hydrophobic Organic Chemicals in Aquatic Food-Webs: Application to Lake Ontario. Ecological Modeling, Vol. 69, pp 1-17.

Gobas, F.A.P.C. and X. Zhang. 1994. A Bioaccumulation and Trophic Transfer Model for Contaminants in Aquatic Food Webs. Version 1.00, Copyright May 1994.

Kawana, K. and T. Tanimoto. 1984. Journal of the Oceanographic Society of Japan, Vol. 40, pp 175-183. (abstract only)

MacCoy, D.E. and R.W. Black. 1998. U.S.G.S. Fact Sheet 105-98 9/1/1998. Organic Compounds and Trace Elements in Freshwater Streambed Sediment and Fish from the Puget Sound Basin. (http://wwwdwatcm.wr.usgs.gov/pugt/fs.105-98.html)

Mackay, D. and J. Campfens. 1997. Fugacity-Based Model of PCB Bioaccumulation in Complex Aquatic Food Webs. Environ. Sci. Technol., Vol. 31, No. 2, pp 577-583.

Massachusetts Department of Environmental Protection (DEP), 1997. Fish Mercury Distribution in Massachusetts Lakes - Final Report. Office of Research and Standards, Wall Experiment Station and Office of Watershed Management. May,1997.

Meyers, P.A., M.J. Leehneer, B.J. Eadie, and S.J. Maule. 1984. Organic Geochemistry of Suspended and Settling Particulate Matter in Lake Michigan. Geochimica et Cosmochimica Acta, Vol. 48, No. 3, pp 443-452.

Ratte, H.T. Bioaccumulation and Txicity of Slver Cmpounds: A Review. Environmental Toxicology and Chemistry, Vol. 18, No. 1, pp 89-108.

Sample, B.E., D.M. Opresco, G.W. Suter II, 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Oak Ridge National Laboratory for U.S. Department of Energy, Office of Environmental Management, ES/ER/TM-86/R3. June 1996.

Scheuhammer, A.M., 1991. Effects of Acidification on the Availability of Toxic Metals and Calcium to Wild Birds and mammals. *Environmental Pollution*, 71: 329-375.

USGS, 1996. Summary Document for the USGS Workshop on Mercury Cycling in the Environment, Golden, Colorado, July 7-9, 1996. U.S. Geological Survey, Water Resources Division, Office of Water Quality, Reston, Virginia. October, 1996.

USGS, 1998. Organic Compunds and Trace Elements in Freshwater Streambed Sediment and Fish from the Puget Sound Basin. U.S. Geological Survey, National Water Quality Assessment Program, Fact Sheet 105-98, September, 1998.

**TABLE I-1**

SEDIMENTATION PONDS 2 AND 3 SEDIMENT
SUMMARY OF ANALYTICAL DATA
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island
(ppm)

| Contaminant | Frequency of Detection | Range Detected | | | Location of Maximum Detected Concentration | Arithmetic Mean Concentration |
|---|---|---|---|---|---|---|
| *Volatile Organic Compounds* | | | | | | |
| 1,1,1-Trichloroethane | 1 / 9 | | 0.002 | | SED95-15 | 0.002 |
| Acetone | 2 / 9 | 0.0728 | - | 0.20 | SED95-37 | 0.043 |
| Chlorobenzene | 5 / 9 | 0.004 | - | 0.044 | SED95-14 | 0.012 |
| Methyl ethyl Ketone | 3 / 9 | 0.01 | - | 0.07 | SED95-37 | 0.017 |
| Toluene | 1 / 9 | | 0.01 | | SED95-37 | 0.006 |
| *Semivolatile Organic Compounds* | | | | | | |
| 1,4-Dichlorobenzene | 1 / 9 | | 0.046 | | SED95-41 | 0.046 |
| 4-Methylphenol | 4 / 9 | 0.057 | - | 0.38 | SED95-40 | 0.226 |
| Acenaphthene | 2 / 9 | 0.055 | - | 0.10 | SED95-40 | 0.078 |
| Anthracene | 5 / 9 | 0.052 | - | 0.30 | SED95-40 | 0.178 |
| Benzo(a)anthracene | 8 / 9 | 0.12 | - | 1 | SED95-40 | 0.308 |
| Benzo(a)pyrene | 8 / 9 | 0.12 | - | 0.98 | SED95-40 | 0.294 |
| Benzo(b)fluoranthene | 8 / 9 | 0.138 | - | 1.5 | SED95-40 | 0.444 |
| Benzo(g,h,i)perylene | 7 / 9 | 0.058 | - | 0.34 | SED95-40 | 0.14 |
| Benzo(k)fluoranthene | 7 / 9 | 0.051 | - | 0.23 | SED95-37 | 0.122 |
| bis(2-Ethylhexyl)phthalate | 8 / 9 | 0.525 | - | 3.1 | SED95-37 | 1.244 |
| Butylbenzylphthalate | 7 / 9 | 0.073 | - | 0.494 | SED95-35 | 0.222 |
| Carbazole | 3 / 9 | 0.055 | - | 0.11 | SED95-40 | 0.076 |
| Chrysene | 8 / 9 | 0.119 | - | 1 | SED95-40 | 0.305 |
| Di-n-butylphthalate | 2 / 9 | 0.1 | - | 0.22 | SED95-35 | 0.174 |
| Di-n-octylphthalate | 6 / 9 | 0.05 | - | 0.37 | SED95-37 | 0.188 |
| Dibenzofuran | 1 / 9 | | 0.089 | | SED95-40 | 0.089 |
| Fluoranthene | 8 / 9 | 0.24 | - | 1.6 | SED95-40 | 0.501 |
| Fluorene | 3 / 9 | 0.063 | - | 0.12 | SED95-40 | 0.087 |
| Indeno(1,2,3-c,d)pyrene | 8 / 9 | 0.051 | - | 0.31 | SED95-40 | 0.111 |
| Phenanthrene | 8 / 9 | 0.130 | - | 0.97 | SED95-40 | 0.333 |
| Phenol | 2 / 9 | 0.088 | - | 0.1 | SED95-40 | 0.094 |
| Pyrene | 8 / 9 | 0.235 | - | 1.9 | SED95-40 | 0.581 |
| *Pesticides/PCBs* | | | | | | |
| Aldrin | 6 / 9 | 0.0027 | - | 0.012 | SED95-37 | 0.004 |
| alpha-Chlordane | 1 / 9 | | 0.0081 | | SED95-40 | 0.002 |
| gamma-Chlordane | 3 / 9 | 0.0020 | - | 0.0062 | SED95-40 | 0.002 |

**TABLE I-1**

SEDIMENTATION PONDS 2 AND 3 SEDIMENT
SUMMARY OF ANALYTICAL DATA
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island
(ppm)

| Contaminant | Frequency of Detection | Range Detected | | | Location of Maximum Detected Concentration | Arithmetic Mean Concentration |
|---|---|---|---|---|---|---|
| *Metals* | | | | | | |
| Aluminum, total | 9 / 9 | 4440 | - | 19800 | SED95-41 | 13829 |
| Arsenic, total | 8 / 9 | 1.1 | - | 10.8 | SED95-14 | 4.4 |
| Barium, total | 9 / 9 | 22 | - | 245 | SED95-15 | 145 |
| Beryllium, total | 9 / 9 | 1.30 | - | 4.2 | SED95-41 | 2.3 |
| Cadmium, total | 3 / 9 | 0.51 | - | 0.9 | SED95-40 | 0.26 |
| Calcium, total | 9 / 9 | 485 | - | 9460 | SED95-40 | 4558 |
| Chromium, total | 8 / 9 | 8 | - | 76.2 | SED95-14 | 32 |
| Cobalt, total | 9 / 9 | 3 | - | 22.6 | SED95-37 | 14 |
| Copper, total | 8 / 9 | 14 | - | 81.8 | SED95-40 | 37 |
| Iron, total | 9 / 9 | 6400 | - | 37100 | SED95-41 | 24228 |
| Lead, total | 9 / 9 | 6 | - | 179 | SED95-40 | 68 |
| Magnesium, total | 9 / 9 | 504 | - | 9310 | SED95-14 | 4407 |
| Manganese, total | 9 / 9 | 112 | - | 1210 | SED95-15 | 673 |
| Mercury, total | 7 / 8 | 0.035 | - | 1 | SED95-41 | 0.17 |
| Nickel, total | 8 / 8 | 2 | - | 25 | SED95-37 | 11 |
| Potassium, total | 9 / 9 | 671 | - | 10100 | SED95-37 | 5368 |
| Sodium, total | 1 / 9 | | 153 | | SED95-40 | 38 |
| Vanadium, total | 9 / 9 | 4 | - | 43 | SED95-37 | 25 |
| Zinc, total | 9 / 9 | 45 | - | 467 | SED95-40 | 224 |
| *Wet Chemestry* | | | | | | |
| Cadmium | 9 / 9 | 18 | - | 76 | SED95-41 | 47.5 |
| Copper | 9 / 9 | 470 | - | 6200 | SED95-40 | 3158 |
| Mercury | 5 / 9 | 0.51 | - | 177 | SED95-35 | 20.3 |
| Nickel | 5 / 9 | 210 | - | 2000 | SED95-14 | 635.8 |
| Zinc | 9 / 9 | 7600 | - | 34000 | SED95-37 | 17756 |
| AVS | 9 / 9 | 1500 | - | 130000 | SED95-37 | 59189 |
| SEM/AVS ratio | 9 / 9 | 0.14 | - | 0.95 | ND | 0.4 |
| Percent Organic Carbon | 9 / 9 | 0.13 | - | 3.2 | SED95-40 | 1.3 |
| Percent Solids | 9 / 9 | 44 | - | 85.0 | ND | 62.9 |
| Total Organic Carbon (TOC) | 9 / 9 | 1270 | - | 31500 | SED95-40 | 14790 |
| pH | 9 / 9 | 6.6 | - | 8 | SED95-37 | 7.3 |

Notes:

1. For the purpose of calculating arithmetic mean concentrations, one-half the method detection limit was used to represent the concentrations of constituents reported as non-detects (ND), and the method detection limit was used to represent the concentrations of constituents reported as "BMQL".

2. Analytical results were based on sediment samples: SED95-14, SED95-15, SED95-22, SED95-23, SED95-34, SED95-35, SED95-37, SED95-40, and SED95-41 collected in December 1995. SED 95-14 and SED 95-15 were collected from Cedar Swamp Brook, and SED95-22 and SED95-23 were collected from Quarry Stream.

**TABLE I-2**

SEDIMENTATION PONDS 2 AND 3 SURFACE WATER
SUMMARY OF ANALYTICAL DATA
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island
(ppm)

| Contaminant | Frequency of Detection | Range Detected | | | Location of Maximum Detected Concentration | Arithmetic Mean Concentration |
|---|---|---|---|---|---|---|
| *Volatile Organic Compounds* | | | | | | |
| 1,1,1-Trichloroethane | 1 / 9 | | 0.00069 | | SW95-41 | 5.20E-04 |
| Benzene | 1 / 9 | | 0.00053 | | SW95-14 | 5.00E-04 |
| Chlorobenzene | 5 / 9 | 0.001 | - | 0.00550 | SW95-14 | 2.58E-03 |
| Chloromethane | 3 / 9 | 0.00063 | - | 0.00125 | SW95-22 | 6.70E-04 |
| Ethylbenzene | 1 / 9 | | 0.00125 | | SW95-34 | 5.80E-04 |
| Toluene | 2 / 9 | 0.00056 | - | 0.00500 | SW95-22 | 1.01E-03 |
| *Semivolatile Organic Compounds* | | | | | | |
| 4-Methylphenol | 1 / 9 | | 0.00525 | | SW95-22 | 2.81E-03 |
| Butylbenzylphthalate | 1 / 9 | | 0.00225 | | SW95-22 | 2.25E-03 |
| Phenol | 1 / 9 | | 0.01475 | | SW95-22 | 3.86E-03 |
| *Pesticides/PCBs* | | | | | | |
| Aldrin | 2 / 9 | 0.00001 | - | 0.00002 | SW95-35 | 1.00E-05 |
| *Total Metals* | | | | | | |
| Aluminum, total | 9 / 9 | 0.1 | - | 1.6 | SW95-37 | 6.30E-01 |
| Arsenic, total | 1 / 9 | | 0.0020 | | SW95-23 | 1.34E-03 |
| Barium, total | 9 / 9 | 0.0244 | - | 0.068 | SW95-37 | 5.50E-02 |
| Beryllium, total | 7 / 9 | 0.0004 | - | 0.004 | SW95-22 | 1.17E-03 |
| Cadmium, total | 4 / 9 | 0.0002 | - | 0.001 | SW95-40 | 2.10E-04 |
| Calcium, total | 9 / 9 | 7.1 | - | 52.9 | SW95-40 | 3.35E+01 |
| Chromium, total | 6 / 9 | 0.0006 | - | 0.0021 | SW95-35 | 1.20E-03 |
| Cobalt, total | 6 / 9 | 0.0006 | - | 0.0019 | SW95-14 | 1.07E-03 |
| Copper, total | 1 / 9 | | 0.0039 | | SW95-23 | 3.27E-03 |
| Cyanide, total | 1 / 9 | | 0.0115 | | SW95-40 | 5.72E-03 |
| Iron, total | 9 / 9 | 1.1 | - | 4.2 | SW95-14 | 2.65E+00 |
| Lead, total | 5 / 9 | 0.0 | - | 0.0 | SW95-23 | 2.47E-03 |
| Magnesium, total | 9 / 9 | 2.1 | - | 10.4 | SW95-14 | 7.87E+00 |
| Manganese, total | 9 / 9 | 0.1 | - | 2.9 | SW95-14 | 1.53E+00 |
| Mercury, total | 7 / 9 | 0.0001 | - | 0.0008 | SW95-23 | 3.00E-04 |
| Nickel, total | 2 / 9 | 0.0016 | - | 0.0059 | SW95-37 | 3.13E-03 |
| Potassium, total | 9 / 9 | 0.9900 | - | 21.7500 | SW95-40 | 1.08E+01 |
| Selenium, total | 1 / 9 | | 0.0039 | | SW95-34 | 2.03E-03 |
| Sodium, total | 9 / 9 | 6.9 | - | 52.2 | SW95-34 | 3.34E+01 |
| Vanadium, total | 6 / 9 | 0.001 | - | 0.006 | SW95-37 | 2.65E-03 |
| Zinc, total | 9 / 9 | 0.018 | - | 0.387 | SW95-37 | 7.22E-02 |

**TABLE I-2**

SEDIMENTATION PONDS 2 AND 3 SURFACE WATER
SUMMARY OF ANALYTICAL DATA
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island
(ppm)

| Contaminant | Frequency of Detection | Range Detected | | | Location of Maximum Detected Concentration | Arithmetic Mean Concentration |
|---|---|---|---|---|---|---|
| *Dissolved Metals* | | | | | | |
| Aluminum (Al) | 1 / 9 | | 0.39 | | SW95-23 | 4.73E-02 |
| Arsenic (As) | 1 / 9 | | 0.0025 | | SW95-23 | 1.27E-03 |
| Barium (Ba) | 9 / 9 | 0.03 | - | 0.11 | SW95-35 | 6.14E-02 |
| Beryllium (Be) | 2 / 9 | 0.00 | - | 0.00 | SW95-22 | 8.00E-04 |
| Cadmium (Cd) | 1 / 9 | | 0.00044 | | SW95-23 | 1.90E-04 |
| Calcium (Ca) | 9 / 9 | 8.75 | - | 67.00 | SW95-22 | 4.09E+01 |
| Chromium (Cr) | 1 / 9 | | 0.0013 | | SW95-23 | 6.90E-04 |
| Cobalt (Co) | 1 / 9 | | 0.0018 | | SW95-23 | 6.30E-04 |
| Copper (Cu) | 1 / 9 | | 0.0049 | | SW95-23 | 1.84E-03 |
| Iron (Fe) | 4 / 9 | 0.98 | - | 1.82 | SW95-14 | 6.66E-01 |
| Lead (Pb) | 1 / 9 | | 0.0017 | | SW95-23 | 6.30E-04 |
| Magnesium (Mg) | 9 / 9 | 2.88 | - | 14.90 | SW95-14 | 9.46E+00 |
| Manganese (Mn) | 9 / 9 | 0.15 | - | 4.20 | SW95-14 | 1.79E+00 |
| Nickel (Ni) | 3 / 9 | 0.0019 | - | 0.02 | SW95-35 | 4.74E-03 |
| Potassium (K) | 8 / 9 | 1.58 | - | 15.00 | SW95-41 | 1.03E+01 |
| Selenium (Se) | 3 / 9 | 0.01 | - | 0.01 | SW95-14 | 3.89E-03 |
| Sodium (Na) | 8 / 9 | 18.20 | - | 69.70 | SW95-14 | 4.08E+01 |
| Vanadium (V) | 5 / 9 | 0.0031 | - | 0.0048 | SW95-14 | 2.66E-03 |
| Zinc (Zn) | 1 / 9 | | 0.07 | | SW95-22 | 1.51E-02 |
| *Wet Chemistry* | | | | | | |
| Ammonia (N) | 9 / 9 | 0.2 | - | 8.8 | SW95-34 | 4.13E+00 |
| Hardness | 9 / 9 | 43 | - | 290 | SW95-40 | 1.59E+02 |
| Nitrate (N) | 9 / 9 | 0.1 | - | 7.6 | SW95-40 | 2.06E+00 |
| Nitrite (N) | 8 / 9 | 0.005 | - | 0.2 | SW95-41 | 5.51E-02 |
| Phosphate, total | 8 / 9 | 0.045 | - | 0.4 | SW95-14 | 1.71E-01 |
| Total Dissolved Solids (TDS) | 9 / 9 | 70 | - | 340 | SW95-34 | 2.49E+02 |
| Total Kjeldahl Nitrogen (TKN) | 7 / 9 | 2.1 | - | 13.7 | SW95-41 | 6.60E+00 |
| Total Suspended Solids (TSS) | 6 / 9 | 6.5 | - | 48 | SW95-34 | 1.33E+01 |

Notes:

1. For the purpose of calculating arithmetic mean concentrations, one-half the method detection limit was used to represent the concentrations of constituents reported as non-detects (ND), and the method detection limit was used to represent the concentrations of constituents reported as "BMQL".

2. Analytical results based on time averaged concentrations for surface water samples: SW95-40, SW95-41, SW95-34, SW95-35, and SW95-37.

# TABLE I-3

SEDIMENTATION POND 4 SEDIMENT
SUMMARY OF ANALYTICAL DATA
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island
(ppm)

| Contaminant | Frequency of Detection | Range Detected | Location of Maximum Detected Concentration | Arithmetic Mean Concentration |
|---|---|---|---|---|
| *Metals* | | | | |
| Aluminum, total | 1 / 1 | 5590 | SED95-24 | 5590 |
| Barium, total | 1 / 1 | 98 | SED95-24 | 98 |
| Beryllium, total | 1 / 1 | 0.1 | SED95-24 | 0.1 |
| Calcium, total | 1 / 1 | 1550 | SED95-24 | 1550 |
| Chromium, total | 1 / 1 | 8.4 | SED95-24 | 8 |
| Cobalt, total | 1 / 1 | 7.1 | SED95-24 | 7 |
| Copper, total | 1 / 1 | 10.9 | SED95-24 | 11 |
| Iron, total | 1 / 1 | 9470 | SED95-24 | 9470 |
| Magnesium, total | 1 / 1 | 3500 | SED95-24 | 3500 |
| Manganese, total | 1 / 1 | 144 | SED95-24 | 144 |
| Nickel, total | 1 / 1 | 3.2 | SED95-24 | 3.2 |
| Potassium, total | 1 / 1 | 3910 | SED95-24 | 3910 |
| Vanadium, total | 1 / 1 | 11.4 | SED95-24 | 11.4 |
| Zinc, total | 1 / 1 | 24 | SED95-24 | 24 |
| *Wet Chemestry* | | | | |
| Cadmium | 1 / 1 | 6 | SED95-24 | 6 |
| Copper | 1 / 1 | 450 | SED95-24 | 450 |
| Nickel | 1 / 1 | 500 | SED95-24 | 500 |
| Zinc | 1 / 1 | 2000 | SED95-24 | 2000 |
| AVS | 1 / 1 | 21000 | SED95-24 | 21000 |
| SEM/AVS ratio | 1 / 1 | 0.14 | SED95-24 | 0.14 |
| Percent Organic Carbon | 1 / 1 | 0.18 | SED95-24 | 0.18 |
| Percent Solids | 1 / 1 | 80 | SED95-24 | 80 |
| Total Organic Carbon (TOC) | 1 / 1 | 1810 | SED95-24 | 1810 |
| pH | 1 / 1 | 6.2 | SED95-24 | 6.2 |

Notes:

1. For the purpose of calculating arithmetic mean concentrations, one-half the method detection limit was used to represent the concentrations of constituents reported as non-detects (ND), and the method detection limit was used to represent the concentrations of constituents reported as "BMQL".
2. Analytical results were based on sediment samples: SED95-24.

**TABLE I-4**

SEDIMENTATION POND 4 SURFACE WATER
SUMMARY OF ANALYTICAL DATA
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island
(ppm)

| Contaminant | Frequency of Detection | Range Detected | Location of Maximum Detected Concentration | Arithmetic Mean Concentration |
|---|---|---|---|---|
| *Semivolatile Organic Compounds* | | | | |
| Butylbenzylphthalate | 1 / 1 | 0.010 | SW95-24 | 0.010 |
| *Total Metals* | | | | |
| Aluminum, total | 1 / 1 | 0.042 | SW95-24 | 0.042 |
| Arsenic, total | 1 / 1 | 0.004 | SW95-24 | 0.004 |
| Barium, total | 1 / 1 | 0.038 | SW95-24 | 0.038 |
| Calcium, total | 1 / 1 | 21 | SW95-24 | 21.100 |
| Chromium, total | 1 / 1 | 0.002 | SW95-24 | 0.002 |
| Cobalt, total | 1 / 1 | 0.001 | SW95-24 | 0.001 |
| Copper, total | 1 / 1 | 0.009 | SW95-24 | 0.009 |
| Iron, total | 1 / 1 | 0.136 | SW95-24 | 0.136 |
| Magnesium, total | 1 / 1 | 6.5 | SW95-24 | 6.525 |
| Manganese, total | 1 / 1 | 0.044 | SW95-24 | 0.044 |
| Mercury, total | 1 / 1 | 0.001 | SW95-24 | 0.00058 |
| Nickel, total | 1 / 1 | 0.003 | SW95-24 | 0.0027 |
| Potassium, total | 1 / 1 | 9.0 | SW95-24 | 9.040 |
| Sodium, total | 1 / 1 | 12 | SW95-24 | 11.945 |
| Vanadium, total | 1 / 1 | 0.002 | SW95-24 | 0.002 |
| Zinc,total | 1 / 1 | 0.034 | SW95-24 | 0.034 |

**TABLE I-4**

SEDIMENTATION POND 4 SURFACE WATER
SUMMARY OF ANALYTICAL DATA
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island
(ppm)

| Contaminant | Frequency of Detection | Range Detected | Location of Maximum Detected Concentration | Arithmetic Mean Concentration |
|---|---|---|---|---|
| *Dissolved Metals* | | | | |
| Arsenic (As) | 1 / 1 | 0.003 | SW95-24 | 0.003 |
| Barium (Ba) | 1 / 1 | 0.031 | SW95-24 | 0.031 |
| Beryllium (Be) | 1 / 1 | 0.000 | SW95-24 | 0.00041 |
| Calcium (Ca) | 1 / 1 | 37.6 | SW95-24 | 37.6 |
| Chromium (Cr) | 1 / 1 | 0.001 | SW95-24 | 0.001 |
| Cobalt (Co) | 1 / 1 | 0.001 | SW95-24 | 0.001 |
| Copper (Cu) | 1 / 1 | 0.012 | SW95-24 | 0.012 |
| Iron (Fe) | 1 / 1 | 0.007 | SW95-24 | 0.007 |
| Magnesium (Mg) | 1 / 1 | 7.4 | SW95-24 | 7.44 |
| Manganese (Mn) | 1 / 1 | 0.005 | SW95-24 | 0.005 |
| Nickel (Ni) | 1 / 1 | 0.002 | SW95-24 | 0.0019 |
| Potassium (K) | 1 / 1 | 8.9 | SW95-24 | 8.86 |
| *Wet Chemistry* | | | | |
| Ammonia (N) | 1 / 1 | 0.2 | SW95-24 | 0.2 |
| Hardness | 1 / 1 | 230 | SW95-24 | 230 |
| Nitrate (N) | 1 / 1 | 1.00 | SW95-24 | 1 |
| Nitrite (N) | 1 / 1 | 0.01 | SW95-24 | 0.01 |
| Phosphate, total | 1 / 1 | 0.18 | SW95-24 | 0.18 |
| Total Dissolved Solids (TDS) | 1 / 1 | 190.0 | SW95-24 | 190 |

Notes:

1. For the purpose of calculating arithmetic mean concentrations, one-half the method detection limit was used to represent the concentrations of constituents reported as non-detects (ND), and the method detection limit was used to represent the concentrations of constituents reported as "BMQL".

3. Analytical results based on surface water samples: SW95-24.

**TABLE I-5**

UPPER SIMMONS RESERVOIR SEDIMENT
SUMMARY OF ANALYTICAL DATA
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island
(ppm)

| Contaminant | Frequency of Detection | Range Detected | | | Location of Maximum Detected Concentration | Arithmetic Mean Concentration |
|---|---|---|---|---|---|---|
| *Volatile Organic Compounds* | | | | | | |
| 1,1-Dichloroethane | 1 / 17 | | 0.004 | | SED93-26-O | 4.00E-03 |
| 2-Hexanone | 1 / 17 | | 0.057 | | SED93-26-O | 1.94E-02 |
| Acetone | 13 / 17 | 0.024 | - | 0.335 | SED93-26-O | 1.03E-01 |
| Benzene | 3 / 17 | 0.006 | - | 0.021 | SED93-29-ORE | 1.18E-02 |
| Carbon Disulfide | 4 / 17 | 0.004 | - | 0.1135 | SED93-26-O | 2.78E-02 |
| Chlorobenzene | 6 / 17 | 0.003 | - | 0.076 | SED95-42 | 2.06E-02 |
| Methyl ethyl Ketone | 9 / 17 | 0.01 | - | 0.1185 | SED93-26-O | 3.32E-02 |
| Methylene Chloride | 9 / 17 | 0.01 | - | 0.045 | SED93-27-O | 1.86E-02 |
| Styrene | 1 / 17 | | 0.005 | | SED93-26-O | 5.00E-03 |
| Tetrachloroethene | 1 / 17 | | 0.012 | | SED93-26-O | 8.81E-03 |
| Toluene | 4 / 17 | 0.002 | - | 0.041 | SED93-22-O | 1.67E-02 |
| Trichloroethene | 1 / 17 | | 0.003 | | SED93-22-O | 3.00E-03 |
| Xylenes | 1 / 17 | | 0.02 | | SED93-26-O | 1.18E-02 |
| *Semivolatile Organic Compounds* | | | | | | |
| 2-Methylnaphthalene | 2 / 12 | 0.039 | - | 0.047 | SED93-21-I | 4.30E-02 |
| Acenaphthene | 2 / 12 | 0.062 | - | 0.0755 | SED98-51 | 6.88E-02 |
| Acenaphthylene | 3 / 12 | 0.012 | - | 0.059 | SED93-21-I | 4.03E-02 |
| Anthracene | 6 / 12 | 0.036 | - | 0.22 | SED98-51 | 1.12E-01 |
| Benzo(a)anthracene | 7 / 12 | 0.125 | - | 0.7 | SED98-51 | 3.63E-01 |
| Benzo(a)pyrene | 7 / 12 | 0.12 | - | 0.545 | SED98-51 | 3.14E-01 |
| Benzo(b)fluoranthene | 7 / 12 | 0.195 | - | 0.985 | SED98-51 | 3.97E-01 |
| Benzo(g,h,i)perylene | 6 / 12 | 0.054 | - | 0.21 | SED95-42 | 1.35E-01 |
| Benzo(k)fluoranthene | 6 / 12 | 0.14 | - | 0.26 | SED93-25-O | 2.18E-01 |
| bis(2-Ethylhexyl)phthalate | 12 / 12 | 0.042 | - | 18 | SED95-43 | 2.11E+00 |
| Butylbenzylphthalate | 3 / 12 | 0.029 | - | 0.345 | SED98-51 | 2.25E-01 |
| Carbazole | 2 / 5 | 0.065 | - | 0.16 | SED98-51 | 1.13E-01 |
| Chrysene | 8 / 12 | 0.023 | - | 0.775 | SED98-51 | 3.70E-01 |
| Di-n-butylphthalate | 8 / 12 | 0.028 | - | 0.2 | SED93-21-O | 1.24E-01 |
| Di-n-octylphthalate | 2 / 5 | 0.495 | - | 23.5 | SED95-43 | 5.00E+00 |
| Dibenz(a,h)anthracene | 3 / 5 | 0.049 | - | 0.357 | SED98-51 | 1.83E-01 |
| Dibenzofuran | 2 / 12 | 0.039 | - | 0.3215 | SED98-51 | 2.42E-01 |
| Diethylphthalate | 2 / 12 | 0.042 | - | 0.0865 | SED93-26-O | 5.50E-02 |
| Fluoranthene | 11 / 12 | 0.012 | - | 1.45 | SED98-51 | 4.43E-01 |
| Fluorene | 4 / 12 | 0.023 | - | 0.105 | SED98-51 | 7.15E-02 |
| Indeno(1,2,3-c,d)pyrene | 5 / 12 | 0.1 | - | 0.2 | SED95-42 | 1.64E-01 |
| Naphthalene | 2 / 12 | 0.036 | - | 0.051 | SED98-51 | 4.35E-02 |
| Phenanthrene | 7 / 12 | 0.12 | - | 0.975 | SED98-51 | 3.70E-01 |
| Pyrene | 11 / 12 | 0.01 | - | 1.65 | SED98-51 | 4.18E-01 |
| *Pesticides/PCBs* | | | | | | |
| 4,4'-DDD | 6 / 9 | 0.0042 | - | 0.013 | SED98-50 | 6.35E-03 |
| 4,4'-DDE | 4 / 9 | 0.0028 | - | 0.012 | SED98-52 | 4.75E-03 |
| 4,4'-DDT | 5 / 9 | 0.0018 | - | 0.047 | SED98-50 | 8.64E-03 |
| alpha-Chlordane | 3 / 9 | 0.0035 | - | 0.0071 | SED93-21-I | 2.99E-03 |
| delta-BHC | 3 / 6 | 0.0055 | - | 0.0093 | SED98-52 | 4.41E-03 |
| Endosulfan-sulfate | 1 / 6 | | 0.0026 | | SED95-43 | 2.28E-03 |
| Endosulfan I | 1 / 6 | | 0.0051 | | SED98-52 | 2.00E-03 |
| gamma-Chlordane | 3 / 9 | 0.0017 | - | 0.0046 | SED93-21-I | 2.18E-03 |
| Methoxychlor | 1 / 6 | | 0.01 | | SED98-51 | 9.25E-03 |
| PCB 1232 | 2 / 6 | 0.041 | - | 0.064 | SED98-52 | 3.83E-02 |
| PCB 1242 | 2 / 9 | 0.06 | | 0.066 | SED93-21-I | 3.67E-02 |
| PCB 1254 | 3 / 9 | 0.042 | - | 0.087 | SED98-52 | 4.54E-02 |

**TABLE I-5**

UPPER SIMMONS RESERVOIR SEDIMENT
SUMMARY OF ANALYTICAL DATA
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island
(ppm)

| Contaminant | Frequency of Detection | Range Detected | | | Location of Maximum Detected Concentration | Arithmetic Mean Concentration |
|---|---|---|---|---|---|---|
| *Metals* | | | | | | |
| Aluminum, total | 18 / 18 | 3470 | - | 21300 | SED98-50 | 1.26E+04 |
| Arsenic, total | 9 / 11 | 0.58 | - | 13.8 | SED98-50 | 3.93E+00 |
| Barium, total | 18 / 18 | 30.7 | - | 145 | SED98-50 | 7.34E+01 |
| Beryllium, total | 11 / 11 | 0.83 | - | 29.8 | SED98-50 | 1.27E+01 |
| Cadmium, total | 11 / 11 | 0.25 | - | 4.7 | SED98-50 | 1.81E+00 |
| Calcium, total | 18 / 18 | 617 | - | 12700 | SED93-27-O | 3.89E+03 |
| Chromium, total | 11 / 11 | 6.4 | - | 19.8 | SED98-50 | 1.20E+01 |
| Cobalt, total | 13 / 18 | 1.9 | - | 12.2 | SED98-50 | 4.32E+00 |
| Copper, total | 9 / 11 | 13.4 | - | 36.1 | SED93-26-O | 2.05E+01 |
| Cyanide, total | 3 / 5 | 1.4 | - | 14.9 | SED98-50 | 5.09E+00 |
| Iron, total | 18 / 18 | 2560 | - | 37500 | SED93-23-I | 1.45E+04 |
| Lead, total | 18 / 18 | 5.2 | - | 87.9 | SED98-50 | 4.31E+01 |
| Magnesium, total | 18 / 18 | 458 | - | 2445 | SED95-43 | 1.44E+03 |
| Manganese, total | 18 / 18 | 23.5 | - | 1130 | SED98-50 | 4.81E+02 |
| Mercury, total | 5 / 18 | 0.105 | - | 0.16 | SED93-25-O | 1.25E-01 |
| Nickel, total | 14 / 18 | 6.435 | - | 55.4 | SED93-23-I | 1.36E+01 |
| Potassium, total | 15 / 18 | 572 | - | 4120 | SED93-23-I | 1.49E+03 |
| Selenium, total | 5 / 11 | 0.45 | - | 2.05 | SED93-26-O | 1.04E+00 |
| Sodium, total | 16 / 18 | 102 | - | 1010 | SED93-29-ORE | 2.95E+02 |
| Vanadium, total | 18 / 18 | 9 | - | 223 | SED93-23-I | 3.90E+01 |
| Zinc, total | 18 / 18 | 13 | - | 351 | SED98-50 | 1.44E+02 |
| *Wet Chemestry* | | | | | | |
| Cadmium | 12 / 12 | 0.00050 | - | 100 | SED95-42 | 1.08E+01 |
| Copper | 12 / 12 | 0.011 | - | 2200 | SED95-42 | 3.33E+02 |
| Mercury | 2 / 12 | 0.3 | - | 0.6 | SED95-42 | 7.51E-02 |
| Nickel | 12 / 12 | 0.025 | - | 1390 | SED95-43 | 1.86E+02 |
| Zinc | 12 / 12 | 0.354 | - | 11600 | SED95-42 | 1.79E+03 |
| AVS | 11 / 12 | 0.46 | - | 58000 | SED95-42 | 8.04E+03 |
| SEM/AVS ratio | 12 / 12 | 0.118 | - | 6.40 | SED93-25-O | 1.19E+00 |
| Percent Organic Carbon | 12 / 12 | 1.16 | - | 16 | SED93-23-O | 1.08E+01 |
| Percent Solids | 13 / 13 | 12.3 | - | 63 | SED95-43 | 3.40E+01 |
| Total Organic Carbon (TOC) | 13 / 13 | 12700 | - | 160000 | SED93-23-O | 1.11E+05 |
| pH | 2 / 2 | 6 | - | 6.7 | SED95-43 | 6.35E+00 |
| Lead | 10 / 10 | 0.009 | - | 0.812 | SED93-22-O | 1.14E-01 |

Notes:

1. For the purpose of calculating arithmetic mean concentrations, one-half the method detection limit was used to represent the concentrations of constituents reported as non-detects (ND), and the method detection limit was used to represent the concentrations of constituents reported as "BMQL".

2. Analytical results were based on samples: SED93-21-I, SED93-23-I, SED93-21-O, SED93-22-O, SED93-23-O, SED93-24-O, SED93-25-O, SED93-2 SED93-28-O, SED93-29-ORE, SED93-30-O, SED93-31-O, SED95-42, SED95-43, SED98-50, SED98-51 and SED98-52.

**TABLE 1-6**

UPPER SIMMONS RESERVOIR SURFACE WATER
SUMMARY OF ANALYTICAL DATA (ppm)
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Contaminant | Frequency of Detection | Range Detected | | | Location of Maximum Detected Concentration | Arithmetic Mean Concentration |
|---|---|---|---|---|---|---|
| *Volatile Organic Compounds* | | | | | | |
| 1,1,2-Trichloroethane | 1 / 13 | | 0.0006 | | SW95-42 | 5.08E-04 |
| 1,2-Dichlorobenzene | 1 / 13 | | 0.002 | | SW95-42 | 6.15E-04 |
| 1,2-Dichloropropane | 1 / 10 | | 0.0008 | | SW95-42 | 5.30E-04 |
| 1,4-Dichlorobenzene | 2 / 13 | 0.002 | - | 0.004 | SW95-42 | 8.85E-04 |
| Acetone | 3 / 13 | 0.002 | - | 0.004 | SW95-06 | 2.92E-03 |
| Benzene | 2 / 13 | 0.001 | - | 0.002 | SW95-42 | 6.54E-04 |
| Carbon Tetrachloride | 1 / 13 | | 0.001 | | SW95-42 | 5.15E-04 |
| Chlorobenzene | 7 / 13 | 0.001 | - | 0.088 | SW95-42 | 1.00E-02 |
| cis-1,2-Dichloroethene | 1 / 13 | | 0.001 | | SW95-42 | 5.23E-04 |
| Tetrachloroethene | 1 / 13 | | 0.001 | | SW95-42 | 5.08E-04 |
| *Semivolatile Organic Compounds* | | | | | | |
| bis(2-Ethylhexyl)phthalate | 1 / 13 | | 0.006 | | SW95-42 | 2.77E-03 |
| Butylbenzylphthalate | 3 / 13 | 0.002 | - | 0.004 | SW95-04 | 2.71E-03 |
| Di-n-butylphthalate | 1 / 13 | | 0.002 | | SW95-04 | 2.00E-03 |
| Diethylphthalate | 1 / 13 | | 0.002 | | SW98-52 | 2.00E-03 |
| *Pesticides/PCBs* | | | | | | |
| delta-BHC | 1 / 13 | | 0.00001 | | SW95-42 | 5.58E-06 |
| *Total Metals* | | | | | | |
| Aluminum, total | 7 / 16 | 0.0888 | - | 1.35 | SW95-43 | 2.56E-01 |
| Arsenic, total | 4 / 16 | 0.0011 | - | 0.0023 | SW95-07 | 1.17E-03 |
| Barium, total | 16 / 16 | 0.0461 | - | 0.189 | SW95-42 | 7.50E-02 |
| Beryllium, total | 8 / 16 | 0.0003 | - | 0.0016 | SW95-43 | 3.83E-04 |
| Cadmium, total | 2 / 8 | 0.0003 | - | 0.0006 | SW95-42 | 2.25E-04 |
| Calcium, total | 16 / 16 | 29 | - | 73 | SW95-42 | 4.31E+01 |
| Chromium, total | 4 / 16 | 0.0027 | - | 0.0072 | SW95-42 | 1.99E-03 |
| Cobalt, total | 3 / 16 | 0.0017 | - | 0.0047 | SW95-42 | 1.06E-03 |
| Copper, total | 3 / 16 | 0.0067 | - | 0.0075 | SW95-08 | 4.02E-03 |
| Cyanide, total | 2 / 19 | 0.01 | - | 0.01 | SW95-04 | 4.78E-03 |
| Iron, total | 16 / 16 | 0.63 | - | 4.2 | SW95-42 | 1.53E+00 |
| Magnesium, total | 16 / 16 | 8.21 | - | 50.6 | SW95-42 | 1.49E+01 |
| Manganese, total | 16 / 16 | 1.36 | - | 14.9 | SW95-42 | 3.25E+00 |
| Nickel, total | 8 / 16 | 0.0075 | - | 0.023 | SW95-08 | 7.98E-03 |
| Potassium, total | 16 / 16 | 11 | - | 59.3 | SW95-42 | 1.68E+01 |
| Selenium, total | 1 / 16 | | 0.006 | | SW95-42 | 2.20E-03 |
| Sodium, total | 16 / 16 | 42 | - | 212 | SW95-42 | 7.29E+01 |
| Thallium, total | 2 / 16 | 0.0026 | - | 0.02 | SW95-42 | 2.82E-03 |
| Vanadium, total | 8 / 16 | 0.005 | - | 0.012 | SW95-42 | 3.32E-03 |
| Zinc,total | 2 / 9 | 0.023 | - | 0.06 | SW95-07 | 1.93E-02 |

**TABLE I-6**

UPPER SIMMONS RESERVOIR SURFACE WATER
SUMMARY OF ANALYTICAL DATA (ppm)
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Contaminant | Frequency of Detection | Range Detected | | | Location of Maximum Detected Concentration | Arithmetic Mean Concentration |
|---|---|---|---|---|---|---|
| *Dissolved Metals* | | | | | | |
| Barium (Ba) | 11 / 11 | 0.03 | - | 0.17 | SW95-42 | 6.28E-02 |
| Calcium (Ca) | 11 / 11 | 33.8 | - | 60.8 | SW95-42 | 4.46E+01 |
| Cobalt (Co) | 1 / 11 | | 0.003 | | SW95-42 | 6.32E-04 |
| Copper (Cu) | 2 / 11 | | 0.008 | | SW95-09 | 3.23E-03 |
| Iron (Fe) | 2 / 11 | 0.53 | - | 0.605 | SW95-43 | 1.13E-01 |
| Magnesium (Mg) | 11 / 11 | 7.8 | - | 37.8 | SW95-42 | 1.41E+01 |
| Manganese (Mn) | 11 / 11 | 1.32 | - | 11.6 | SW95-42 | 2.52E+00 |
| Nickel (Ni) | 2 / 11 | | 0.006 | | SW95-42 | 4.47E-03 |
| Potassium (K) | 10 / 11 | 5.76 | - | 12.4 | SW95-43 | 1.04E+01 |
| Selenium (Se) | 6 / 11 | 0.005 | - | 0.018 | SW95-42 | 6.14E-03 |
| Sodium (Na) | 11 / 11 | 34.7 | - | 141 | SW95-42 | 6.58E+01 |
| Vanadium (V) | 2 / 11 | 0.005 | - | 0.011 | SW95-42 | 3.27E-03 |
| *Wet Chemistry* | | | | | | |
| Ammonia (N) | 13 / 13 | 1.4 | - | 33 | SW95-42 | 10.3 |
| Hardness | 13 / 13 | 105 | - | 389 | SW95-42 | 166 |
| Nitrate (N) | 13 / 13 | 0.39 | - | 3.1 | SW95-42 | 1.4 |
| Nitrite (N) | 12 / 13 | 0.02 | - | 0.23 | SW98-50 | 0.05 |
| Phosphate, total | 11 / 11 | 0.12 | - | 0.62 | SW98-52 | 0.27 |
| Total Dissolved Solids (TDS) | 13 / 13 | 3.8 | - | 810 | SW95-42 | 255 |
| Total Kjeldahl Nitrogen (TKN) | 10 / 10 | 2.4 | - | 40 | SW95-42 | 10.7 |
| Total Suspended Solids (TSS) | 10 / 13 | 10 | - | 130 | SW98-51 | 26.6 |

Notes:

1. For the purpose of calculating arithmetic mean concentrations, one-half the method detection limit was used to represent the concentrations of constituents reported as non-detects (ND), and the method detection limit was used to represent the concentrations of constituents reported as "BMQL".

3. Analytical results based on surface water samples: SW95-04, SW95-05, SW95-06, SW95-07, SW95-08, SW95-09, SW95-42, and SW95-43 collected on December 15,1995, and October 3,1996, and SW98-50, SW98-51 and SW98-52 collected on May 27, 1998.

**TABLE I-7**

**NORTH BASIN SEDIMENT**
**SUMMARY OF ANALYTICAL DATA (ppm)**
**Central Landfill - OU2 Remedial Investigation**
**Johnston, Rhode Island**

| Contaminant | Frequency of Detection | Range Detected | | | Location of Maximum Detected Concentration | Arithmetic Mean Concentration |
|---|---|---|---|---|---|---|
| ***Volatile Organic Compounds*** | | | | | | |
| Acetone | 2 / 5 | 0.02 | - | 0.30 | SED98-51 | 7.17E-02 |
| Carbon Disulfide | 1 / 5 | | 0.004 | | SED95-43 | 4.00E-03 |
| Chlorobenzene | 4 / 5 | 0.00 | - | 0.08 | SED95-42 | 2.28E-02 |
| Methyl ethyl Ketone | 2 / 5 | 0.01 | - | 0.07 | SED98-51 | 2.20E-02 |
| Toluene | 1 / 5 | | 0.002 | | SED95-42 | 2.00E-03 |
| ***Semivolatile Organic Compounds*** | | | | | | |
| 2-Methylnaphthalene | 2 / 6 | 0.04 | - | 0.05 | SED93-21-I | 4.30E-02 |
| Acenaphthene | 2 / 6 | 0.06 | - | 0.08 | SED98-51 | 6.88E-02 |
| Acenaphthylene | 3 / 6 | 0.01 | - | 0.06 | SED93-21-I | 4.03E-02 |
| Anthracene | 6 / 6 | 0.04 | - | 0.22 | SED98-51 | 1.12E-01 |
| Benzo(a)anthracene | 6 / 6 | 0.13 | - | 0.70 | SED98-51 | 3.84E-01 |
| Benzo(a)pyrene | 6 / 6 | 0.12 | - | 0.55 | SED98-51 | 3.23E-01 |
| Benzo(b)fluoranthene | 6 / 6 | 0.20 | - | 0.99 | SED98-51 | 4.42E-01 |
| Benzo(g,h,i)perylene | 6 / 6 | 0.05 | - | 0.21 | SED95-42 | 1.35E-01 |
| Benzo(k)fluoranthene | 5 / 6 | 0.16 | - | 0.26 | SED93-21-I | 2.24E-01 |
| bis(2-Ethylhexyl)phthalate | 6 / 6 | 0.74 | - | 18 | SED95-43 | 4.09E+00 |
| Butylbenzylphthalate | 1 / 6 | | 0.35 | | SED98-51 | 2.73E-01 |
| Carbazole | 2 / 4 | 0.07 | - | 0.16 | SED98-51 | 1.13E-01 |
| Chrysene | 6 / 6 | 0.14 | - | 0.78 | SED98-51 | 4.30E-01 |
| Di-n-butylphthalate | 3 / 6 | 0.03 | - | 0.15 | SED93-21-I | 1.03E-01 |
| Di-n-octylphthalate | 2 / 4 | 0.5 | - | 23.5 | SED95-43 | 6.12E+00 |
| Dibenz(a,h)anthracene | 3 / 4 | 0.05 | - | 0.36 | SED98-51 | 1.83E-01 |
| Dibenzofuran | 2 / 6 | 0.04 | - | 0.32 | SED98-51 | 2.28E-01 |
| Fluoranthene | 6 / 6 | 0.26 | - | 1.45 | SED98-51 | 7.37E-01 |
| Fluorene | 4 / 6 | 0.02 | - | 0.11 | SED98-51 | 7.15E-02 |
| Indeno(1,2,3-c,d)pyrene | 5 / 6 | 0.10 | - | 0.20 | SED93-21-I | 1.64E-01 |
| Naphthalene | 2 / 6 | 0.04 | - | 0.05 | SED98-51 | 4.35E-02 |
| Phenanthrene | 6 / 6 | 0.15 | - | 0.98 | SED98-51 | 4.01E-01 |
| Pyrene | 6 / 6 | 0.23 | - | 1.65 | SED98-51 | 7.03E-01 |
| ***Pesticides/PCBs*** | | | | | | |
| 4,4'-DDD | 4 / 6 | 0.004 | - | 0.012 | SED95-42 | 6.04E-03 |
| 4,4'-DDE | 3 / 6 | 0.005 | - | 0.012 | SED98-52 | 5.33E-03 |
| 4,4'-DDT | 3 / 6 | 0.004 | - | 0.008 | SED98-52 | 4.23E-03 |
| Aldrin | 1 / 6 | | 0.0024 | | SED93-21-I | 1.29E-03 |
| alpha-Chlordane | 3 / 6 | 0.004 | - | 0.007 | SED93-21-I | 3.63E-03 |
| delta-BHC | 2 / 5 | 0.008 | - | 0.009 | SED98-52 | 4.46E-03 |
| Endosulfan-sulfate | 1 / 5 | | 0.0026 | | SED95-43 | 2.28E-03 |
| Endosulfan I | 1 / 5 | | 0.005 | | SED98-52 | 2.21E-03 |
| gamma-Chlordane | 3 / 6 | 0.0017 | - | 0.0046 | SED93-21-I | 2.42E-03 |
| Methoxychlor | 1 / 5 | | 0.010 | | SED98-51 | 7.08E-03 |
| PCB 1232 | 2 / 5 | 0.041 | - | 0.064 | SED98-52 | 3.22E-02 |
| PCB 1242 | 2 / 6 | 0.060 | - | 0.066 | SED93-21-I | 3.00E-02 |
| PCB 1254 | 3 / 6 | 0.042 | - | 0.087 | SED98-52 | 4.31E-02 |
| ***Metals*** | | | | | | |
| Aluminum, total | 6 / 6 | 3470 | - | 21200 | SED93-23-I | 1.25E+04 |
| Arsenic, total | 5 / 5 | 1.80 | - | 8.2 | SED98-52 | 5.08E+00 |
| Barium, total | 6 / 6 | 51.10 | - | 124.0 | SED93-23-I | 8.64E+01 |
| Beryllium, total | 5 / 5 | 0.83 | - | 7.1 | SED98-52 | 3.68E+00 |
| Cadmium, total | 5 / 5 | 0.25 | - | 1.9 | SED98-52 | 1.16E+00 |
| Calcium, total | 6 / 6 | 1270 | - | 2675 | SED95-43 | 2.04E+03 |
| Chromium, total | 5 / 5 | 8.5 | - | 15.6 | SED98-52 | 1.19E+01 |
| Cobalt, total | 6 / 6 | 3.40 | - | 11 | SED95-43 | 6.57E+00 |
| Copper, total | 3 / 5 | 20.30 | - | 26.9 | SED98-52 | 1.95E+01 |
| Cyanide, total | 2 / 4 | 1.40 | - | 7.7 | SED98-52 | 2.64E+00 |
| Iron, total | 6 / 6 | 9710 | - | 37500 | SED93-23-I | 2.21E+04 |
| Lead, total | 6 / 6 | 42 | - | 78 | SED95-42 | 5.99E+01 |
| Magnesium, total | 6 / 6 | 1150 | - | 2445 | SED95-43 | 1.83E+03 |
| Manganese, total | 6 / 6 | 383 | - | 736 | SED98-52 | 5.31E+02 |
| Mercury, total | 4 / 6 | 0.11 | - | 0.15 | SED95-42 | 1.18E-01 |
| Nickel, total | 6 / 6 | 6.80 | - | 55.4 | SED93-23-I | 2.40E+01 |
| Potassium, total | 5 / 6 | 1280 | - | 4120 | SED93-23-I | 2.47E+03 |
| Selenium, total | 1 / 5 | | 0.45 | | SED93-21-I | 4.50E-01 |
| Sodium, total | 4 / 6 | 117 | - | 259 | SED98-52 | 1.31E+02 |
| Vanadium, total | 6 / 6 | 13 | - | 223 | SED93-23-I | 7.29E+01 |
| Zinc, total | 6 / 6 | 109 | - | 324 | SED93-23-I | 1.96E+02 |
| Percent Solids | | | | | | |
| ***Wet Chemistry*** | | | | | | |
| Cadmium | 2 / 2 | 29 | - | 100 | SED95-42 | 6.45E+01 |
| Copper | 2 / 2 | 1800 | - | 2200 | SED95-42 | 2.00E+03 |
| Mercury | 2 / 2 | 0.3 | - | 1 | SED95-42 | 4.50E-01 |
| Nickel | 2 / 2 | 840 | - | 1390 | SED95-43 | 1.12E+03 |
| Zinc | 2 / 2 | 9900 | - | 11600 | SED95-42 | 1.08E+04 |
| AVS | 2 / 2 | 44600 | - | 58000 | SED95-42 | 5.13E+04 |
| SEM/AVS ratio | 2 / 2 | 0.25 | - | 0.29 | SED95-43 | 2.70E-01 |
| Percent Organic Carbon | 2 / 2 | 1 | - | 3 | SED95-42 | 2.10E+00 |
| Percent Solids | 2 / 2 | 61 | - | 63 | SED95-43 | 6.20E+01 |
| Total Organic Carbon (TOC) | 2 / 2 | 12700 | - | 28600 | SED95-42 | 2.07E+04 |
| pH | 2 / 2 | 6 | - | 7 | SED95-43 | 6.35E+00 |

Notes:

1. For the purpose of calculating arithmetic mean concentrations, one-half the method detection limit was used to represent the concentrations of constituents reported as non-detects (ND), and the method detection limit was used to represent the concentrations of constituents reported as "BMQL."

2. Analytical results were based on samples: SED93-21-I, SED93-23-I, SED95-08, SED95-42, SED95-43, and SED98-51, and SED98-52

3. Multiple samples collected from the same location were averaged together to obtain an averaged concentration for that location. These concentrations were used in the calculation of the averages presented above

4. Concentrations presented for organic contaminants (VOCs, SVOCs and Pesticides) have been normalized to the total organic carbon (TOC) content of the sediment sample using the following formula: Contaminant (mg/kg)/ TOC (mg/kg) x $10^6$ (mg/kg) = Contaminant mg/kg/TOC

**TABLE I- 8**

NORTH BASIN SURFACE WATER
SUMMARY OF ANALYTICAL DATA (ppm)
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Contaminant | Frequency of Detection | Range Detected | | | Location of Maximum Detected Concentration | Arithmetic Mean Concentration |
|---|---|---|---|---|---|---|
| *Volatile Organic Compounds* | | | | | | |
| 1,1,2-Trichloroethane | 1 / 6 | | 0.0006 | | SW95-42 | 5.17E-04 |
| 1,2-Dichlorobenzene | 1 / 6 | | 0.002 | | SW95-42 | 7.50E-04 |
| 1,2-Dichloropropane | 1 / 4 | | 0.0008 | | SW95-42 | 5.75E-04 |
| 1,4-Dichlorobenzene | 2 / 6 | 0.002 | - | 0.004 | SW95-42 | 1.33E-03 |
| Acetone | 2 / 6 | 0.003 | - | 0.004 | SW98-51 | 2.92E-03 |
| Benzene | 2 / 6 | 0.001 | - | 0.002 | SW95-42 | 8.33E-04 |
| Carbon Tetrachloride | 1 / 6 | | 0.0007 | | SW95-42 | 5.33E-04 |
| Chlorobenzene | 5 / 6 | 0.002 | - | 0.088 | SW95-42 | 2.08E-02 |
| cis-1,2-Dichloroethene | 1 / 6 | | 0.0008 | | SW95-42 | 5.50E-04 |
| Tetrachloroethene | 1 / 6 | | 0.0006 | | SW95-42 | 5.17E-04 |
| *Semivolatile Organic Compounds* | | | | | | |
| bis(2-Ethylhexyl)phthalate | 1 / 6 | | 0.006 | | SW95-42 | 3.08E-03 |
| Butylbenzylphthalate | 1 / 6 | | 0.002 | | SW95-08 | 2.00E-03 |
| Diethylphthalate | 1 / 6 | | 0.002 | | SW98-52 | 2.00E-03 |
| Pesticides/PCBs | | | | | | |
| delta-BHC | 1 / 6 | | 0.000012 | | SW95-42 | 6.17E-06 |
| *Total Metals* | | | | | | |
| Aluminum, total | 4 / 6 | 0.0888 | - | 1.35 | SW95-43 | 3.47E-01 |
| Arsenic, total | 1 / 6 | | 0.0012 | | SW95-42 | 1.03E-03 |
| Barium, total | 6 / 6 | 0.0464 | - | 0.189 | SW95-42 | 1.02E-01 |
| Beryllium, total | 3 / 6 | 0.0005 | - | 0.0016 | SW95-43 | 5.08E-04 |
| Cadmium, total | 2 / 3 | 0.00032 | - | 0.00055 | SW95-42 | 3.57E-04 |
| Calcium, total | 6 / 6 | 28.7 | - | 72.5 | SW95-42 | 4.69E+01 |
| Chromium, total | 2 / 6 | 0.0036 | - | 0.0072 | SW95-42 | 2.51E-03 |
| Cobalt, total | 2 / 6 | 0.0017 | - | 0.0047 | SW95-42 | 1.63E-03 |
| Copper, total | 1 / 6 | | 0.0075 | | SW95-08 | 3.78E-03 |
| Iron, total | 6 / 6 | 0.75 | - | 4.17 | SW95-42 | 2.30E+00 |
| Magnesium, total | 6 / 6 | 8.21 | - | 50.6 | SW95-42 | 2.16E+01 |
| Manganese, total | 6 / 6 | 1.53 | - | 14.9 | SW95-42 | 5.59E+00 |
| Nickel, total | 4 / 6 | 0.0104 | - | 0.0227 | SW95-08 | 1.25E-02 |
| Potassium, total | 6 / 6 | 12.3 | - | 59.3 | SW95-42 | 2.33E+01 |
| Selenium, total | 1 / 6 | | 0.006 | | SW95-42 | 2.39E-03 |
| Sodium, total | 6 / 6 | 43.3 | - | 212 | SW95-42 | 9.67E+01 |
| Thallium, total | 1 / 6 | | 0.02 | | SW95-42 | 4.67E-03 |
| Vanadium, total | 3 / 6 | 0.0058 | - | 0.0115 | SW95-42 | 4.23E-03 |
| Zinc,total | 1 / 4 | | 0.023 | | SW95-43 | 1.54E-02 |

**TABLE I- 8**

NORTH BASIN SURFACE WATER
SUMMARY OF ANALYTICAL DATA (ppm)
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Contaminant | Frequency of Detection | Range Detected | | | Location of Maximum Detected Concentration | Arithmetic Mean Concentration |
|---|---|---|---|---|---|---|
| *Dissolved Metals* | | | | | | |
| Barium (Ba) | 5 / 5 | 0.041 | - | 0.167 | SW95-42 | 7.37E-02 |
| Calcium (Ca) | 5 / 5 | 33.800 | - | 60.8 | SW95-42 | 4.29E+01 |
| Cobalt (Co) | 1 / 5 | | 0.003 | | SW95-42 | 8.98E-04 |
| Iron (Fe) | 2 / 5 | 0.530 | - | 0.605 | SW95-43 | 2.39E-01 |
| Magnesium (Mg) | 5 / 5 | 9.750 | - | 37.8 | SW95-42 | 1.61E+01 |
| Manganese (Mn) | 5 / 5 | 1.460 | - | 11.6 | SW95-42 | 3.85E+00 |
| Nickel (Ni) | 2 / 5 | 0.006 | - | 0.0154 | SW95-42 | 6.12E-03 |
| Potassium (K) | 4 / 5 | 7.620 | - | 12.4 | SW95-43 | 9.99E+00 |
| Selenium (Se) | 2 / 5 | 0.008 | - | 0.0179 | SW95-42 | 6.58E-03 |
| Sodium (Na) | 5 / 5 | 46.700 | - | 141 | SW95-42 | 7.15E+01 |
| Vanadium (V) | 2 / 5 | 0.005 | - | 0.011 | SW95-42 | 4.17E-03 |
| Zinc (Zn) | 2 / 5 | 0.007 | - | 0.0088 | SW98-52 | 6.34E-03 |
| *Wet Chemistry* | | | | | | |
| Ammonia (N) | 6 / 6 | 1 | - | 33 | SW95-42 | 1.46E+01 |
| Hardness | 6 / 6 | 105 | - | 389 | SW95-42 | 2.01E+02 |
| Nitrate (N) | 6 / 6 | 1 | - | 3.1 | SW95-42 | 1.73E+00 |
| Nitrite (N) | 6 / 6 | 0.02 | - | 0.05 | SW95-42 | 3.67E-02 |
| Phosphate, total | 5 / 5 | 0.15 | - | 0.62 | SW98-52 | 3.44E-01 |
| Total Dissolved Solids (TDS) | 6 / 6 | 7.5 | - | 810 | SW95-42 | 2.12E+02 |
| Total Kjeldahl Nitrogen (TKN) | 4 / 4 | 4 | - | 40 | SW95-42 | 2.13E+01 |
| Total Suspended Solids (TSS) | 5 / 6 | 10 | - | 130 | SW98-51 | 3.45E+01 |

Notes:

1. For the purpose of calculating arithmetic mean concentrations, one-half the method detection limit was used to represent the concentrations of constituents reported as non-detects (ND), and the method detection limit was used to represent the concentrations of constituents reported as "BMQL".

3. Analytical results based on surface water samples: SW95-04, SW95-05, SW95-06, SW95-07, SW95-08, SW95-09, SW95-42, and SW95-43 SW98-50, SW98-51 and SW98-52.

**TABLE 1-9**

LOWER SIMMONS RESERVOIR SEDIMENT
SUMMARY OF ANALYTICAL DATA (ppm)
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Contaminant | Frequency of Detection | Range Detected | | | Location of Maximum Detected Concentration | Arithmetic Mean Concentration |
|---|---|---|---|---|---|---|
| *Volatile Organic Compounds* | | | | | | |
| Acetone | 4 / 5 | 0.076 | - | 0.22 | SED98-53 | 1.26E-01 |
| Chloromethane | 2 / 5 | 0.003 | - | 0.004 | SED98-53 | 3.50E-03 |
| Methyl ethyl Ketone | 4 / 5 | 0.022 | - | 0.057 | SED95-01 | 3.31E-02 |
| *Semivolatile Organic Compounds* | | | | | | |
| 4-Chloro-3-methylphenol | 1 / 5 | | 0.057 | | SED95-03 | 5.70E-02 |
| Benzo(a)anthracene | 1 / 5 | | 0.095 | | SED98-54 | 9.50E-02 |
| Benzo(a)pyrene | 1 / 5 | | 0.12 | | SED98-54 | 1.20E-01 |
| Benzo(b)fluoranthene | 2 / 5 | 0.13 | - | 0.22 | SED98-54 | 1.75E-01 |
| Benzo(k)fluoranthene | 1 / 5 | 0.096 | - | 0.096 | SED98-54 | 9.60E-02 |
| bis(2-Ethylhexyl)phthalate | 2 / 5 | 0.38 | - | 0.4 | SED98-54 | 3.64E-01 |
| Butylbenzylphthalate | 1 / 5 | | 1.9 | | SED95-02 | 6.62E-01 |
| Chrysene | 1 / 5 | | 0.14 | | SED98-54 | 1.40E-01 |
| Fluoranthene | 3 / 5 | 0.08 | - | 0.19 | SED98-54 | 1.33E-01 |
| Phenanthrene | 1 / 5 | | 0.081 | | SED98-54 | 8.10E-02 |
| Pyrene | 5 / 5 | 0.065 | - | 0.2 | SED98-54 | 1.11E-01 |
| *Pesticides/PCBs* | | | | | | |
| 4,4'-DDD | 1 / 5 | | 0.008 | | SED98-53 | 3.96E-03 |
| 4,4'-DDE | 2 / 5 | 0.006 | - | 0.013 | SED98-53 | 5.55E-03 |
| 4,4'-DDT | 0 / 5 | 0.000 | - | ND | ND | NCC |
| Aldrin | 0 / 5 | 0.000 | - | ND | ND | NCC |
| alpha-BHC | 0 / 5 | 0.000 | - | ND | ND | NCC |
| alpha-Chlordane | 2 / 5 | 0.0037 | - | 0.0043 | SED98-53 | 2.51E-03 |
| delta-BHC | 2 / 5 | 0.005 | - | 0.008 | SED98-53 | 3.51E-03 |
| Endosulfan I | 1 / 5 | | 0.005 | | SED98-53 | 2.16E-03 |
| *Metals* | | | | | | |
| Aluminum, total | 5 / 5 | 2540 | - | 22400 | SED95-01 | 1.18E+04 |
| Antimony, total | 1 / 3 | | 1.3 | | SED95-02 | 7.10E-01 |
| Arsenic, total | 5 / 5 | 1.9 | - | 16 | SED95-01 | 9.72E+00 |
| Barium, total | 5 / 5 | 15 | - | 287 | SED95-01 | 1.73E+02 |
| Beryllium, total | 5 / 5 | 1.8 | - | 18 | SED98-53 | 9.54E+00 |
| Cadmium, total | 4 / 4 | 3.8 | - | 5.9 | SED98-53 | 4.43E+00 |
| Calcium, total | 5 / 5 | 621 | - | 6200 | SED98-53 | 4.49E+03 |
| Chromium, total | 4 / 5 | 12.4 | - | 32.9 | SED95-02 | 1.90E+01 |
| Cobalt, total | 5 / 5 | 2.5 | - | 22.6 | SED95-01 | 1.37E+01 |
| Copper, total | 4 / 5 | 19.6 | - | 37.2 | SED95-01 | 2.21E+01 |
| Cyanide, total | 2 / 4 | 8.1 | - | 12.1 | SED98-53 | 6.31E+00 |
| Iron, total | 5 / 5 | 5230 | - | 34800 | SED95-01 | 2.47E+04 |
| Lead, total | 5 / 5 | 32 | - | 93 | SED95-01 | 6.17E+01 |
| Magnesium, total | 5 / 5 | 375 | - | 2970 | SED95-01 | 1.52E+03 |
| Manganese, total | 5 / 5 | 248 | - | 13900 | SED95-02 | 8.42E+03 |
| Mercury, total | 3 / 5 | 0.13 | - | 0.37 | SED95-01 | 2.37E-01 |
| Nickel, total | 4 / 5 | 12.9 | - | 35.4 | SED98-53 | 1.64E+01 |
| Potassium, total | 3 / 5 | 356 | - | 5060 | SED95-01 | 2.15E+03 |
| Selenium, total | 1 / 5 | | 5 | | SED98-54 | 2.86E+00 |
| Sodium, total | 3 / 5 | 124 | - | 260 | SED98-53 | 1.35E+02 |
| Thallium, total | 3 / 5 | 5.9 | - | 26.4 | SED95-02 | 1.01E+01 |
| Vanadium, total | 4 / 5 | 24.3 | - | 80.3 | SED98-53 | 4.08E+01 |
| Zinc, total | 5 / 5 | 46 | - | 438 | SED98-53 | 2.68E+02 |
| *Wet Chemistry* | | | | | | |
| Cadmium | 3 / 3 | 25 | - | 180 | SED95-01 | 1.25E+02 |
| Copper | 3 / 3 | 350 | - | 1900 | SED95-01 | 1.05E+03 |
| Nickel | 2 / 3 | 1000 | - | 1000 | SED95-01 | 6.68E+02 |
| Zinc | 3 / 3 | 3200 | - | 26000 | SED95-01 | 1.47E+04 |
| AVS | 1 / 3 | | 5000 | | SED95-03 | 1.89E+03 |
| SEM/AVS ratio | 1 / 3 | | 0.72 | | SED95-03 | 2.40E-01 |
| Percent Organic Carbon | 3 / 3 | 1.9 | - | 5.9 | SED95-01 | 4.43E+00 |
| Percent Solids | 3 / 3 | 18 | - | 63 | SED95-03 | 3.73E+01 |
| Total Organic Carbon (TOC) | 3 / 3 | 18500 | - | 59100 | SED95-01 | 4.43E+04 |
| pH | 3 / 3 | 6.1 | - | 6.7 | SED95-03 | 6.40E+00 |

Notes:

1. For the purpose of calculating arithmetic mean concentrations, one-half the method detection limit was used to represent the concentrations of constituents reported as non-detects (ND), and the method detection limit was used to represent the concentrations of constituents reported as "BMQL".
2. Analytical results were based on samples: SED95-01, SED95-02, and SED95-03, SED98-53, and SED98-54.
3. Concentrations presented for organic contaminants (VOCs, SVOCs and Pesticides) have been normalized to the total organic carbon (TOC) content of the sediment sample using the following formula; Contaminant (mg/kg)/ TOC (mg/kg) x $10^{-6}$ (mg/kg) =

**TABLE I-10**

LOWER SIMMONS RESERVOR SURFACE WATER
SUMMARY OF ANALYTICAL DATA (ppm)
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Contaminant | Frequency of Detection | Range Detected | | | Location of Maximum Detected Concentration | Arithmetic Mean Concentration |
|---|---|---|---|---|---|---|
| *Pesticides/PCBs* | | | | | | |
| 4,4'-DDT | 1 / 6 | | 0.0001 | | SW98-54 | 3.17E-05 |
| Aldrin | 1 / 6 | | 0.000025 | | SW95-03 | 1.17E-05 |
| Endosulfan I | 1 / 6 | | 0.000011 | | SW98-54 | 9.20E-06 |
| *Total Metals* | | | | | | |
| Aluminum, total | 3 / 6 | 0.235 | - | 1.44 | SW95-02 | 3.60E-01 |
| Arsenic, total | 4 / 6 | 0.0013 | - | 0.0045 | SW95-02 | 2.11E-03 |
| Barium, total | 6 / 6 | 0.0419 | - | 0.112 | SW95-02 | 6.55E-02 |
| Beryllium, total | 3 / 6 | 0.00034 | - | 0.00091 | SW95-01 | 4.05E-04 |
| Calcium, total | 6 / 6 | 30.7 | - | 44.8 | SW95-03 | 3.88E+01 |
| Chromium, total | 3 / 6 | 0.0022 | - | 0.0028 | SW95-03 | 1.80E-03 |
| Cobalt, total | 2 / 6 | 0.0016 | - | 0.0022 | SW95-02 | 1.08E-03 |
| Copper, total | 2 / 6 | 0.0065 | - | 0 | SW95-03 | 5.37E-03 |
| Iron, total | 6 / 6 | 0.785 | - | 3 | SW95-02 | 1.41E+00 |
| Magnesium, total | 6 / 6 | 7.63 | - | 12.7 | SW95-03 | 1.04E+01 |
| Manganese, total | 6 / 6 | 1.11 | - | 2.55 | SW95-02 | 1.84E+00 |
| Nickel, total | 1 / 6 | 0.0075 | - | 0.0075 | SW95-02 | 3.98E-03 |
| Potassium, total | 6 / 6 | 9.83 | - | 13.4 | SW95-03 | 1.15E+01 |
| Silver, total | 1 / 6 | | 0.006 | | SW95-03 | 1.63E-03 |
| Sodium, total | 6 / 6 | 38 | - | 69 | SW95-03 | 5.17E+01 |
| Vanadium, total | 3 / 6 | 0.0053 | - | 0.0067 | SW95-02 | 3.46E-03 |
| Zinc,total | 2 / 5 | 0.017 | - | 0.02 | SW95-02 | 1.38E-02 |
| *Dissolved Metals* | | | | | | |
| Arsenic (As) | 1 / 5 | | 0.0036 | | SW95-02 | 1.96E-03 |
| Barium (Ba) | 3 / 5 | 0.0527 | - | 0.058 | SW95-03 | 3.69E-02 |
| Beryllium (Be) | 1 / 5 | | 0.0006 | | SW95-02 | 3.08E-04 |
| Calcium (Ca) | 5 / 5 | 32 | - | 51 | SW95-03 | 3.94E+01 |
| Chromium (Cr) | 1 / 5 | | 0.0022 | | SW95-02 | 8.30E-04 |
| Cobalt (Co) | 1 / 5 | | 0.002 | | SW95-02 | 7.26E-04 |
| Copper (Cu) | 1 / 5 | | 0.0053 | | SW95-02 | 2.80E-03 |
| Iron (Fe) | 2 / 5 | | 0.0374 | | SW98-53 | 3.75E-02 |
| Magnesium (Mg) | 5 / 5 | 7.35 | - | 13.9 | SW95-03 | 1.04E+01 |
| Manganese (Mn) | 5 / 5 | 1.03 | - | 1.71 | SW95-02 | 1.32E+00 |
| Nickel (Ni) | 2 / 5 | 0.006 | - | 0.007 | SW95-01 | 3.89E-03 |
| Potassium (K) | 5 / 5 | 4.62 | - | 13 | SW95-03 | 9.46E+00 |
| Selenium (Se) | 2 / 5 | 0.0067 | - | 0.0077 | SW95-02 | 4.38E-03 |
| Sodium (Na) | 5 / 5 | 33.8 | - | 69.3 | SW95-03 | 5.07E+01 |
| Vanadium (V) | 1 / 5 | | 0.0063 | | SW95-01 | 2.87E-03 |
| Zinc (Zn) | 1 / 4 | | 0.0055 | | SW98-54 | 3.78E-03 |
| *Wet Chemistry* | | | | | | |
| Ammonia (N) | 5 / 6 | 2.5 | - | 5.7 | SW98-53 | 3.36E+00 |
| Hardness | 6 / 6 | 110 | - | 210 | SW95-01 | 1.42E+02 |
| Nitrate (N) | 6 / 6 | 0.66 | - | 1.53 | SW95-02 | 1.10E+00 |
| Nitrite (N) | 6 / 6 | 0.02 | - | 0.1 | SW98-54 | 5.00E-02 |
| Phosphate, total | 5 / 5 | 0.16 | - | 0.3 | SW98-53 | 2.16E-01 |
| Total Dissolved Solids (TDS) | 4 / 4 | 190 | - | 300 | SW95-02 | 2.53E+02 |
| Total Kjeldahl Nitrogen (TKN) | 6 / 6 | 1.3 | - | 6.5 | SW95-03 | 3.63E+00 |
| Total Suspended Solids (TSS) | 3 / 6 | 13 | - | 44 | SW95-02 | 1.70E+01 |

Notes:

1. For the purpose of calculating arithmetic mean concentrations, one-half the method detection limit was used to represent the concentrations of constituents reported as non-detects (ND), and the method detection limit was used to represent the concentrations of constituents reported as "BMQL".

2. If a location was sampled more than once, the summary statistics are based on the average concentration over time at that location.

3. Analytical results based on surface water samples: SW95-01, SW95-02, SW95-03, SW98-53, and SW98-54.

**TABLE I-11**

PHYSICAL AND CHEMICAL INPUT PARAMETERS FOR
GOBAS BIOACCUMULATION MODEL
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Constituent | Molecular Weight | | log Kow | | Henry's Law Constant (Pa/m3/mol) | |
|---|---|---|---|---|---|---|
| *Volatile Organic Compounds* | | | | | | |
| 1,2-Dichlorobenzene | 147 | 1 | 3.6 | 1 | 196 | 1 |
| 1,4-Dichlorobenzene | 147 | | 3.6 | | 293 | |
| 1,1-Dichloroethane | 99 | 1 | 1.79 | 1 | 437 | 1 |
| 2-Hexanone | NA | | NA | | NA | |
| Acetone | 58 | 1 | -0.24 | 1 | 2.09 | 1 |
| Benzene | 78 | 1 | 2.12 | 1 | 566.33 | 1 |
| Carbon disulfide | 76 | 1 | 2.00 | 1 | 1246.08 | 1 |
| Chlorobenzene | 113 | 1 | 2.84 | 1 | 376.88 | 1 |
| Chloromethane | 50.5 | 1 | 0.95 | 1 | 4458 | 1 |
| Methyl ethyl ketone | 72 | 1 | 0.26 | 1 | 2.78 | 1 |
| Methylene chloride (dichloromethane) | 85 | 1 | 1.30 | 1 | 205.67 | 1 |
| Styrene | 104.14 | 5 | 2.92 | 5 | 337.38 | 5 |
| Tetrachloroethene | 166 | 1 | 2.60 | 1 | 2624.08 | 1 |
| Toluene | 92 | 1 | 2.73 | 1 | 645.39 | 1 |
| Trichloroethene | 131 | 1 | 2.38 | 1 | 921.99 | 1 |
| Xylenes | 106 | 1 | 3.26 | 1 | 713.29 | 1 |
| *Semivolatile Organic Compounds* | | | | | | |
| 2-Methylnaphthalene | NA | | NA | | NA | |
| 4-chloro-3-methylphenol | 142.6 | 9 | 3.10 | 9 | 0.08 | 8 |
| 4-methylphenol | 108.13 | 5 | 1.94 | 5 | 0.08 | 5 |
| Acenaphthene | 154 | 1 | 4.00 | 1 | 9.32 | 1 |
| Acenaphthylene | 152 | 1 | 3.70 | 1 | 149.96 | 1 |
| Anthracene | 178 | 1 | 4.45 | 1 | 103.35 | 1 |
| Benzo(a)anthracene | 228 | 1 | 5.60 | 1 | 0.12 | 1 |
| Benzo(a)pyrene | 252 | 1 | 6.06 | 1 | 0.16 | 1 |
| Benzo(b)fluoranthene | 252 | 1 | 6.06 | 1 | 1.21 | 1 |
| Benzo(g,h,i)perylene | 276 | 1 | 6.51 | 1 | 0.01 | 1 |
| Benzo(k)fluoranthene | 252 | 1 | 6.06 | 1 | 3.99 | 1 |
| bis(2-Ethylhexyl)phthalate | 391 | 1 | NA | | NA | |
| Butylbenzylphthalate | 312.39 | 5 | 4.41 | 5 | 0.19 | 1 |
| Carbazole | 167.21 | 9 | 3.59 | 6 | 0.06 | 6 |
| Phenol | 94 | 1 | 1.46 | 1 | 0.05 | 1 |
| Pyrene | 202 | 1 | 4.88 | 1 | 0.51 | 1 |
| *Pesticides* | | | | | | |
| Aldrin | 365 | 1 | 5.30 | 1 | 1.62E+00 | 1 |
| total Chlordane (alpha + gamma) | 410 | 1 | 6.00 | 3 | 9.76E-01 | 1 |
| DDT | 355 | 1 | 6.19 | 1 | 5.20E+01 | 1 |
| DDE | 318 | 1 | 7.00 | 1 | 6.89E+00 | 1 |
| DDD | 320 | 1 | 6.20 | 1 | 8.06E-01 | 1 |
| delta-BHC | 291 | 1 | 4.10 | 1 | 2.10E-02 | 1 |
| total Endosulfans (sulfate + I) | 406.9 | 4 | 3.13 | 4 | 2.90E-02 | 4 |
| methoxychlor | 345.65 | 4 | 4.53 | 5 | 6.41E-01 | 5 |
| *Polychlorinated Biphenyls* | | | | | | |
| Aroclor 1232 | 221 | 7 | 5.1 | 2 | 5.27E+01 | 8 |
| Aroclor 1242 | 266.5 | 2 | 5.6 | 2 | 5.27E+01 | 2 |
| Aroclor 1254 | 328.4 | 2 | 6.5 | 2 | 8.31E+03 | 6 |

Notes

1. EPA, 1986. Superfund Public Health Evaluation Manual. EPA/540/1-86/060. Exhibit A-1
2. ATSDR (1989), Toxicological Profile for Selected PCBs (Aroclor-1260, -1254, -1248, -1242, -1232, -1221, and -1016).
3. EPA, July, 1998. Ambient Water Quality Criteria Derivation Methodology Human Health - Technical Support Document - Final Draft. EPA/822/B-98/005. Table 2.4.
4. W.E. Johson et al., "Data Base of the Occurrence and Distribution of Pesticides in Chesapeake Bay", Agriculture Network Information Center "http://waffle.nal.usda.gov/cbp/index.html" Last updated March 27, 1997
5. EPA. July 1998. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities - Volume Two [Peer Review Draft]. Office of Solid Waste and Emergency Response. EPA530-D-98-001B.
6. Oak Ridge National Laboratory, (1998). Risk Assessment Information System contains updated toxicity values from IRIS and HEAST. (http://risk.isd.ornl.gov/tox/tox_values.html)
7. Eisler, R. 1986. Polychlorinated biphenyl hazards to fish, wildlife, and invertebrates: a synoptic review. U.S. Fish Wildl. Serv. Biol. Rep. 85(1.7). 72 pp
8. Because a Henry's Law Constant could not be identified for Aroclor 1232, we applied the constant for Aroclor 1242.

**TABLE I-12**

BIOLOGICAL INPUT PARAMETERS FOR GOBAS BIOACCUMULATION MODEL
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Organism | Abbreviation | Weight (kg) | Lipid Content (kg/kg) | Feeding Preference (%) |
|---|---|---|---|---|
| Largemouth Bass (*Micropterus salmoides*) | LB | 0.15 [6] | 0.03273 [4] | PS (33); BF (34); CF (33) [7] |
| Pumpkinseed (*Lepomis gibbosus*) | PS | 0.034 [5] | 0.0502 [4] | ZP (10); CH (30); OL (30); CF (30) [7] |
| Bullfrog (tadpoles) | BF | 0.0357 [2] | 0.0076 [2] | PM (70); ZP (10); CH (10); OL (10) [8] |
| Crayfish | CF | NA | 0.00732 [2] | detrivores - not an input variable |
| Chironomidae | CH | NA | 0.009672 [3] | detrivores - not an input variable |
| Oligochaeta | OL | NA | 0.01 [1] | detrivores - not an input variable |
| Phytoplankton/macrophytes | PM | NA | 0.005 [1] | not an input variable |
| Zooplankton | ZP | NA | 0.05 [1] | not an input variable |

1. Gobas, F.A.P.C. (1993).
2. EPA Wildlife Exposure Factors Handbook (1993).
3. Chironomidae lipid content presented at "http://www.science.nus.edu.sg/~webdbs/fish/livefood/bloodwm.html", Department of Biological Sciences, National University of Singapore, Lower Kent Ridge Road, Science Faculty, Singapore 117600
4. EPA Exposure Factors Handbook (August, 1997).
5. Carlander (1977); Mean of means for 102-126 mm long specimens.
6. Carlander (1977); Predicted weight of 229 mm long specimen.
7. Carlander (1977); conservative estimates based on discussions in text
8. EPA Wildlife Exposure Factors Handbook (1993), conservative estimates based on discussion in text.

**TABLE I-13**

SEDIMENTATION PONDS 2 AND 3
GOBAS BIOACCUMULATION MODEL RESULTS
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Estimated Concentrations | | Acetone | Phenol | 4-Methylphenol | Benzo(a)anthracene | Benzo(a)pyrene | Benzo(b)fluoranthene | Carbazole | Pyrene | Chlordane | Aldrin |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total concentration in the water : | mg/l | 1.00E-07 | 3.86E-03 | 2.81E-03 | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-05 |
| Freely dissolved concentration in the water : | mg/l | 1.00E-07 | 3.86E-03 | 2.81E-03 | 9.28E-08 | 8.17E-08 | 8.17E-08 | 9.99E-08 | 9.85E-08 | 8.36E-08 | 9.62E-06 |
| Concentration in sediment solids (dry weight sediments): | mg/kg | 4.30E-02 | 9.40E-02 | 2.26E-01 | 2.26E-01 | 2.94E-01 | 4.44E-01 | 7.60E-02 | 5.81E-01 | 4.20E-03 | 3.50E-03 |
| Concentration in phytoplankton (wet weight): | mg/kg | 2.88E-10 | 5.57E-04 | 1.22E-03 | 1.85E-04 | 4.69E-04 | 4.69E-04 | 1.94E-06 | 3.74E-05 | 4.18E-04 | 9.60E-03 |
| Concentration in zooplankton (wet weight): | mg/kg | 2.88E-09 | 5.57E-03 | 1.22E-02 | 1.85E-03 | 4.69E-03 | 4.69E-03 | 1.94E-05 | 3.74E-04 | 4.18E-03 | 9.60E-02 |
| Concentration in Chironomidae (wet weight): | mg/kg | 2.14E-02 | 4.68E-02 | 1.13E-01 | 5.37E+00 | 6.99E+00 | 2.21E-01 | 3.78E-02 | 2.89E-01 | 2.75E-03 | 2.30E-03 |
| Concentration in Oligochaetes (wet weight): | mg/kg | 2.83E-02 | 6.18E-02 | 1.49E-01 | 7.10E+00 | 9.23E+00 | 2.92E-01 | 5.00E-02 | 3.82E-01 | 2.84E-03 | 2.37E-03 |
| Concentration in Crayfish (wet weight): | mg/kg | 2.93E-02 | 6.39E-02 | 1.54E-01 | 7.34E+00 | 9.55E+00 | 3.02E-01 | 5.17E-02 | 3.95E-01 | 2.08E-03 | 1.73E-03 |
| Concentration in Pumpkinseed (wet weight): | mg/kg | 4.62E-06 | 3.66E-03 | 8.05E-03 | 3.69E+00 | 1.00E+01 | 3.20E-01 | 3.36E-04 | 4.53E-02 | 1.21E-02 | 9.56E-02 |
| Concentration in Largemouth bass (wet weight): | mg/kg | 1.64E-05 | 5.63E-03 | 1.24E-02 | 1.20E+01 | 3.00E+01 | 9.52E-01 | 1.16E-03 | 1.57E-01 | 1.55E-02 | 8.54E-02 |
| Concentration in Bullfrog tadpoles (wet weight): | mg/kg | 6.10E-07 | 8.48E-04 | 1.87E-03 | 5.33E-01 | 1.63E+00 | 5.27E-02 | 4.57E-05 | 6.13E-03 | 1.48E-03 | 1.70E-02 |
| Average Concentration in Benthic Invertebrates | mg/kg | 2.63E-02 | 5.75E-02 | 1.38E-01 | 6.60E+00 | 8.59E+00 | 2.72E-01 | 4.65E-02 | 3.56E-01 | 2.56E-03 | 2.13E-03 |
| Average Concentration in Fish | mg/kg | 1.05E-05 | 4.65E-03 | 1.02E-02 | 7.84E+00 | 2.00E+01 | 6.36E-01 | 7.50E-04 | 1.01E-01 | 1.38E-02 | 9.05E-02 |

**TABLE 1-14**

UPPER SIMMONS RESERVOIR
GOBAS BIOACCUMULATION MODEL RESULTS
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Estimated Concentrations | | Acetone | Carbon Disulfide | 1,2-Dichlorobenzene | 1,4-Dichlorobenzene | Chlorobenzene | Styrene | Acenaphthylene | Butylbenzylphthalate | Benzo(a)anthracene |
|---|---|---|---|---|---|---|---|---|---|---|
| Total concentration in the water : | mg/l | 2.92E-03 | 1.00E-07 | 6.15E-04 | 8.50E-04 | 2.58E-03 | 1.00E-07 | 1.00E-07 | 2.71E-03 | 1.00E-07 |
| Freely dissolved concentration in the water : | mg/l | 2.92E-03 | 1.00E-07 | 6.08E-04 | 8.40E-04 | 2.57E-03 | 9.98E-08 | 9.86E-08 | 2.52E-03 | 4.62E-08 |
| Concentration in sediment solids (dry weight sediments): | mg/kg | 1.03E-01 | 2.78E-02 | 1.46E-01 | 1.46E-01 | 2.06E-02 | 5.00E-03 | 4.03E-02 | 2.25E-01 | 3.63E-01 |
| Concentration in phytoplankton (wet weight): | mg/kg | 8.40E-06 | 5.00E-08 | 1.21E-02 | 1.67E-02 | 8.91E-03 | 4.15E-07 | 2.47E-06 | 3.24E-01 | 9.19E-05 |
| Concentration in zooplankton (wet weight): | mg/kg | 8.40E-05 | 5.00E-07 | 1.21E-01 | 1.67E-01 | 8.91E-02 | 4.15E-06 | 2.47E-05 | 3.24E+00 | 9.19E-04 |
| Concentration in Chironomidae (wet weight): | mg/kg | 6.85E-03 | 1.85E-03 | 9.70E-03 | 9.70E-03 | 1.37E-03 | 3.33E-04 | 2.68E-03 | 1.50E-02 | 2.42E-02 |
| Concentration in Oligochaetes (wet weight): | mg/kg | 9.06E-03 | 2.44E-03 | 1.28E-02 | 1.28E-02 | 1.81E-03 | 4.40E-04 | 3.54E-03 | 1.98E-02 | 3.19E-02 |
| Concentration in Crayfish (wet weight): | mg/kg | 9.36E-03 | 2.53E-03 | 1.33E-02 | 1.32E-02 | 1.87E-03 | 4.55E-04 | 3.66E-03 | 2.05E-02 | 3.30E-02 |
| Concentration in Pumpkinseed (wet weight): | mg/kg | 5.65E-05 | 1.12E-06 | 7.91E-02 | 1.09E-01 | 5.83E-02 | 3.38E-06 | 4.54E-05 | 2.09E+00 | 1.71E-02 |
| Concentration in Largemouth bass (wet weight): | mg/kg | 8.96E-05 | 3.32E-06 | 1.22E-01 | 1.68E-01 | 8.94E-02 | 6.52E-06 | 1.29E-04 | 3.24E+00 | 5.48E-02 |
| Concentration in Bullfrog tadpoles (wet weight): | mg/kg | 1.30E-05 | 1.81E-07 | 1.85E-02 | 2.55E-02 | 1.35E-02 | 7.19E-07 | 7.65E-06 | 5.03E-01 | 2.58E-03 |
| Average Concentration in Benthic Invertebrates | mg/kg | 8.42E-03 | 2.27E-03 | 1.19E-02 | 1.19E-02 | 1.68E-03 | 4.09E-04 | 3.30E-03 | 1.84E-02 | 2.97E-02 |
| Average Concentration in Fish | mg/kg | 7.30E-05 | 2.22E-06 | 1.00E-01 | 1.39E-01 | 7.38E-02 | 4.95E-06 | 8.70E-05 | 2.67E+00 | 3.60E-02 |

# TABLE I-14

UPPER SIMMONS RESERVOIR
GOBAS BIOACCUMULATION MODEL RESULTS
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Estimated Concentrations | | Benzo(a)pyrene | Benzo(b)fluoranthene | Carbazole | Aldrin | Aroclor 1232 | Aroclor 1242 | Aroclor 1254 | delta-BHC | Chlordane |
|---|---|---|---|---|---|---|---|---|---|---|
| Total concentration in the water : | mg/l | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-07 | 5.58E-06 | 1.00E-07 |
| Freely dissolved concentration in the water : | mg/l | 2.29E-08 | 2.29E-08 | 9.89E-08 | 6.28E-08 | 9.95E-08 | 4.58E-08 | 9.62E-09 | 5.38E-06 | 2.52E-08 |
| Concentration in sediment solids (dry weight sediments): | mg/kg | 3.14E-01 | 3.97E-01 | 1.13E-01 | 1.59E-03 | 3.83E-02 | 3.67E-02 | 4.54E-02 | 4.41E-03 | 5.17E-03 |
| Concentration in phytoplankton (wet weight): | mg/kg | 1.32E-04 | 1.32E-04 | 1.92E-06 | 6.26E-05 | 7.89E-07 | 9.12E-05 | 1.52E-04 | 3.39E-04 | 1.26E-04 |
| Concentration in zooplankton (wet weight): | mg/kg | 1.32E-03 | 1.32E-03 | 1.92E-05 | 6.26E-04 | 7.89E-06 | 9.12E-04 | 1.52E-03 | 3.39E-03 | 1.26E-03 |
| Concentration in Chironomidae (wet weight): | mg/kg | 2.09E-02 | 2.64E-02 | 7.52E-03 | 1.40E-04 | 3.38E-03 | 3.24E-03 | 4.00E-03 | 3.89E-04 | 4.56E-04 |
| Concentration in Oligochaetes (wet weight): | mg/kg | 2.76E-02 | 3.49E-02 | 9.94E-03 | 1.45E-04 | 3.48E-03 | 3.34E-03 | 4.13E-03 | 4.01E-04 | 4.70E-04 |
| Concentration in Crayfish (wet weight): | mg/kg | 2.85E-02 | 3.61E-02 | 1.03E-02 | 1.06E-04 | 2.55E-03 | 2.44E-03 | 3.02E-03 | 2.93E-04 | 3.44E-04 |
| Concentration in Pumpkinseed (wet weight): | mg/kg | 3.06E-02 | 3.85E-02 | 7.67E-05 | 7.46E-04 | 4.06E-05 | 6.33E-03 | 1.97E-02 | 3.42E-03 | 2.51E-03 |
| Concentration in Largemouth bass (wet weight): | mg/kg | 9.07E-02 | 1.14E-01 | 2.47E-04 | 6.33E-04 | 1.45E-05 | 5.57E-03 | 3.30E-02 | 2.29E-03 | 3.25E-03 |
| Concentration in Bullfrog tadpoles (wet weight): | mg/kg | 5.20E-03 | 6.49E-03 | 1.14E-05 | 1.16E-04 | 2.42E-06 | 4.23E-04 | 1.81E-03 | 5.21E-04 | 3.86E-04 |
| Average Concentration in Benthic Invertebrates | mg/kg | 2.57E-02 | 3.25E-02 | 9.24E-03 | 1.30E-04 | 3.14E-03 | 3.00E-03 | 3.72E-03 | 3.61E-04 | 4.23E-04 |
| Average Concentration in Fish | mg/kg | 6.07E-02 | 7.65E-02 | 1.62E-04 | 6.89E-04 | 2.75E-05 | 5.95E-03 | 2.64E-02 | 2.85E-03 | 2.88E-03 |

**TABLE I-14**

UPPER SIMMONS RESERVOIR
GOBAS BIOACCUMULATION MODEL RESULTS
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Estimated Concentrations | | DDD | DDE | DDT | Total Endosulfans | Methoxychlor |
|---|---|---|---|---|---|---|
| Total concentration in the water : | mg/l | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-07 |
| Freely dissolved concentration in the water : | mg/l | 1.75E-08 | 3.26E-09 | 1.79E-08 | 9.96E-08 | 9.09E-08 |
| Concentration in sediment solids (dry weight sediments): | mg/kg | 6.35E-03 | 4.75E-03 | 8.64E-03 | 4.28E-03 | 9.25E-03 |
| Concentration in phytoplankton (wet weight): | mg/kg | 1.39E-04 | 1.63E-04 | 1.38E-04 | 6.72E-07 | 1.54E-05 |
| Concentration in zooplankton (wet weight): | mg/kg | 1.39E-03 | 1.63E-03 | 1.38E-03 | 6.72E-06 | 1.54E-04 |
| Concentration in Chironomidae (wet weight): | mg/kg | 5.60E-04 | 4.19E-04 | 7.62E-04 | 3.77E-04 | 8.16E-04 |
| Concentration in Oligochaetes (wet weight): | mg/kg | 5.77E-04 | 4.32E-04 | 7.85E-04 | 3.89E-04 | 8.41E-04 |
| Concentration in Crayfish (wet weight): | mg/kg | 4.23E-04 | 3.16E-04 | 5.75E-04 | 2.85E-04 | 6.16E-04 |
| Concentration in Pumpkinseed (wet weight): | mg/kg | 3.30E-03 | 3.32E-03 | 4.02E-03 | 9.88E-06 | 3.08E-04 |
| Concentration in Largemouth bass (wet weight): | mg/kg | 4.81E-03 | 5.88E-03 | 5.83E-03 | 5.30E-06 | 1.62E-04 |
| Concentration in Bullfrog tadpoles (wet weight): | mg/kg | 5.18E-04 | 8.87E-04 | 5.56E-04 | 1.14E-06 | 2.99E-05 |
| Average Concentration in Benthic Invertebrates | mg/kg | 5.20E-04 | 3.89E-04 | 7.07E-04 | 3.50E-04 | 7.57E-04 |
| Average Concentration in Fish | mg/kg | 4.06E-03 | 4.60E-03 | 4.92E-03 | 7.59E-06 | 2.35E-04 |

**TABLE I-15**

UPPER SIMMONS RESERVOIR NORTH BASIN
GOBAS BIOACCUMULATION MODEL RESULTS
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Estimated Concentrations | | Acetone | Carbon Disulfide | 1,2-Dichlorobenzene | 1,4-Dichlorobenzene | Chlorobenzene | Acenaphthylene | Butylbenzylphthalate |
|---|---|---|---|---|---|---|---|---|
| Total concentration in the water : | mg/l | 2.92E-03 | 1.00E-07 | 7.50E-04 | 1.33E-03 | 2.08E-02 | 1.00E-07 | 2.00E-03 |
| Freely dissolved concentration in the water : | mg/l | 2.92E-03 | 1.00E-07 | 7.48E-04 | 1.33E-03 | 2.08E-02 | 9.96E-08 | 1.96E-03 |
| Concentration in sediment solids (dry weight sediments): | mg/kg | 7.17E+01 | 4.00E-03 | 1.13E-01 | 1.13E-01 | 2.28E-02 | 4.03E-02 | 2.73E-01 |
| Concentration in phytoplankton (wet weight): | mg/kg | 8.39E-06 | 5.00E-08 | 1.49E-02 | 2.64E-02 | 7.19E-02 | 2.50E-06 | 2.52E-01 |
| Concentration in zooplankton (wet weight): | mg/kg | 8.39E-05 | 5.00E-07 | 1.49E-01 | 2.64E-01 | 7.19E-01 | 2.50E-05 | 2.52E+00 |
| Concentration in Chironomidae (wet weight): | mg/kg | 2.54E+01 | 2.66E-04 | 4.01E-02 | 4.01E-02 | 8.06E-03 | 1.43E-02 | 9.65E-02 |
| Concentration in Oligochaetes (wet weight): | mg/kg | 3.36E+01 | 3.52E-04 | 5.30E-02 | 5.30E-02 | 1.07E-02 | 1.88E-02 | 1.28E-01 |
| Concentration in Crayfish (wet weight): | mg/kg | 3.47E+01 | 3.64E-04 | 5.48E-02 | 5.48E-02 | 1.10E-02 | 1.95E-02 | 1.32E-01 |
| Concentration in Pumpkinseed (wet weight): | mg/kg | 5.54E-03 | 4.41E-07 | 9.76E-02 | 1.73E-01 | 4.71E-01 | 1.72E-04 | 1.63E+00 |
| Concentration in Largemouth bass (wet weight): | mg/kg | 1.95E-02 | 9.07E-07 | 1.51E-01 | 2.66E-01 | 7.22E-01 | 5.77E-04 | 2.54E+00 |
| Concentration in Bullfrog tadpoles (wet weight): | mg/kg | 7.37E-04 | 9.11E-08 | 2.28E-02 | 4.03E-02 | 1.09E-01 | 2.44E-05 | 3.93E-01 |
| Average Concentration in Benthic Invertebrates | mg/kg | 3.12E+01 | 3.27E-04 | 4.93E-02 | 4.93E-02 | 9.91E-03 | 1.75E-02 | 1.19E-01 |
| Average Concentration in Fish | mg/kg | 1.25E-02 | 6.74E-07 | 1.24E-01 | 2.19E-01 | 5.96E-01 | 3.74E-04 | 2.09E+00 |

**TABLE I-15**

UPPER SIMMONS RESERVOIR NORTH BASIN
GOBAS BIOACCUMULATION MODEL RESULTS
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Estimated Concentrations | | Benzo(a)anthracene | Benzo(a)pyrene | Benzo(b)fluoranthene | Carbazole | Aldrin | Aroclor 1232 | Aroclor 1242 | Aroclor 1254 |
|---|---|---|---|---|---|---|---|---|---|
| Total concentration in the water : | mg/l | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-07 |
| Freely dissolved concentration in the water : | mg/l | 7.79E-08 | 5.49E-08 | 5.49E-08 | 9.97E-08 | 8.76E-08 | 9.99E-08 | 7.79E-08 | 3.07E-08 |
| Concentration in sediment solids (dry weight sediments): | mg/kg | 3.84E-01 | 3.23E-01 | 4.42E-01 | 1.13E-01 | 1.30E-03 | 3.22E-02 | 3.00E-02 | 4.31E-02 |
| Concentration in phytoplankton (wet weight): | mg/kg | 1.55E-04 | 3.15E-04 | 3.15E-04 | 1.94E-06 | 8.73E-05 | 7.92E-07 | 1.55E-04 | 4.86E-04 |
| Concentration in zooplankton (wet weight): | mg/kg | 1.55E-03 | 3.15E-03 | 3.15E-03 | 1.94E-05 | 8.73E-04 | 7.92E-06 | 1.55E-03 | 4.86E-03 |
| Concentration in Chironomidae (wet weight): | mg/kg | 1.36E-01 | 1.14E-01 | 1.56E-01 | 4.00E-02 | 6.11E-04 | 1.51E-02 | 1.41E-02 | 2.02E-02 |
| Concentration in Oligochaetes (wet weight): | mg/kg | 1.79E-01 | 1.51E-01 | 2.07E-01 | 5.28E-02 | 6.30E-04 | 1.56E-02 | 1.45E-02 | 2.09E-02 |
| Concentration in Crayfish (wet weight): | mg/kg | 1.86E-01 | 1.56E-01 | 2.14E-01 | 5.46E-02 | 4.61E-04 | 1.14E-02 | 1.06E-02 | 1.53E-02 |
| Concentration in Pumpkinseed (wet weight): | mg/kg | 9.41E-02 | 1.65E-01 | 2.26E-01 | 3.54E-04 | 1.44E-03 | 1.54E-04 | 2.53E-02 | 9.73E-02 |
| Concentration in Largemouth bass (wet weight): | mg/kg | 3.05E-01 | 4.92E-01 | 6.73E-01 | 1.23E-03 | 1.13E-03 | 4.69E-05 | 2.18E-02 | 1.63E-01 |
| Concentration in Bullfrog tadpoles (wet weight): | mg/kg | 1.38E-02 | 2.74E-02 | 3.72E-02 | 4.81E-05 | 1.78E-04 | 6.66E-06 | 1.36E-03 | 8.19E-03 |
| Average Concentration in Benthic Invertebrates | mg/kg | 1.67E-01 | 1.40E-01 | 1.92E-01 | 4.91E-02 | 5.67E-04 | 1.40E-02 | 1.31E-02 | 1.88E-02 |
| Average Concentration in Fish | mg/kg | 1.99E-01 | 3.29E-01 | 4.49E-01 | 7.91E-04 | 1.29E-03 | 1.01E-04 | 2.35E-02 | 1.30E-01 |

**TABLE I-15**

UPPER SIMMONS RESERVOIR NORTH BASIN
GOBAS BIOACCUMULATION MODEL RESULTS
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Estimated Concentrations | | delta-BHC | Chlordane | DDD | DDE | DDT | Total Endosulfans | Methoxychlor |
|---|---|---|---|---|---|---|---|---|
| Total concentration in the water : | mg/l | 6.17E-06 | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-07 |
| Freely dissolved concentration in the water : | mg/l | 6.11E-06 | 5.84E-08 | 4.70E-08 | 1.23E-08 | 4.75E-08 | 9.99E-08 | 9.76E-08 |
| Concentration in sediment solids (dry weight sediments): | mg/kg | 4.50E-03 | 6.10E-03 | 6.00E-03 | 5.30E-03 | 4.20E-03 | 4.50E-03 | 7.10E-03 |
| Concentration in phytoplankton (wet weight): | mg/kg | 3.85E-04 | 2.92E-04 | 3.72E-04 | 6.15E-04 | 3.68E-04 | 6.74E-07 | 1.65E-05 |
| Concentration in zooplankton (wet weight): | mg/kg | 3.85E-03 | 2.92E-03 | 3.72E-03 | 6.15E-03 | 3.68E-03 | 6.74E-06 | 1.65E-04 |
| Concentration in Chironomidae (wet weight): | mg/kg | 2.11E-03 | 2.87E-03 | 2.82E-03 | 2.49E-03 | 1.97E-03 | 2.11E-03 | 3.34E-03 |
| Concentration in Oligochaetes (wet weight): | mg/kg | 2.18E-03 | 2.95E-03 | 2.91E-03 | 2.57E-03 | 2.03E-03 | 2.18E-03 | 3.44E-03 |
| Concentration in Crayfish (wet weight): | mg/kg | 1.60E-03 | 2.16E-03 | 2.13E-03 | 1.88E-03 | 1.49E-03 | 1.60E-03 | 2.52E-03 |
| Concentration in Pumpkinseed (wet weight): | mg/kg | 4.01E-03 | 1.13E-02 | 1.38E-02 | 1.72E-02 | 1.05E-02 | 2.43E-05 | 7.97E-04 |
| Concentration in Largemouth bass (wet weight): | mg/kg | 2.63E-03 | 1.44E-02 | 2.00E-02 | 3.07E-02 | 1.52E-02 | 9.43E-06 | 3.37E-04 |
| Concentration in Bullfrog tadpoles (wet weight): | mg/kg | 5.97E-04 | 1.18E-03 | 1.68E-03 | 3.77E-03 | 1.47E-03 | 1.68E-06 | 4.98E-05 |
| Average Concentration in Benthic Invertebrates | mg/kg | 1.96E-03 | 2.66E-03 | 2.62E-03 | 2.31E-03 | 1.83E-03 | 1.96E-03 | 3.10E-03 |
| Average Concentration in Fish | mg/kg | 3.32E-03 | 1.28E-02 | 1.69E-02 | 2.39E-02 | 1.29E-02 | 1.69E-05 | 5.67E-04 |

**TABLE I-16**

LOWER SIMMONS RESERVOIR
GOBAS BIOACCUMULATION MODEL RESULTS
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Estimated Concentrations | | Acetone | Chloromethane | 4-chloro-3-methylphenol | delta-BHC | Chlordane | DDD | DDE | DDT | Total Endosulfans | Aldrin |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total concentration in the water : | mg/l | 3.40E-03 | 6.70E-04 | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-07 | 1.00E-07 | 3.17E-05 | 9.20E-06 | 1.17E-05 |
| Freely dissolved concentration in the water : | mg/l | 3.40E-03 | 6.70E-04 | 1.00E-07 | 9.87E-08 | 4.90E-08 | 3.77E-08 | 1.17E-08 | 1.46E-05 | 9.19E-06 | 1.02E-05 |
| Concentration in sediment solids (dry weight sediments): | mg/kg | 1.26E-01 | 4.30E-02 | 5.70E-02 | 3.51E-03 | 2.51E-03 | 3.96E-03 | 5.55E-03 | 3.03E-03 | 2.16E-03 | 1.90E-03 |
| Concentration in phytoplankton (wet weight): | mg/kg | 9.78E-06 | 2.99E-05 | 6.29E-07 | 6.21E-06 | 2.45E-04 | 2.99E-04 | 5.86E-04 | 1.13E-01 | 6.20E-05 | 1.01E-02 |
| Concentration in zooplankton (wet weight): | mg/kg | 9.78E-05 | 2.99E-04 | 6.29E-06 | 6.21E-05 | 2.45E-03 | 2.99E-03 | 5.86E-03 | 1.13E+00 | 6.20E-04 | 1.01E-01 |
| Concentration in Chironomidae (wet weight): | mg/kg | 2.08E-02 | 2.14E-02 | 2.84E-02 | 7.69E-04 | 5.50E-04 | 8.67E-04 | 1.22E-03 | 6.63E-04 | 4.73E-04 | 4.16E-04 |
| Concentration in Oligochaetes (wet weight): | mg/kg | 2.75E-02 | 2.83E-02 | 3.75E-02 | 7.92E-04 | 5.67E-04 | 8.94E-04 | 1.25E-03 | 6.84E-04 | 4.88E-04 | 4.29E-04 |
| Concentration in Crayfish (wet weight): | mg/kg | 2.84E-02 | 2.93E-02 | 3.88E-02 | 5.80E-04 | 4.15E-04 | 6.54E-04 | 9.17E-04 | 5.01E-04 | 3.57E-04 | 3.14E-04 |
| Concentration in Pumpkinseed (wet weight): | mg/kg | 6.85E-05 | 2.00E-04 | 8.68E-05 | 1.18E-04 | 3.87E-03 | 5.84E-03 | 1.05E-02 | 9.93E-01 | 6.26E-04 | 9.91E-02 |
| Concentration in Largemouth bass (wet weight): | mg/kg | 1.14E-04 | 3.17E-04 | 2.99E-04 | 5.88E-05 | 5.05E-03 | 8.53E-03 | 1.84E-02 | 1.46E+00 | 4.08E-04 | 8.91E-02 |
| Concentration in Bullfrog tadpoles (wet weight): | mg/kg | 1.55E-05 | 4.60E-05 | 1.19E-05 | 1.16E-05 | 6.97E-04 | 1.04E-03 | 3.06E-03 | 3.21E-01 | 9.45E-05 | 1.79E-02 |
| Average Concentration in Benthic Invertebrates | mg/kg | 2.56E-02 | 2.63E-02 | 3.49E-02 | 7.14E-04 | 5.10E-04 | 8.05E-04 | 1.13E-03 | 6.16E-04 | 4.39E-04 | 3.86E-04 |
| Average Concentration in Fish | mg/kg | 9.13E-05 | 2.59E-04 | 1.93E-04 | 8.82E-05 | 4.46E-03 | 7.19E-03 | 1.44E-02 | 1.23E+00 | 5.17E-04 | 9.41E-02 |

# TABLE I-17

SEDIMENTATION POND 4
GOBAS BIOACCUMULATION MODEL RESULTS
0

| Estimated Concentrations | | Butylbenylphthalate |
|---|---|---|
| Total concentration in the water : | mg/l | 1.00E-02 |
| Freely dissolved concentration in the water : | mg/l | 1.00E-02 |
| Concentration in sediment solids (dry weight sediments): | mg/kg | 2.05E-01 |
| Concentration in phytoplankton (wet weight): | mg/kg | 1.28E+00 |
| Concentration in phytoplankton (g/kg lipid): | mg/kg | 2.57E+02 |
| Concentration in zooplankton (wet weight): | mg/kg | 1.28E+01 |
| Concentration in zooplankton (g/kg lipid): | mg/kg | 2.57E+02 |
| Concentration in Chironomidae (wet weight): | mg/kg | 8.29E-01 |
| Concentration in Chironomidae (g/kg lipid): | mg/kg | 1.13E+02 |
| Concentration in Oligochaetes (wet weight): | mg/kg | 1.10E+00 |
| Concentration in Oligochaetes (g/kg lipid): | mg/kg | 1.13E+02 |
| Concentration in Crayfish (wet weight): | mg/kg | 1.13E+00 |
| Concentration in Pumpkinseed (wet weight): | mg/kg | 8.33E+00 |
| Concentration in Largemouth bass (wet weight): | mg/kg | 1.30E+01 |
| Concentration in Bullfrog tadpoles (wet weight): | mg/kg | 2.00E+00 |
| Average Concentration in Benthic Invertebrates | mg/kg | 1.02E+00 |
| Average Concentration in Fish | mg/kg | 1.07E+01 |

**TABLE I-18**

CALCULATION OF SEDIMENT/INVERTEBRATE BIOCONCENTRATION FACTORS FOR HEAVY METALS
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Metal | $Kd_{bs}$[1] (L water/kg sediment) | BCF (L water/kg FW tissue) | | IAF[3] |
|---|---|---|---|---|
| Cadmium | 75 | 81 | 2a | 1.08 |
| Nickel | 65 | 47 | 2a | 0.72 |
| Mercury | 3000 | 5500 | 2a | 1.83 |
| Selenium | 5 | 16 | 2a | 3.20 |
| Arsenic | 29 | 44 | 2a | 1.52 |
| Barium | 41 | 1 | 2c | 0.02 |
| Beryllium | 790 | 42 | 2b | 0.0532 |
| Chromium | 1.80E+06 | 16 | 2a | 0.000009 |
| Silver | 8.3 | 204 | 2b | 25 |
| Thallium | 71 | 1 | 2c | 0.014 |
| Zinc | 6.20E+01 | 47 | 2a | 0.758065 |

1. These values are "Bed sediment-sediment pore water partition coefficients" (L water/kg bottom sediment) presented in EPA530-D-98-001B (July, 1998), based on an average sediment pH of 6.79 and linear 'interpolation of values reported in the source document.

2a. These values are fish/surface water bioconcentration factors presented in EPA/540/1-86/060 (October, 1986).

2b. These values are fish/surface water bioconcentration factors presented in EPA 530-D-98-001B, July 1998.

2c. If BCF not available, we assumed a BCF of 1.

3. These values are conservatively predicted benthic invertebrate bioconcentration factors, calculated as $BCF/Kd_{bs}$.

**TABLE I-19**

CALCULATION OF SEDIMENT/TADPOLE BIOCONCENTRATION FACTORS FOR HEAVY METALS
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Metal | Sediment (ppb) | Tadpole (ppb) | BCF |
|---|---|---|---|
| mercury | 400 | 181 | 0.45 |

Savannah River Site data, as summarized in Burger & Snodgrass, 1998.

**TABLE I-20**

SUMMARY OF SURFACE WATER/FISH BIOCONCENTRATION FACTORS FOR HEAVY METALS
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Metal | Bioconcentration Factor L/kg FW tissue | |
|---|---|---|
| Aluminum | 1 | 2 |
| Arsenic | 44 | 1b |
| Barium | 1 | 2 |
| Beryllium | 42 | 1a |
| Cadmium | 81 | 1b |
| Chromium | 16 | 1b |
| Copper | 200 | 1b |
| Iron | 1 | 2 |
| Manganese | 1 | 2 |
| Mercury | 5500 | 1b |
| Nickel | 47 | 1b |
| Selenium | 16 | 1b |
| Silver | 204 | 1a |
| Thallium | 1 | 2 |
| Vanadium | 1 | 2 |
| Zinc | 47 | 1b |

1 These values are fish/surface water bioconcentration factors presented in:
a. EPA 530-D-98-001B, July 1998.
b. EPA/540/1-86/060 (October, 1986).

2 If BCF not available, we assumed a BCF of 1.

# TABLE I-21

CALCULATION OF SEDIMENT/FISH
BIOCONCENTRATION FACTORS FOR HEAVY
METALS
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Metal | Sediment (ppm) | Fish (ppm) | BCF |
|---|---|---|---|
| Beryllium | 1 | <0.2 | 0.10 |
| Cadmium | 0.2 | <0.2 | 0.50 |
| Mercury | 0.11 | 0.18 | 1.64 |
| Nickel | 36 | 1.7 | 0.05 |
| Silver | 0.25 | <0.2 | 0.40 |
| Zinc | 94 | 66.7 | 0.71 |

Based on comparisons of median sediment and fish tissue concentrations reported in USGS Fact Sheet 105-98 9/1/1998 Organic Compounds and Trace Elements in Freshwater Streambed Sediment and Fish from the Puget Sound Basin by Dorene E. MacCoy and Robert W. Black
The URL for this document is
http://wwwdwatcm.wr.usgs.gov/pugt/fs.105-98.html

# TABLE I-22

WEIGHT ASSIGNMENTS FOR SURFACE WATER BODIES
BASED ON RELATIVE SURFACE AREAS
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Water Body | Surface Area (acres) | Proportion of Total |
|---|---|---|
| Sedimentation Basin 2 | 5.43 | 0.040 |
| Sedimentation Basin 3 | 1.97 | 0.014 |
| sum of basins 2 & 3 = | 7.40 | 0.054 |
| Sedimentation Basin 4 | 0.84 | 0.006 |
| Upper Simmons Reservoir | 51.11 | 0.375 |
| USR North Basin | 14.20 | 0.104 |
| Lower Simmons Reservoir | 77.00 | 0.565 |
| Total Surface Area = | 136.34 | acres |

Notes:

1. The area reported for Sedimentation Basin No. 4 includes the approximate area of Quarry Stream.
2. The area reported for Sedimentation Basin No. 3 includes the approximate area of Cedar Swamp Brook.
3. The area reported for Sedimentation Basins Nos. 2 and 3 includes the approximate areas of Cedar Swamp Brookm and Quarry Stream.

**TABLE I-23**

SITE-SPECIFIC FISH BODY BURDENS
FOR ZINC
(mg/kg wet weight)
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Metal | Upper Simmons | Lower Simmons |
|---|---|---|
| Zinc | 5 | 4.9 |

These site specific fish body burdens for zinc are the average concentrations of zinc in fish tissue samples collected in 1993 and 1994 from Upper Simmons and Lower Simmons Reservoir (See Appendix K).

# TABLE I-24

## SUMMARY OF EXPOSURE POINT CONCENTRATIONS FOR GREAT BLUE HERONS (ppm)
Central Landfill - OU2
Johnston, Rhode Island

| Constituent | Sedimentation Ponds 2 and 3 | | | | | Sedimentation Pond 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish |
| *Volatile Organic Compounds* | | | | | | | | | | |
| Acetone | 0.043 | NCC | 2.63E-02 | 6.10E-07 | 1.05E-05 | NCC | NCC | NCC | NCC | NCC |
| carbon disulfide | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| chloromethane | *4.30E-02* | 0.00067 | 2.63E-02 | 4.60E-05 | 2.59E-04 | NCC | NCC | NCC | NCC | NCC |
| 1,2-dichlorobenzene | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| 1,4-dichlorobenzene | 0.046 | NCC | 2.82E-02 | 2.95E-05 | 4.71E-04 | NCC | NCC | NCC | NCC | NCC |
| chlorobenzene | 0.012 | 0.00258 | 7.34E-03 | 1.36E-02 | 7.40E-02 | NCC | NCC | NCC | NCC | NCC |
| styrene | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| *Semivolatile Organic Compounds* | | | | | | | | | | |
| acenaphthylene | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| butylbenzylphthalate | 2.217E-01 | 2.25E-03 | 1.36E-01 | 4.48E-01 | 2.38E+00 | *2.05E-01* | 0.01 | 1.02E+00 | 2.00E+00 | 1.07E+01 |
| phenol | 9.400E-02 | 3.86E-03 | 5.75E-02 | 8.48E-04 | 4.65E-03 | NCC | NCC | NCC | NCC | NCC |
| 4-chloro-3-methylphenol | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| 4-methylphenol | 2.255E-01 | 2.81E-03 | 1.38E-01 | 1.87E-03 | 1.02E-02 | NCC | NCC | NCC | NCC | NCC |
| benzo(a)anthracene | 3.083E-01 | NCC | 6.60E+00 | 5.33E-01 | 7.84E+00 | NCC | NCC | NCC | NCC | NCC |
| benzo(a)pyrene | 2.939E-01 | NCC | 8.59E+00 | 1.63E+00 | 2.00E+01 | NCC | NCC | NCC | NCC | NCC |
| benzo(b)flouranthene | 4.437E-01 | NCC | 2.72E-01 | 5.27E-02 | 6.36E-01 | NCC | NCC | NCC | NCC | NCC |
| carbozole | 7.600E-02 | NCC | 4.65E-02 | 4.57E-05 | 7.50E-04 | NCC | NCC | NCC | NCC | NCC |
| pyrene | 5.811E-01 | NCC | 3.56E-01 | 6.13E-03 | 1.01E-01 | NCC | NCC | NCC | NCC | NCC |
| *Pesticides/PCBs* | | | | | | | | | | |
| Aldrin | 3.51E-03 | 1.00E-05 | 2.13E-03 | 1.70E-02 | 9.05E-02 | NCC | NCC | NCC | NCC | NCC |
| delta-BHC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| Aroclor 1232 | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| Aroclor 1242 | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| Aroclor 1254 | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| DDD | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| DDE | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| DDT | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| Total Chlordanes | 4.24E-03 | NCC | 2.56E-03 | 1.48E-03 | 1.38E-02 | NCC | NCC | NCC | NCC | NCC |
| Methoxychlor | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| Total Endosulfans | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |

# TABLE I-24

SUMMARY OF EXPOSURE POINT CONCENTRATIONS FOR GREAT BLUE HERONS (ppm)
Central Landfill - OU2
Johnston, Rhode Island

| Constituent | Upper Simmons Reservoir | | | | |
|---|---|---|---|---|---|
| | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish |
| *Volatile Organic Compounds* | | | | | |
| Acetone | 1.03E-01 | 2.92E-03 | 8.42E-03 | 1.30E-05 | 7.30E-05 |
| carbon disulfide | 2.78E-02 | NCC | 2.27E-03 | 1.81E-07 | 2.22E-06 |
| chloromethane | NCC | NCC | NCC | NCC | NCC |
| 1,2-dichlorobenzene | *1.46E-01* | 6.15E-04 | 1.19E-02 | 1.85E-02 | 1.00E-01 |
| 1,4-dichlorobenzene | *1.46E-01* | 8.85E-04 | 1.19E-02 | 2.55E-02 | 1.39E-01 |
| chlorobenzene | 2.06E-02 | 1.00E-02 | 1.68E-03 | 1.35E-02 | 7.38E-02 |
| styrene | 5.00E-03 | NCC | 4.09E-04 | 7.19E-07 | 4.95E-06 |
| *Semivolatile Organic Compounds* | | | | | |
| acenaphthylene | 4.03E-02 | NCC | 3.30E-03 | 7.65E-06 | 8.70E-05 |
| butylbenzylphthalate | 2.25E-01 | 2.71E-03 | 1.84E-02 | 5.03E-01 | 2.67E+00 |
| phenol | NCC | NCC | NCC | NCC | NCC |
| 4-chloro-3-methylphenol | NCC | NCC | NCC | NCC | NCC |
| 4-methylphenol | NCC | NCC | NCC | NCC | NCC |
| benzo(a)anthracene | 3.63E-01 | NCC | 2.97E-02 | 2.58E-03 | 3.60E-02 |
| benzo(a)pyrene | 3.14E-01 | NCC | 2.57E-02 | 5.20E-03 | 6.07E-02 |
| benzo(b)flouranthene | 3.97E-01 | NCC | 3.25E-02 | 6.49E-03 | 7.65E-02 |
| carbozole | 1.13E-01 | NCC | 9.24E-03 | 1.14E-05 | 1.62E-04 |
| pyrene | 4.18E-01 | NCC | 3.42E-02 | 6.33E-04 | 9.94E-03 |
| *Pesticides/PCBs* | | | | | |
| Aldrin | 1.59E-03 | NCC | 1.30E-04 | 1.16E-04 | 6.89E-04 |
| delta-BHC | 4.41E-03 | 5.58E-06 | 3.61E-04 | 5.21E-04 | 2.85E-03 |
| Aroclor 1232 | 3.83E-02 | NCC | 3.14E-03 | 2.42E-06 | 2.75E-05 |
| Aroclor 1242 | 3.67E-02 | NCC | 3.00E-03 | 4.23E-04 | 5.95E-03 |
| Aroclor 1254 | 4.54E-02 | NCC | 3.72E-03 | 1.81E-03 | 2.64E-02 |
| DDD | 6.35E-03 | NCC | 5.20E-04 | 5.18E-04 | 4.06E-03 |
| DDE | 4.75E-03 | NCC | 3.89E-04 | 8.87E-04 | 4.60E-03 |
| DDT | 8.64E-03 | NCC | 7.07E-04 | 5.56E-04 | 4.92E-03 |
| Total Chlordanes | 5.16E-03 | NCC | 4.23E-04 | 3.86E-04 | 2.88E-03 |
| Methoxychlor | 9.25E-03 | NCC | 7.57E-04 | 2.99E-05 | 2.35E-04 |
| Total Endosulfans | 4.28E-03 | NCC | 3.50E-04 | 1.14E-06 | 7.59E-06 |

# TABLE I-24

SUMMARY OF EXPOSURE POINT CONCENTRATIONS FOR GREAT BLUE HERONS (ppm)
Central Landfill - OU2
Johnston, Rhode Island

| Constituent | Lower Simmons Reservoir | | | | | Upper Simmons Reservoir North Basin | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish |
| *Volatile Organic Compounds* | | | | | | | | | | |
| Acetone | 1.26E-01 | 3.40E-03 | 2.56E-02 | 1.55E-05 | 9.13E-05 | 7.17E-02 | 2.92E-03 | 3.12E+01 | 7.37E-04 | 1.25E-02 |
| carbon disulfide | NCC | NCC | NCC | NCC | NCC | 4.00E-03 | NCC | 3.27E-04 | 9.11E-08 | 6.74E-07 |
| chloromethane | 0.0035 | NCC | 2.63E-02 | 4.60E-05 | 2.59E-04 | NCC | NCC | NCC | NCC | NCC |
| 1,2-dichlorobenzene | NCC | NCC | NCC | NCC | NCC | NCC | 7.50E-04 | 4.93E-02 | 2.28E-02 | 1.24E-01 |
| 1,4-dichlorobenzene | NCC | NCC | NCC | NCC | NCC | NCC | 1.33E-03 | 4.93E-02 | 4.03E-02 | 2.19E-01 |
| chlorobenzene | NCC | NCC | NCC | NCC | NCC | 2.28E-02 | 2.08E-02 | 9.91E-03 | 1.09E-01 | 5.96E-01 |
| styrene | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| *Semivolatile Organic Compounds* | | | | | | | | | | |
| acenaphthylene | NCC | NCC | NCC | NCC | NCC | 4.03E-02 | NCC | 1.75E-02 | 2.44E-05 | 3.74E-04 |
| butylbenzylphthalate | 6.62E-01 | NCC | 4.05E-02 | 2.59E-04 | 4.17E-03 | 2.73E-01 | NCC | 1.19E-01 | 3.93E-01 | 2.09E+00 |
| phenol | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| 4-chloro-3-methylphenol | 0.057 | NCC | 3.49E-02 | 1.19E-05 | 1.93E-04 | NCC | NCC | NCC | NCC | NCC |
| 4-methylphenol | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| benzo(a)anthracene | 0.095 | NCC | 5.81E-02 | 5.06E-03 | 7.04E-02 | 3.84E-01 | NCC | 1.67E-01 | 1.38E-02 | 1.99E-01 |
| benzo(a)pyrene | 0.12 | NCC | 7.34E-02 | 1.51E-02 | 1.74E-01 | 3.23E-01 | NCC | 1.40E-01 | 2.74E-02 | 3.29E-01 |
| benzo(b)flouranthene | 0.175 | NCC | 1.07E-01 | 2.15E-02 | 2.52E-01 | 4.42E-01 | NCC | 1.92E-01 | 3.72E-02 | 4.49E-01 |
| carbozole | NCC | NCC | NCC | NCC | NCC | 1.13E-01 | NCC | 4.91E-02 | 4.81E-05 | 7.91E-04 |
| pyrene | 0.111 | NCC | 6.79E-02 | 1.22E-03 | 1.96E-02 | 7.03E-01 | NCC | 3.06E-01 | 5.27E-03 | 8.69E-02 |
| *Pesticides/PCBs* | | | | | | | | | | |
| Aldrin | *1.90E-03* | 1.17E-05 | 3.86E-04 | 1.79E-02 | 9.41E-02 | 1.29E-03 | NCC | 5.67E-04 | 1.78E-04 | 1.29E-03 |
| delta-BHC | 3.51E-03 | NCC | 7.14E-04 | 1.16E-05 | 8.82E-05 | 4.46E-03 | 6.17E-06 | 1.96E-03 | 5.97E-04 | 3.32E-03 |
| Aroclor 1232 | NCC | NCC | NCC | NCC | NCC | 3.22E-02 | NCC | 1.40E-02 | 6.66E-06 | 1.01E-04 |
| Aroclor 1242 | NCC | NCC | NCC | NCC | NCC | 3.00E-02 | NCC | 1.31E-02 | 1.36E-03 | 2.35E-02 |
| Aroclor 1254 | NCC | NCC | NCC | NCC | NCC | 4.31E-02 | NCC | 1.88E-02 | 8.19E-03 | 1.30E-01 |
| DDD | 3.96E-03 | NCC | 8.05E-04 | 1.04E-03 | 7.19E-03 | 6.04E-03 | NCC | 2.62E-03 | 1.68E-03 | 1.69E-02 |
| DDE | 5.55E-03 | NCC | 1.13E-03 | 3.06E-03 | 1.44E-02 | 5.33E-03 | NCC | 2.31E-03 | 3.77E-03 | 2.39E-02 |
| DDT | *3.03E-03* | 3.17E-05 | 6.16E-04 | 3.21E-01 | 1.23E+00 | 4.23E-03 | NCC | 1.83E-03 | 1.47E-03 | 1.29E-02 |
| Total Chlordanes | 2.51E-03 | NCC | 5.10E-04 | 6.97E-04 | 4.46E-03 | 6.05E-03 | NCC | 2.66E-03 | 1.18E-03 | 1.28E-02 |
| Methoxychlor | NCC | NCC | NCC | NCC | NCC | 7.08E-03 | NCC | 3.10E-03 | 4.98E-05 | 5.67E-04 |
| Total Endosulfans | 2.16E-03 | 9.20E-06 | 4.39E-04 | 9.45E-05 | 5.17E-04 | 4.50E-03 | NCC | 1.96E-03 | 1.68E-06 | 1.69E-05 |

# TABLE I-24

## SUMMARY OF EXPOSURE POINT CONCENTRATIONS FOR GREAT BLUE HERONS (ppm)
Central Landfill - OU2
Johnston, Rhode Island

| Constituent | Sedimentation Ponds 2 and 3 | | | | | Sedimentation Pond 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish |
| *Metals* | | | | | | | | | | |
| Aluminum | 1.38E+04 | 6.30E-01 | 6.30E-01 [2] | 6.30E-01 [2] | 6.30E-01 [2] | 5.59E+03 | 4.19E-02 | 4.19E-02 [3] | 4.19E-02 [2] | 4.19E-02 [2] |
| Arsenic | 4.44E+00 | 1.34E-03 | 6.74E+00 [3] | 5.90E-02 [2] | 5.90E-02 [2] | NCC | 3.50E-03 | 1.54E-01 [2] | 1.54E-01 [2] | 1.54E-01 |
| Barium | 1.45E+02 | 5.50E-02 | 3.54E+00 [3] | 5.50E-02 [2] | 5.50E-02 [2] | 9.80E+01 | 3.83E-02 | 2.39E+00 [3] | 3.83E-02 | 3.83E-02 |
| Beryllium | 2.27E+00 | 1.17E-03 | 1.21E-01 [3] | 4.91E-02 [2] | 4.91E-02 [2] | 1.00E-01 | NCC | 1.00E-02 [5] | 2.00E-03 [3] | 2.00E-03 [5] |
| Cadmium | 2.60E-01 | 2.10E-04 | 2.81E-01 [3] | 1.70E-02 [2] | 1.70E-02 [2] | NCC | NCC | NCC | NCC | NCC |
| Chromium | 3.19E+01 | 1.20E-03 | 2.83E-04 [3] | 1.92E-02 [2] | 1.92E-02 [2] | 8.40E+00 | 1.67E-03 | 7.47E-05 [3] | 2.66E-02 [2] | 2.66E-02 [2] |
| Copper | 3.73E+01 | 3.27E-03 | 6.54E-01 [2] | 6.54E-01 [2] | 6.54E-01 [2] | 1.09E+01 | 8.55E-03 | 1.71E+00 [2] | 1.71E+00 [2] | 1.71E+00 [2] |
| Iron | 2.42E+04 | 2.65E+00 | 2.65E+00 [2] | 2.65E+00 [2] | 2.65E+00 [2] | 9.47E+03 | 1.36E-01 | 1.36E-01 [2] | 1.36E-01 [2] | 1.36E-01 [2] |
| Manganese | 6.73E+02 | 1.53E+00 | 1.53E+00 [2] | 1.53E+00 [2] | 1.53E+00 [2] | 1.44E+02 | 4.43E-02 | 4.43E-02 [2] | 4.43E-02 [2] | 4.43E-02 [2] |
| Mercury | 1.74E-01 | 3.00E-04 | 3.20E-01 [3] | 1.65E+00 [2] | 1.65E+00 [2] | NCC | 5.80E-04 | 3.19E+00 [2] | 3.19E+00 [2] | 3.19E+00 [2] |
| Nickel | 1.14E+01 | 3.13E-03 | 8.25E+00 [3] | 1.47E-01 [2] | 1.47E-01 [2] | 3.20E+00 | 2.70E-03 | 2.31E+00 [3] | 1.27E-01 [2] | 1.27E-01 [2] |
| Selenium | NCC | 2.03E-03 | 3.25E-02 [2] | 3.25E-02 [2] | 3.25E-02 [2] | NCC | NCC | NCC | NCC | NCC |
| Silver | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| Thallium | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| Vanadium | 2.51E+01 | 2.65E-03 | 2.65E-03 [2] | 2.65E-03 [2] | 2.65E-03 [2] | 1.14E+01 | 1.55E-03 | 1.55E-03 [2] | 1.55E-03 [2] | 1.55E-03 [2] |
| Zinc | 2.24E+02 | 7.22E-02 | 1.70E+02 [3] | 3.39E+00 [2] | 3.39E+00 [2] | 2.40E+01 | 3.40E-02 | 1.82E+01 [3] | 1.60E+00 [2] | 1.60E+00 [2] |

# TABLE I-24

## SUMMARY OF EXPOSURE POINT CONCENTRATIONS FOR GREAT BLUE HERONS (ppm)
Central Landfill - OU2
Johnston, Rhode Island

| Constituent | Upper Simmons Reservoir | | | | |
|---|---|---|---|---|---|
| | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish |
| *Metals* | | | | | |
| Aluminum | 1.26E+04 | 2.56E-01 | 2.56E-01 [2] | 2.56E-01 [2] | 2.56E-01 [2] |
| Arsenic | 3.93E+00 | 1.17E-03 | 5.96E+00 [3] | 5.13E-02 [2] | 5.13E-02 [2] |
| Barium | 7.34E+01 | 7.50E-02 | 1.79E+00 [3] | 7.50E-02 [2] | 7.50E-02 [2] |
| Beryllium | 1.27E+01 | 3.83E-04 | 6.74E-01 [3] | 1.61E-02 [2] | 1.61E-02 [2] |
| Cadmium | 1.81E+00 | 2.25E-04 | 1.95E+00 [3] | 1.82E-02 [2] | 1.82E-02 [2] |
| Chromium | 1.20E+01 | 1.99E-03 | 1.06E-04 [3] | 3.19E-02 [2] | 3.19E-02 [2] |
| Copper | 2.05E+01 | 4.02E-03 | 8.04E-01 [2] | 8.04E-01 [2] | 8.04E-01 [2] |
| Iron | 1.45E+04 | 1.53E+00 | NCC [2] | NCC [2] | 1.53E+00 [2] |
| Manganese | 4.81E+02 | 3.25E+00 | 3.25E+00 [2] | 3.25E+00 [2] | 3.25E+00 [2] |
| Mercury | 1.25E-01 | NCC | 2.29E-01 [3] | 5.66E-02 [6] | 4.09E-02 [5] |
| Nickel | 1.36E+01 | 7.98E-03 | 9.85E+00 [3] | 3.75E-01 [2] | 3.75E-01 [2] |
| Selenium | 1.04E+00 | 2.20E-03 | 3.31E+00 [3] | 3.53E-02 [2] | 3.53E-02 [2] |
| Silver | NCC | NCC | NCC [5] | NCC [3] | NCC [3] |
| Thallium | NCC | 2.82E-03 | 2.82E-03 [2] | 2.82E-03 [2] | 2.82E-03 [2] |
| Vanadium | 3.90E+01 | 3.32E-03 | 3.32E-03 [2] | 3.32E-03 [2] | 3.32E-03 [2] |
| Zinc | 1.44E+02 | 1.93E-02 | 1.09E+02 [3] | 5.00E+00 [2] | 5.00E+00 [8] |

# TABLE I-24

## SUMMARY OF EXPOSURE POINT CONCENTRATIONS FOR GREAT BLUE HERONS (ppm)
Central Landfill - OU2
Johnston, Rhode Island

| Constituent | Lower Simmons Reservoir | | | | | Upper Simmons Reservoir North Basin | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish |
| *Metals* | | | | | | | | | | |
| Aluminum | 1.18E+04 | 3.60E-01 | 3.60E-01 [2] | 3.60E-01 [2] | 3.60E-01 [2] | 1.25E+04 | 3.47E-01 | 3.47E-01 [2] | 3.47E-01 [2] | 3.47E-01 [2] |
| Arsenic | 9.72E+00 | 2.11E-03 | 1.47E+01 [3] | 9.28E-02 [2] | 9.28E-02 [2] | 5.08E+00 | 1.03E-03 | 7.71E+00 [3] | 4.55E-02 [2] | 4.55E-02 [2] |
| Barium | 1.73E+02 | 6.55E-02 | 4.21E+00 [3] | 6.55E-02 [2] | 6.55E-02 [2] | 8.64E+01 | 1.02E-01 | 2.11E+00 [3] | 1.02E-01 [2] | 1.02E-01 [2] |
| Beryllium | 9.54E+00 | 4.05E-04 | 5.07E-01 [3] | 1.70E-02 [2] | 1.70E-02 [2] | 3.68E+00 | 5.08E-04 | 1.95E-01 [3] | 2.14E-02 [2] | 2.14E-02 [2] |
| Cadmium | 4.43E+00 | NCC | 4.78E+00 [3] | 4.43E-01 [5] | 4.43E-01 [5] | 1.16E+00 | 3.57E-04 | 1.25E+00 [3] | 2.89E-02 [2] | 2.89E-02 [2] |
| Chromium | 1.90E+01 | 1.80E-03 | 1.68E-04 [3] | 2.88E-02 [2] | 2.88E-02 [2] | 1.19E+01 | 2.51E-03 | 1.05E-04 [3] | 4.01E-02 [2] | 4.01E-02 [2] |
| Copper | 2.21E+01 | 5.37E-03 | 1.07E+00 [2] | 1.07E+00 [2] | 1.07E+00 [2] | 1.95E+01 | 3.78E-03 | 7.55E-01 [2] | 7.55E-01 [2] | 7.55E-01 [2] |
| Iron | 2.47E+04 | 1.41E+00 | 1.41E+00 [2] | 1.41E+00 [2] | 1.41E+00 [2] | 2.21E+04 | 2.30E+00 | 2.30E+00 [2] | 2.30E+00 [2] | 2.30E+00 [2] |
| Manganese | 8.42E+03 | 1.84E+00 | 1.84E+00 [2] | 1.84E+00 [2] | 1.84E+00 [2] | 5.31E+02 | 5.59E+00 | 5.59E+00 [2] | 5.59E+00 [2] | 5.59E+00 [2] |
| Mercury | 2.37E-01 | NCC | 4.35E-01 [6] | 1.07E-01 [5] | 2.24E-03 [5] | 1.18E-01 | NCC | 2.17E-01 [3] | 5.35E-02 [6] | 3.87E-02 [5] |
| Nickel | 1.64E+01 | 3.98E-03 | 1.19E+01 [3] | 1.87E-01 [2] | 1.87E-01 [2] | 2.40E+01 | 1.25E-02 | 1.73E+01 [3] | 5.89E-01 [2] | 5.89E-01 [2] |
| Selenium | 2.86E+00 | 4.38E-03 | 9.15E+00 [3] | 7.01E-02 [2] | 7.01E-02 [2] | 4.50E-01 | 2.39E-03 | 3.83E-02 [2] | 3.83E-02 [2] | 3.83E-02 [2] |
| Silver | NCC | 1.63E-03 | 3.32E-01 [2] | 3.32E-01 [2] | 3.32E-01 [2] | NCC | NCC | NCC | NCC | NCC |
| Thallium | 1.01E+01 | ND | 1.42E-01 [3] | 1.42E-01 [3] | 1.42E-01 [3] | 5.58E-01 | 4.67E-03 | 7.86E-03 [3] | 4.67E-03 [2] | 4.67E-03 [2] |
| Vanadium | 4.08E+01 | 3.46E-03 | 3.46E-03 [2] | 3.46E-03 [2] | 3.46E-03 [2] | 7.29E+01 | 4.23E-03 | 4.23E-03 [2] | 4.23E-03 [2] | 4.23E-03 [2] |
| Zinc | 2.68E+02 | 1.38E-02 | 2.03E+02 [3] | 4.89E+00 [2] | 4.89E+00 [8] | 1.96E+02 | 1.54E-02 | 1.49E+02 [3] | 7.24E-01 [2] | 7.24E-01 [2] |

Notes:

1. Values in italics were calculated as 0.5 * MDL.
2. These values were calculated by multiplying the measured or estimated dissolved surface water contaminant concentration by published BCFs for fish.
3. These values were calculated by multiplying the measured or sediment contaminant concentration by the IAFs presented on Table 18.
4. Tissue EPCs for organic compounds were calculated using the Gobas Food Web Model.
5. These values were calculated by multiplying the measured sediment contaminant concentration by the fish/sediment accumulation factors based on dry weight presented on Table 15, and by the fraction of solid content of fish (0.2) to convert the fish body burden from dry weight to wet weight.
6. These values were calculated by multiplying the measured sediment contaminant concentration by the tadpole/sediment accumulation factors presented on Table 16.
7. The mean dissolve selenium concentration is presented for the Lower Simmons Reservoir because selenium was not detected in total metals analyses.
8. These values are site-specific fish body burdens based on the average wet weight concentration of zinc in fish tissue.

# TABLE I-25

## SUMMARY OF WEIGHTED EXPOSURE POINT CONCENTRATIONS FOR GREAT BLUE HERONS (ppm)
Central Landfill - OU2
Johnston, Rhode Island

| Constituent | Sedimentation Ponds 2 and 3 | | | | | Sedimentation Pond 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish |
| *Volatile Organic Compounds* | | | | | | | | | | |
| Acetone | 2.33E-03 | NCC | 1.43E-03 | 3.31E-08 | 5.70E-07 | NCC | NCC | NCC | NCC | NCC |
| carbon disulfide | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| chloromethane | 2.33E-03 | 3.64E-05 | 1.43E-03 | 2.50E-06 | 1.41E-05 | NCC | NCC | NCC | NCC | NCC |
| 1,2-dichlorobenzene | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| 1,4-dichlorobenzene | 2.50E-03 | NCC | 1.53E-03 | 1.60E-06 | 2.56E-05 | NCC | NCC | NCC | NCC | NCC |
| chlorobenzene | 6.60E-04 | 1.40E-04 | 3.99E-04 | 7.37E-04 | 4.02E-03 | NCC | NCC | NCC | NCC | NCC |
| styrene | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| *Semivolatile Organic Compounds* | | | | | | | | | | |
| acenaphthylene | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| butylbenzylphthalate | 1.20E-02 | 1.22E-04 | 7.38E-03 | 2.43E-02 | 1.29E-01 | 1.26E-03 | 6.12E-05 | 6.24E-03 | 1.23E-02 | 6.53E-02 |
| phenol | 5.10E-03 | 2.10E-04 | 3.12E-03 | 4.60E-05 | 2.52E-04 | NCC | NCC | NCC | NCC | NCC |
| 4-chloro-3-methylphenol | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| 4-methylphenol | 1.22E-02 | 1.53E-04 | 7.51E-03 | 1.01E-04 | 5.56E-04 | NCC | NCC | NCC | NCC | NCC |
| benzo(a)anthracene | 1.67E-02 | NCC | 3.58E-01 | 2.89E-02 | 4.26E-01 | NCC | NCC | NCC | NCC | NCC |
| benzo(a)pyrene | 1.60E-02 | NCC | 4.66E-01 | 8.83E-02 | 1.09E+00 | NCC | NCC | NCC | NCC | NCC |
| benzo(b)flouranthene | 2.41E-02 | NCC | 1.48E-02 | 2.86E-03 | 3.45E-02 | NCC | NCC | NCC | NCC | NCC |
| carbozole | 4.13E-03 | NCC | 2.53E-03 | 2.48E-06 | 4.07E-05 | NCC | NCC | NCC | NCC | NCC |
| pyrene | 3.15E-02 | NCC | 1.93E-02 | 3.33E-04 | 5.49E-03 | NCC | NCC | NCC | NCC | NCC |
| *Pesticides/PCBs* | | | | | | | | | | |
| Aldrin | 1.91E-04 | 5.43E-07 | 1.16E-04 | 9.24E-04 | 4.91E-03 | NCC | NCC | NCC | NCC | NCC |
| delta-BHC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| Aroclor 1232 | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| Aroclor 1242 | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| Aroclor 1254 | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| DDD | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| DDE | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| DDT | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| Total Chlordanes | 2.30E-04 | NCC | 1.39E-04 | 8.02E-05 | 7.48E-04 | NCC | NCC | NCC | NCC | NCC |
| Methoxychlor | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| Total Endosulfans | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |

# TABLE I-25

SUMMARY OF WEIGHTED EXPOSURE POINT CONCENTRATIONS FOR GREAT BLUE HERONS (ppm)
Central Landfill - OU2
Johnston, Rhode Island

| Constituent | Sedimentation Ponds 2 and 3 | | | | | Sedimentation Pond 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish |
| *Metals* | | | | | | | | | | |
| Aluminum | 7.51E+02 | 3.42E-02 | 3.42E-02 | 3.42E-02 | 3.42E-02 | 3.42E+01 | 2.57E-04 | 2.57E-04 | 2.57E-04 | 2.57E-04 |
| Arsenic | 2.41E-01 | 7.27E-05 | 3.66E-01 | 3.20E-03 | 3.20E-03 | NCC | 2.14E-05 | 9.43E-04 | 9.43E-04 | 9.43E-04 |
| Barium | 7.87E+00 | 2.99E-03 | 1.92E-01 | 2.99E-03 | 2.99E-03 | 6.00E-01 | 2.35E-04 | 1.46E-02 | 2.35E-04 | 2.35E-04 |
| Beryllium | 1.23E-01 | 6.35E-05 | 6.54E-03 | 2.67E-03 | 2.67E-03 | 6.12E-04 | NCC | 6.12E-05 | 1.22E-05 | 1.22E-05 |
| Cadmium | NCC | 1.14E-05 | NCC | NCC | 9.23E-04 | NCC | NCC | NCC | NCC | NCC |
| Chromium | 1.73E+00 | 6.51E-05 | 1.54E-05 | 1.04E-03 | 1.04E-03 | 5.14E-02 | 1.02E-05 | 4.57E-07 | 1.63E-04 | 1.63E-04 |
| Copper | 2.02E+00 | 1.78E-04 | 3.55E-02 | 3.55E-02 | 3.55E-02 | 6.68E-02 | 5.24E-05 | 1.05E-02 | 1.05E-02 | 1.05E-02 |
| Iron | 1.32E+03 | 1.44E-01 | 1.44E-01 | 1.44E-01 | 1.44E-01 | 5.80E+01 | 8.35E-04 | 8.35E-04 | 8.35E-04 | 8.35E-04 |
| Manganese | 3.65E+01 | 8.32E-02 | 8.32E-02 | 8.32E-02 | 8.32E-02 | 8.82E-01 | 2.71E-04 | 2.71E-04 | 2.71E-04 | 2.71E-04 |
| Mercury | 9.47E-03 | 1.63E-05 | 1.74E-02 | 8.96E-02 | 8.96E-02 | NCC | 3.55E-06 | 1.95E-02 | 1.95E-02 | 1.95E-02 |
| Nickel | 6.19E-01 | 1.70E-04 | 4.48E-01 | 7.99E-03 | 7.99E-03 | 1.96E-02 | 1.65E-05 | 1.42E-02 | 7.77E-04 | 7.77E-04 |
| Selenium | NCC | 1.10E-04 | 1.76E-03 | 1.76E-03 | 1.76E-03 | NCC | NCC | NCC | NCC | NCC |
| Silver | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| Thallium | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| Vanadium | 1.36E+00 | 1.44E-04 | 1.44E-04 | 1.44E-04 | 1.44E-04 | 6.98E-02 | 9.49E-06 | 9.49E-06 | 9.49E-06 | 9.49E-06 |
| Zinc | 1.22E+01 | 3.92E-03 | 9.23E+00 | 1.84E-01 | 1.84E-01 | 1.47E-01 | 2.08E-04 | 1.11E-01 | 9.77E-03 | 9.77E-03 |

Note:

1. Weighted EPCs were calculated by multiplying the water body-specific EPC by the ratio of the surface area of that water body to the combined surface area of all water bodies. Weighted EPCs for each water body were then summed to yield the final EPC.

# TABLE I-25

SUMMARY OF WEIGHTED EXPOSURE POINT CONCENTRATIONS FOR GREAT BLUE HERONS (ppm)
Central Landfill - OU2
Johnston, Rhode Island

| Constituent | Upper Simmons Reservoir | | | | | Lower Simmons Reservoir | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish |
| *Volatile Organic Compounds* | | | | | | | | | | |
| Acetone | 3.86E-02 | 1.09E-03 | 3.16E-03 | 4.86E-06 | 2.74E-05 | 7.13E-02 | 1.92E-03 | 1.45E-02 | 8.73E-06 | 5.16E-05 |
| carbon disulfide | 1.04E-02 | NCC | 8.52E-04 | 6.78E-08 | 8.31E-07 | NCC | NCC | NCC | NCC | NCC |
| chloromethane | NCC | NCC | NCC | NCC | NCC | 1.98E-03 | NCC | 1.49E-02 | 2.60E-05 | 1.46E-04 |
| 1,2-dichlorobenzene | 5.46E-02 | 2.31E-04 | 4.47E-03 | 6.92E-03 | 3.76E-02 | NCC | NCC | NCC | NCC | NCC |
| 1,4-dichlorobenzene | 5.46E-02 | 3.32E-04 | 4.47E-03 | 9.57E-03 | 5.20E-02 | NCC | NCC | NCC | NCC | NCC |
| chlorobenzene | 7.74E-03 | 3.75E-03 | 6.32E-04 | 5.08E-03 | 2.77E-02 | NCC | NCC | NCC | NCC | NCC |
| styrene | 1.87E-03 | NCC | 1.53E-04 | 2.69E-07 | 1.86E-06 | NCC | NCC | NCC | NCC | NCC |
| *Semivolatile Organic Compounds* | | | | | | | | | | |
| acenaphthylene | 1.51E-02 | NCC | 1.24E-03 | 2.87E-06 | 3.26E-05 | NCC | NCC | NCC | NCC | NCC |
| butylbenzylphthalate | 8.43E-02 | 1.02E-03 | 6.90E-03 | 1.89E-01 | 9.99E-01 | 3.74E-01 | NCC | 2.29E-02 | 1.46E-04 | 2.35E-03 |
| phenol | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| 4-chloro-3-methylphenol | NCC | NCC | NCC | NCC | NCC | 3.22E-02 | NCC | 1.97E-02 | 6.71E-06 | 1.09E-04 |
| 4-methylphenol | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC | NCC |
| benzo(a)anthracene | 1.36E-01 | NCC | 1.11E-02 | 9.66E-04 | 1.35E-02 | 5.37E-02 | NCC | 3.28E-02 | 2.86E-03 | 3.98E-02 |
| benzo(a)pyrene | 1.18E-01 | NCC | 9.63E-03 | 1.95E-03 | 2.27E-02 | 6.78E-02 | NCC | 4.15E-02 | 8.54E-03 | 9.83E-02 |
| benzo(b)flouranthene | 1.49E-01 | NCC | 1.22E-02 | 2.43E-03 | 2.87E-02 | 9.88E-02 | NCC | 6.05E-02 | 1.21E-02 | 1.43E-01 |
| carbozole | 4.22E-02 | NCC | 3.46E-03 | 4.28E-06 | 6.06E-05 | NCC | NCC | NCC | NCC | NCC |
| pyrene | 1.57E-01 | NCC | 1.28E-02 | 2.37E-04 | 3.73E-03 | 6.27E-02 | NCC | 3.84E-02 | 6.89E-04 | 1.10E-02 |
| *Pesticides/PCBs* | | | | | | | | | | |
| Aldrin | 5.95E-04 | NCC | 4.88E-05 | 4.35E-05 | 2.58E-04 | 1.07E-03 | 6.59E-06 | 2.18E-04 | 1.01E-02 | 5.31E-02 |
| delta-BHC | 1.65E-03 | 2.09E-06 | 1.35E-04 | 1.95E-04 | 1.07E-03 | 1.98E-03 | NCC | 4.03E-04 | 6.56E-06 | 4.98E-05 |
| Aroclor 1232 | 1.43E-02 | NCC | 1.18E-03 | 9.06E-07 | 1.03E-05 | NCC | NCC | NCC | NCC | NCC |
| Aroclor 1242 | 1.38E-02 | NCC | 1.13E-03 | 1.58E-04 | 2.23E-03 | NCC | NCC | NCC | NCC | NCC |
| Aroclor 1254 | 1.70E-02 | NCC | 1.39E-03 | 6.79E-04 | 9.88E-03 | NCC | NCC | NCC | NCC | NCC |
| DDD | 2.38E-03 | NCC | 1.95E-04 | 1.94E-04 | 1.52E-03 | 2.24E-03 | NCC | 4.55E-04 | 5.88E-04 | 4.06E-03 |
| DDE | 1.78E-03 | NCC | 1.46E-04 | 3.33E-04 | 1.72E-03 | 3.13E-03 | NCC | 6.37E-04 | 1.73E-03 | 8.16E-03 |
| DDT | 3.24E-03 | NCC | 2.65E-04 | 2.08E-04 | 1.85E-03 | 1.71E-03 | 1.79E-05 | 3.48E-04 | 1.81E-01 | 6.93E-01 |
| Total Chlordanes | 1.94E-03 | NCC | 1.59E-04 | 1.45E-04 | 1.08E-03 | 1.42E-03 | NCC | 2.88E-04 | 3.93E-04 | 2.52E-03 |
| Methoxychlor | 3.47E-03 | NCC | 2.84E-04 | 1.12E-05 | 8.81E-05 | NCC | NCC | NCC | NCC | NCC |
| Total Endosulfans | 1.60E-03 | NCC | 1.31E-04 | 4.27E-07 | 2.85E-06 | 1.22E-03 | 5.20E-06 | 2.48E-04 | 5.34E-05 | 2.92E-04 |

# TABLE I-25

SUMMARY OF WEIGHTED EXPOSURE POINT CONCENTRATIONS FOR GREAT BLUE HERONS (ppm)
Central Landfill - OU2
Johnston, Rhode Island

| Constituent | Upper Simmons Reservoir | | | | | Lower Simmons Reservoir | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish |
| *Metals* | | | | | | | | | | |
| Aluminum | 4.73E+03 | 9.60E-02 | 9.60E-02 | 9.60E-02 | 9.60E-02 | 6.69E+03 | 2.03E-01 | 2.03E-01 | 2.03E-01 | 2.03E-01 |
| Arsenic | 1.47E+00 | 4.37E-04 | 2.23E+00 | 1.92E-02 | 1.92E-02 | 5.49E+00 | 1.19E-03 | 8.33E+00 | 5.24E-02 | 5.24E-02 |
| Barium | 2.75E+01 | 2.81E-02 | 6.71E-01 | 2.81E-02 | 2.81E-02 | 9.76E+01 | 3.70E-02 | 2.38E+00 | 3.70E-02 | 3.70E-02 |
| Beryllium | 4.75E+00 | 1.43E-04 | 2.53E-01 | 6.02E-03 | 6.02E-03 | 5.39E+00 | 2.29E-04 | 2.86E-01 | 9.61E-03 | 9.61E-03 |
| Cadmium | 6.77E-01 | 8.43E-05 | 7.32E-01 | 6.83E-03 | 6.83E-03 | 2.50E+00 | NCC | 2.70E+00 | 2.50E-01 | 2.50E-01 |
| Chromium | 4.49E+00 | 7.47E-04 | 3.99E-05 | 1.20E-02 | 1.20E-02 | 1.07E+01 | 1.02E-03 | 9.51E-05 | 1.63E-02 | 1.63E-02 |
| Copper | 7.70E+00 | 1.51E-03 | 3.01E-01 | 3.01E-01 | 3.01E-01 | 1.25E+01 | 3.03E-03 | 6.06E-01 | 6.06E-01 | 6.06E-01 |
| Iron | 5.45E+03 | 5.74E-01 | NCC | NCC | 5.74E-01 | 1.39E+04 | 7.94E-01 | 7.94E-01 | 7.94E-01 | 7.94E-01 |
| Manganese | 1.80E+02 | 1.22E+00 | 1.22E+00 | 1.22E+00 | 1.22E+00 | 4.76E+03 | 1.04E+00 | 1.04E+00 | 1.04E+00 | 1.04E+00 |
| Mercury | 4.69E-02 | NCC | 8.59E-02 | 2.12E-02 | 1.53E-02 | 1.34E-01 | NCC | 2.45E-01 | 6.06E-02 | 1.26E-03 |
| Nickel | 5.10E+00 | 2.99E-03 | 3.69E+00 | 1.41E-01 | 1.41E-01 | 9.27E+00 | 2.24E-03 | 6.70E+00 | 1.06E-01 | 1.06E-01 |
| Selenium | 3.88E-01 | 8.26E-04 | 1.24E+00 | 1.32E-02 | 1.32E-02 | 1.62E+00 | 2.47E-03 | 5.17E+00 | 3.96E-02 | 3.96E-02 |
| Silver | NCC | NCC | NCC | NCC | NCC | NCC | 9.18E-04 | 1.87E-01 | 1.87E-01 | 1.87E-01 |
| Thallium | NCC | 1.06E-03 | 1.06E-03 | 1.06E-03 | 1.06E-03 | 5.71E+00 | NCC | 8.04E-02 | 8.04E-02 | 8.04E-02 |
| Vanadium | 1.46E+01 | 1.25E-03 | 1.25E-03 | 1.25E-03 | 1.25E-03 | 2.30E+01 | 1.95E-03 | 1.95E-03 | 1.95E-03 | 1.95E-03 |
| Zinc | 5.40E+01 | 7.22E-03 | 4.09E+01 | 1.87E+00 | 1.87E+00 | 1.52E+02 | 7.79E-03 | 1.15E+02 | 2.76E+00 | 2.76E+00 |

# TABLE I-25

## SUMMARY OF WEIGHTED EXPOSURE POINT CONCENTRATIONS FOR GREAT BLUE HERONS (ppm)
Central Landfill - OU2
Johnston, Rhode Island

| Constituent | Upper Simmons Reservoir North Basin | | | | |
|---|---|---|---|---|---|
| | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish |
| *Volatile Organic Compounds* | | | | | |
| Acetone | 7.47E-03 | 3.04E-04 | 3.25E+00 | 7.67E-05 | 1.31E-03 |
| carbon disulfide | 4.17E-04 | NCC | 3.41E-05 | 9.48E-09 | 7.02E-08 |
| chloromethane | NCC | NCC | NCC | NCC | NCC |
| 1,2-dichlorobenzene | NCC | 7.81E-05 | 5.13E-03 | 2.37E-03 | 1.29E-02 |
| 1,4-dichlorobenzene | NCC | 1.39E-04 | 5.14E-03 | 4.20E-03 | 2.29E-02 |
| chlorobenzene | 2.37E-03 | 2.16E-03 | 1.03E-03 | 1.14E-02 | 6.21E-02 |
| styrene | NCC | NCC | NCC | NCC | NCC |
| *Semivolatile Organic Compounds* | | | | | |
| acenaphthylene | 4.20E-03 | NCC | 1.82E-03 | 2.54E-06 | 3.90E-05 |
| butylbenzylphthalate | 2.85E-02 | NCC | 1.24E-02 | 4.09E-02 | 2.17E-01 |
| phenol | NCC | NCC | NCC | NCC | NCC |
| 4-chloro-3-methylphenol | NCC | NCC | NCC | NCC | NCC |
| 4-methylphenol | NCC | NCC | NCC | NCC | NCC |
| benzo(a)anthracene | 4.00E-02 | NCC | 1.74E-02 | 1.43E-03 | 2.08E-02 |
| benzo(a)pyrene | 3.36E-02 | NCC | 1.46E-02 | 2.85E-03 | 3.43E-02 |
| benzo(b)flouranthene | 4.60E-02 | NCC | 2.00E-02 | 3.87E-03 | 4.68E-02 |
| carbozole | 1.17E-02 | NCC | 5.12E-03 | 5.00E-06 | 8.24E-05 |
| pyrene | 7.32E-02 | NCC | 3.18E-02 | 5.49E-04 | 9.05E-03 |
| *Pesticides/PCBs* | | | | | |
| Aldrin | 1.35E-04 | NCC | 5.91E-05 | 1.86E-05 | 1.34E-04 |
| delta-BHC | 4.65E-04 | 6.42E-07 | 2.04E-04 | 6.22E-05 | 3.46E-04 |
| Aroclor 1232 | 3.35E-03 | NCC | 1.46E-03 | 6.93E-07 | 1.05E-05 |
| Aroclor 1242 | 3.13E-03 | NCC | 1.36E-03 | 1.42E-04 | 2.45E-03 |
| Aroclor 1254 | 4.49E-03 | NCC | 1.96E-03 | 8.52E-04 | 1.36E-02 |
| DDD | 6.29E-04 | NCC | 2.73E-04 | 1.75E-04 | 1.76E-03 |
| DDE | 5.55E-04 | NCC | 2.41E-04 | 3.93E-04 | 2.49E-03 |
| DDT | 4.40E-04 | NCC | 1.91E-04 | 1.53E-04 | 1.34E-03 |
| Total Chlordanes | 6.30E-04 | NCC | 2.77E-04 | 1.23E-04 | 1.34E-03 |
| Methoxychlor | 7.38E-04 | NCC | 3.23E-04 | 5.19E-06 | 5.91E-05 |
| Total Endosulfans | 4.68E-04 | NCC | 2.04E-04 | 1.75E-07 | 1.76E-06 |

# TABLE I-25

SUMMARY OF WEIGHTED EXPOSURE POINT CONCENTRATIONS FOR GREAT BLUE HERONS (ppm)
Central Landfill - OU2
Johnston, Rhode Island

| Constituent | Upper Simmons Reservoir North Basin | | | | |
|---|---|---|---|---|---|
| | Sediment Arithmetic Mean | Surface Water Arithmetic Mean | Benthic Invertebrates | Amphibians | Fish |
| *Metals* | | | | | |
| Aluminum | 1.30E+03 | 3.61E-02 | 3.61E-02 | 3.61E-02 | 3.61E-02 |
| Arsenic | 5.29E-01 | 1.08E-04 | 8.03E-01 | 4.74E-03 | 4.74E-03 |
| Barium | 8.99E+00 | 1.07E-02 | 2.19E-01 | 1.07E-02 | 1.07E-02 |
| Beryllium | 3.83E-01 | 5.29E-05 | 2.04E-02 | 2.22E-03 | 2.22E-03 |
| Cadmium | 1.20E-01 | 3.71E-05 | 1.30E-01 | 3.01E-03 | 3.01E-03 |
| Chromium | 1.23E+00 | 2.61E-04 | 1.10E-05 | 4.18E-03 | 4.18E-03 |
| Copper | 2.03E+00 | 3.93E-04 | 7.86E-02 | 7.86E-02 | 7.86E-02 |
| Iron | 2.30E+03 | 2.39E-01 | 2.39E-01 | 2.39E-01 | 2.39E-01 |
| Manganese | 5.53E+01 | 5.82E-01 | 5.82E-01 | 5.82E-01 | 5.82E-01 |
| Mercury | 1.23E-02 | NCC | 2.26E-02 | 5.58E-03 | 4.03E-03 |
| Nickel | 2.50E+00 | 1.31E-03 | 1.81E+00 | 6.14E-02 | 6.14E-02 |
| Selenium | 4.69E-02 | 2.49E-04 | 3.99E-03 | 3.99E-03 | 3.99E-03 |
| Silver | NCC | NCC | NCC | NCC | NCC |
| Thallium | 5.81E-02 | 4.86E-04 | 8.19E-04 | 4.86E-04 | 4.86E-04 |
| Vanadium | 7.59E+00 | 4.40E-04 | 4.40E-04 | 4.40E-04 | 4.40E-04 |
| Zinc | 2.04E+01 | 1.60E-03 | 1.55E+01 | 7.54E-02 | 7.54E-02 |

**TABLE I-26**

ENTIRE CENTRAL LANDFILL DRAINAGE AREA
FEEDING AREA NORMALIZED EPCs FOR THE GREAT BLUE HERON
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island
(ppm)

| Constituent | All Central Landfill Water Bodies | | | | |
|---|---|---|---|---|---|
| | Sediment EPC | Surface Water EPC | Benthic Invertebrate EPC | Amphibian EPC | Fish EPC |
| *Volatile Organic Compounds* | | | | | |
| Acetone | 1.20E-01 | 3.32E-03 | 3.27E+00 | 9.03E-05 | 1.38E-03 |
| carbon disulfide | 1.08E-02 | NCC | 8.86E-04 | 7.72E-08 | 9.02E-07 |
| chloromethane | 4.31E-03 | NCC | 1.63E-02 | 2.85E-05 | 1.60E-04 |
| 1,2-dichlorobenzene | 5.46E-02 | 3.09E-04 | 9.60E-03 | 9.29E-03 | 5.06E-02 |
| 1,4-dichlorobenzene | 5.71E-02 | 4.70E-04 | 1.11E-02 | 1.38E-02 | 7.49E-02 |
| chlorobenzene | 1.08E-02 | 6.05E-03 | 2.06E-03 | 1.72E-02 | 9.38E-02 |
| styrene | 1.87E-03 | NCC | 1.53E-04 | 2.69E-07 | 1.86E-06 |
| *Semivolatile Organic Compounds* | | | | | |
| acenaphthylene | 1.93E-02 | NCC | 3.06E-03 | 5.41E-06 | 7.16E-05 |
| butylbenzylphthalate | 5.00E-01 | 1.20E-03 | 5.58E-02 | 2.66E-01 | 1.41E+00 |
| phenol | 5.10E-03 | 2.10E-04 | 3.12E-03 | 4.60E-05 | 2.52E-04 |
| 4-chloro-3-methylphenol | 3.22E-02 | NCC | 1.97E-02 | 6.71E-06 | 1.09E-04 |
| 4-methylphenol | 1.22E-02 | 1.53E-04 | 7.51E-03 | 1.01E-04 | 5.56E-04 |
| benzo(a)anthracene | 2.47E-01 | NCC | 4.20E-01 | 3.42E-02 | 5.00E-01 |
| benzo(a)pyrene | 2.35E-01 | NCC | 5.32E-01 | 1.02E-01 | 1.24E+00 |
| benzo(b)flouranthene | 3.18E-01 | NCC | 1.07E-01 | 2.13E-02 | 2.53E-01 |
| carbozole | 5.80E-02 | NCC | 1.11E-02 | 1.18E-05 | 1.84E-04 |
| pyrene | 3.24E-01 | NCC | 1.02E-01 | 1.81E-03 | 2.93E-02 |
| *Pesticides/PCBs* | | | | | |
| Aldrin | 1.99E-03 | 7.13E-06 | 4.42E-04 | 1.11E-02 | 5.85E-02 |
| delta-BHC | 4.10E-03 | 2.73E-06 | 7.43E-04 | 2.64E-04 | 1.46E-03 |
| Aroclor 1232 | 1.77E-02 | NCC | 2.64E-03 | 1.60E-06 | 2.08E-05 |
| Aroclor 1242 | 1.69E-02 | NCC | 2.49E-03 | 3.00E-04 | 4.68E-03 |
| Aroclor 1254 | 2.15E-02 | NCC | 3.35E-03 | 1.53E-03 | 2.34E-02 |
| DDD | 5.24E-03 | NCC | 9.22E-04 | 9.57E-04 | 7.34E-03 |
| DDE | 5.47E-03 | NCC | 1.02E-03 | 2.45E-03 | 1.24E-02 |
| DDT | 5.39E-03 | 1.79E-05 | 8.04E-04 | 1.81E-01 | 6.96E-01 |
| Total Chlordanes | 4.21E-03 | NCC | 8.63E-04 | 7.41E-04 | 5.68E-03 |
| Methoxychlor | 4.20E-03 | NCC | 6.06E-04 | 1.64E-05 | 1.47E-04 |
| Total Endosulfans | 3.29E-03 | 5.20E-06 | 5.84E-04 | 5.40E-05 | 2.97E-04 |
| *Metals* | | | | | |
| Aluminum | 1.35E+04 | 3.70E-01 | 3.70E-01 | 3.70E-01 | 3.70E-01 |
| Arsenic | 7.73E+00 | 1.83E-03 | 1.17E+01 | 8.05E-02 | 8.05E-02 |
| Barium | 1.43E+02 | 7.90E-02 | 3.48E+00 | 7.90E-02 | 7.90E-02 |
| Beryllium | 1.06E+01 | 4.89E-04 | 5.66E-01 | 2.05E-02 | 2.05E-02 |
| Cadmium | 3.30E+00 | 1.33E-04 | 3.56E+00 | 2.60E-01 | 2.61E-01 |
| Chromium | 1.82E+01 | 2.10E-03 | 1.62E-04 | 3.36E-02 | 3.36E-02 |
| Copper | 2.43E+01 | 5.16E-03 | 1.03E+00 | 1.03E+00 | 1.03E+00 |
| Iron | 2.30E+04 | 1.75E+00 | 1.18E+00 | 1.18E+00 | 1.75E+00 |
| Manganese | 5.03E+03 | 2.92E+00 | 2.92E+00 | 2.92E+00 | 2.92E+00 |
| Mercury | 2.02E-01 | 1.98E-05 | 3.91E-01 | 1.96E-01 | 1.30E-01 |
| Nickel | 1.75E+01 | 6.73E-03 | 1.27E+01 | 3.16E-01 | 3.16E-01 |
| Selenium | 2.05E+00 | 3.66E-03 | 6.42E+00 | 5.85E-02 | 5.85E-02 |
| Silver | 0.00E+00 | 9.18E-04 | 1.87E-01 | 1.87E-01 | 1.87E-01 |
| Thallium | 5.77E+00 | 1.54E-03 | 8.23E-02 | 8.20E-02 | 8.20E-02 |
| Vanadium | 4.67E+01 | 3.79E-03 | 3.79E-03 | 3.79E-03 | 3.79E-03 |
| Zinc | 2.38E+02 | 2.07E-02 | 1.81E+02 | 4.91E+00 | 4.91E+00 |

Notes:

1. Results of this table are based on the assumption that the heron feeds throughout the CLF Drainage Area. EPCs presented are weighted according to the size of the different exposure points within the CLF Drainage Area. The weighted EPC was calculated by multiplying the water body-specific EPC by the ratio of the surface area of that water body to the combined surface area of all water bodies. Weighted EPCs for each water body were then summed to yield the final EPC.
2. NCC = Not a Contaminant of Concern for this media.

**TABLE I-27**

ENTIRE CENTRAL LANDFILL DRAINAGE AREA
CALCULATION OF DAILY DOSES FOR THE GREAT BLUE HERON
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Contaminant | Sediment EPC mg/kg | Water EPC mg/L | Fish Body Burden mg/kg | Amphibian Body Burden mg/kg | Benthic Invertebrate Body Burden mg/kg | Estimated Daily Doses mg/kg-day: Via Fish Ingestion | Via Amphibian Ingestion | Via Invertebrate Ingestion | Via Incidental Soil Ingestion | Via Water Ingestion | Total Daily Dose |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Volatile Organic Compounds*** | | | | | | | | | | | |
| Acetone | 1.20E-01 | 3.32E-03 | 1.38E-03 | 9.03E-05 | 3.27E+00 | 2.02E-04 | 4.88E-07 | 5.89E-02 | 8.41E-04 | 1.49E-04 | 6.01E-02 |
| carbon disulfide | 1.08E-02 | NCC | 9.02E-07 | 7.72E-08 | 8.86E-04 | 1.31E-07 | 4.17E-10 | 1.60E-05 | 7.61E-05 | NCC | 9.22E-05 |
| chloromethane | 4.31E-03 | NCC | 1.60E-04 | 2.85E-05 | 1.63E-02 | 2.34E-05 | 1.54E-07 | 2.93E-04 | 3.03E-05 | NCC | 3.47E-04 |
| 1,2-dichlorobenzene | 5.46E-02 | 3.09E-04 | 5.06E-02 | 9.29E-03 | 9.60E-03 | 7.37E-03 | 5.02E-05 | 1.73E-04 | 3.84E-04 | 1.39E-05 | 7.99E-03 |
| 1,4-dichlorobenzene | 5.71E-02 | 4.70E-04 | 7.49E-02 | 1.38E-02 | 1.11E-02 | 1.09E-02 | 7.43E-05 | 2.00E-04 | 4.01E-04 | 2.12E-05 | 1.16E-02 |
| chlorobenzene | 1.08E-02 | 6.05E-03 | 9.38E-02 | 1.72E-02 | 2.06E-03 | 1.37E-02 | 9.29E-05 | 3.71E-05 | 7.56E-05 | 2.72E-04 | 1.42E-02 |
| styrene | 1.87E-03 | NCC | 1.86E-06 | 2.69E-07 | 1.53E-04 | 2.71E-07 | 1.46E-09 | 2.76E-06 | 1.32E-05 | NCC | 1.62E-05 |
| ***Semivolatile Organic Compounds*** | | | | | | | | | | | |
| acenaphthylene | 1.93E-02 | NCC | 7.16E-05 | 5.41E-06 | 3.06E-03 | 1.04E-05 | 2.92E-08 | 5.51E-05 | 1.36E-04 | NCC | 2.01E-04 |
| butylbenzylphthalate | 5.00E-01 | 1.20E-03 | 1.41E+00 | 2.66E-01 | 5.58E-02 | 2.06E-01 | 1.44E-03 | 1.00E-03 | 3.51E-03 | 5.39E-05 | 2.12E-01 |
| phenol | 5.10E-03 | 2.10E-04 | 2.52E-04 | 4.60E-05 | 3.12E-03 | 3.68E-05 | 2.49E-07 | 5.62E-05 | 3.58E-05 | 9.43E-06 | 1.38E-04 |
| 4-chloro-3-methylphenol | 3.22E-02 | NCC | 1.09E-04 | 6.71E-06 | 1.97E-02 | 1.59E-05 | 3.62E-08 | 3.55E-04 | 2.26E-04 | NCC | 5.97E-04 |
| 4-methylphenol | 1.22E-02 | 1.53E-04 | 5.56E-04 | 1.01E-04 | 7.51E-03 | 8.11E-05 | 5.47E-07 | 1.35E-04 | 8.59E-05 | 6.86E-06 | 3.10E-04 |
| benzo(a)anthracene | 2.47E-01 | NCC | 5.00E-01 | 3.42E-02 | 4.20E-01 | 7.29E-02 | 1.85E-04 | 7.56E-03 | 1.73E-03 | NCC | 8.24E-02 |
| benzo(a)pyrene | 2.35E-01 | NCC | 1.24E+00 | 1.02E-01 | 5.32E-01 | 1.81E-01 | 5.49E-04 | 9.57E-03 | 1.65E-03 | NCC | 1.93E-01 |
| benzo(b)fluoranthene | 3.18E-01 | NCC | 2.53E-01 | 2.13E-02 | 1.07E-01 | 3.68E-02 | 1.15E-04 | 1.93E-03 | 2.23E-03 | NCC | 4.11E-02 |
| carbazole | 5.80E-02 | NCC | 1.84E-04 | 1.18E-05 | 1.11E-02 | 2.68E-05 | 6.35E-08 | 2.00E-04 | 4.07E-04 | NCC | 6.34E-04 |
| pyrene | 3.24E-01 | NCC | 2.93E-02 | 1.81E-03 | 1.02E-01 | 4.27E-03 | 9.76E-06 | 1.84E-03 | 2.27E-03 | NCC | 8.40E-03 |
| ***Polychlorinated Biphenyls and Pesticides*** | | | | | | | | | | | |
| Aldrin | 1.99E-03 | 7.13E-06 | 5.85E-02 | 1.11E-02 | 4.42E-04 | 8.52E-03 | 5.99E-05 | 7.95E-06 | 1.40E-05 | 3.21E-07 | 8.61E-03 |
| delta-BHC | 4.10E-03 | 2.73E-06 | 1.46E-03 | 2.64E-04 | 7.43E-04 | 2.14E-04 | 1.43E-06 | 1.34E-05 | 2.88E-05 | 1.23E-07 | 2.57E-04 |
| Aroclor 1232 | 1.77E-02 | NCC | 2.08E-05 | 1.60E-06 | 2.64E-03 | 3.03E-06 | 8.64E-09 | 4.75E-05 | 1.24E-04 | NCC | 1.75E-04 |
| Aroclor 1242 | 1.69E-02 | NCC | 4.68E-03 | 3.00E-04 | 2.49E-03 | 6.82E-04 | 1.62E-06 | 4.48E-05 | 1.19E-04 | NCC | 8.47E-04 |
| Aroclor 1254 | 2.15E-02 | NCC | 2.34E-02 | 1.53E-03 | 3.35E-03 | 3.42E-03 | 8.27E-06 | 6.03E-05 | 1.51E-04 | NCC | 3.64E-03 |
| DDD | 5.24E-03 | NCC | 7.34E-03 | 9.57E-04 | 9.22E-04 | 1.07E-03 | 5.17E-06 | 1.66E-05 | 3.68E-05 | NCC | 1.13E-03 |
| DDE | 5.47E-03 | NCC | 1.24E-02 | 2.45E-03 | 1.02E-03 | 1.80E-03 | 1.32E-05 | 1.84E-05 | 3.84E-05 | NCC | 1.87E-03 |
| DDT | 5.39E-03 | 1.79E-05 | 6.96E-01 | 1.81E-01 | 8.04E-04 | 1.02E-01 | 9.80E-04 | 1.45E-05 | 3.78E-05 | 8.05E-07 | 1.03E-01 |
| Total Chlordanes | 4.21E-03 | NCC | 5.68E-03 | 7.41E-04 | 8.63E-04 | 8.28E-04 | 4.00E-06 | 1.55E-05 | 2.96E-05 | NCC | 8.78E-04 |
| Methoxychlor | 4.20E-03 | NCC | 1.47E-04 | 1.64E-05 | 6.06E-04 | 2.15E-05 | 8.96E-08 | 1.09E-05 | 2.95E-05 | NCC | 6.20E-05 |
| Total Endosulfans | 3.29E-03 | 5.20E-06 | 2.97E-04 | 5.40E-05 | 5.84E-04 | 4.33E-05 | 2.91E-07 | 1.05E-05 | 2.31E-05 | 2.34E-07 | 7.74E-05 |
| ***Metals*** | | | | | | | | | | | |
| Aluminum | 1.15E+04 | 3.70E-01 | 3.70E-01 | 3.70E-01 | 3.70E-01 | 5.40E-02 | 2.00E-03 | 6.66E-03 | 9.48E+01 | 1.67E-02 | 9.49E+01 |
| Arsenic | 7.73E+00 | 1.83E-03 | 8.05E-02 | 8.05E-02 | 1.17E+01 | 1.17E-02 | 4.35E-04 | 2.11E-01 | 5.43E-02 | 8.23E-05 | 2.78E-01 |
| Barium | 1.43E+02 | 7.90E-02 | 7.90E-02 | 7.90E-02 | 3.48E+00 | 1.15E-02 | 4.27E-04 | 6.26E-02 | 1.00E+00 | 3.55E-03 | 1.08E+00 |
| Beryllium | 1.06E+01 | 4.89E-04 | 2.05E-02 | 2.05E-02 | 5.66E-01 | 2.99E-03 | 1.11E-04 | 1.02E-02 | 7.47E-02 | 2.20E-05 | 8.80E-02 |
| Cadmium | 3.30E+00 | 1.33E-04 | 2.61E-01 | 2.60E-01 | 3.56E+00 | 3.80E-02 | 1.40E-03 | 6.41E-02 | 2.31E-02 | 5.98E-06 | 1.27E-01 |
| Chromium | 1.82E+01 | 2.10E-03 | 3.36E-02 | 3.36E-02 | 1.62E-04 | 4.90E-03 | 1.81E-04 | 2.91E-06 | 1.28E-01 | 9.45E-05 | 1.33E-01 |
| Copper | 2.43E+01 | 5.16E-03 | 1.03E+00 | 1.03E+00 | 1.03E+00 | 1.50E-01 | 5.57E-03 | 1.86E-02 | 1.70E-01 | 2.32E-04 | 3.45E-01 |
| Iron | 2.30E+04 | 1.75E+00 | 1.75E+00 | 1.18E+00 | 1.18E+00 | 2.55E-01 | 6.36E-03 | 2.12E-02 | 1.62E+02 | 7.88E-02 | 1.62E+02 |
| Manganese | 5.03E+03 | 2.92E+00 | 2.92E+00 | 2.92E+00 | 2.92E+00 | 4.26E-01 | 1.58E-02 | 5.26E-02 | 3.53E+01 | 1.31E-01 | 3.59E+01 |
| Mercury | 2.02E-01 | 1.98E-05 | 1.30E-01 | 1.96E-01 | 3.91E-01 | 1.89E-02 | 1.06E-03 | 7.03E-03 | 1.42E-03 | 8.93E-07 | 2.84E-02 |
| Nickel | 1.75E+01 | 6.73E-03 | 3.16E-01 | 3.16E-01 | 1.27E+01 | 4.61E-02 | 1.71E-03 | 2.28E-01 | 1.23E-01 | 3.03E-04 | 3.99E-01 |
| Selenium | 2.05E+00 | 3.66E-03 | 5.85E-02 | 5.85E-02 | 6.42E+00 | 8.54E-03 | 3.16E-04 | 1.15E-01 | 1.44E-02 | 1.65E-04 | 1.39E-01 |
| Silver | 0.00E+00 | 9.18E-04 | 1.87E-01 | 1.87E-01 | 1.87E-01 | 2.73E-02 | 1.01E-03 | 3.37E-03 | 0.00E+00 | 4.13E-05 | 3.17E-02 |
| Thallium | 5.77E+00 | 1.54E-03 | 8.20E-02 | 8.20E-02 | 8.23E-02 | 1.19E-02 | 4.43E-04 | 1.48E-03 | 4.05E-02 | 6.94E-05 | 5.44E-02 |
| Vanadium | 4.67E+01 | 3.79E-03 | 3.79E-03 | 3.79E-03 | 3.79E-03 | 5.53E-04 | 2.05E-05 | 6.83E-05 | 3.28E-01 | 1.71E-04 | 3.29E-01 |
| Zinc | 2.38E+02 | 2.07E-02 | 4.91E+00 | 4.91E+00 | 1.81E+02 | 7.15E-01 | 2.65E-02 | 3.25E+00 | 1.67E+00 | 9.34E-04 | 5.67E+00 |

Notes:

| | |
|---|---|
| Contaminated Fraction of Feeding Area = | 1 |
| Total Daily Food Intake (kg/kg-day) = | 0.18 (EPA, 1993) |
| Total Daily Water Intake (kg/kg-day) = | 0.045 (EPA, 1993) |
| Fraction Composed of Fish = | 0.81 (EPA, 1993) |
| Fraction Composed of Amphibians = | 0.03 (EPA, 1993) |
| Fraction Composed of Invertebrates= | 0.1 (EPA, 1993) |
| Fraction Incidentally Ingested Sediment = | 0.039 (EPA, 1993) |

**TABLE I-28**

UPPER SIMMONS RESERVOIR
CALCULATION OF DAILY DOSES FOR GREAT BLUE HERON
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Contaminant | Sediment EPC mg/kg | Water EPC mg/L | Fish Body Burden mg/kg | Amphibian Body Burden mg/kg | Benthic Invertebrate Body Burden mg/kg | Estimated Daily Doses mg/kg-day: Via Fish Ingestion | Via Amphibian Ingestion | Via Invertebrate Ingestion | Via Incidental Sed. Ingestion | Via Water Ingestion | Total Daily Dose |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Volatile Organic Compounds*** | | | | | | | | | | | |
| Acetone | 1.03E-01 | 2.92E-03 | 7.30E-05 | 1.30E-05 | 8.42E-03 | 1.06E-05 | 7.00E-08 | 1.52E-04 | 7.23E-04 | NCC | 8.85E-04 |
| carbon disulfide | 2.78E-02 | NCC | 2.22E-06 | 1.81E-07 | 2.27E-03 | 3.23E-07 | 9.76E-10 | 4.09E-05 | 1.95E-04 | NCC | 2.37E-04 |
| 1,2-dichlorobenzene | 1.46E-01 | 6.15E-04 | 1.00E-01 | 1.85E-02 | 1.19E-02 | 1.46E-02 | 9.97E-05 | 2.15E-04 | NCC | NCC | 1.50E-02 |
| 1,4-dichlorobenzene | 1.46E-01 | 8.85E-04 | 1.39E-01 | 2.55E-02 | 1.19E-02 | 2.02E-02 | 1.38E-04 | 2.15E-04 | NCC | NCC | 2.06E-02 |
| chlorobenzene | 2.06E-02 | 1.00E-02 | 7.38E-02 | 1.35E-02 | 1.68E-03 | 1.08E-02 | 7.32E-05 | 3.03E-05 | 1.45E-04 | NCC | 1.10E-02 |
| styrene | 5.00E-03 | NCC | 4.95E-06 | 7.19E-07 | 4.09E-04 | 7.22E-07 | 3.88E-09 | 7.36E-06 | 3.51E-05 | NCC | 4.32E-05 |
| ***Semivolatile Organic Compounds*** | | | | | | | | | | | |
| acenaphthylene | 4.03E-02 | NCC | 8.70E-05 | 7.65E-06 | 3.30E-03 | 1.27E-05 | 4.13E-08 | 5.93E-05 | 2.83E-04 | NCC | 3.55E-04 |
| butylbenzylphthalate | 2.25E-01 | 2.71E-03 | 2.67E+00 | 5.03E-01 | 1.84E-02 | 3.89E-01 | 2.72E-03 | 3.31E-04 | 1.58E-03 | NCC | 3.93E-01 |
| benzo(a)anthracene | 3.63E-01 | NCC | 3.60E-02 | 2.58E-03 | 2.97E-02 | 5.24E-03 | 1.39E-05 | 5.34E-04 | 2.55E-03 | NCC | 8.34E-03 |
| benzo(a)pyrene | 3.14E-01 | NCC | 6.07E-02 | 5.20E-03 | 2.57E-02 | 8.84E-03 | 2.81E-05 | 4.62E-04 | 2.21E-03 | NCC | 1.15E-02 |
| benzo(b)flouranthene | 3.97E-01 | NCC | 7.65E-02 | 6.49E-03 | 3.25E-02 | 1.11E-02 | 3.50E-05 | 5.84E-04 | 2.79E-03 | NCC | 1.46E-02 |
| carbozole | 1.13E-01 | NCC | 1.62E-04 | 1.14E-05 | 9.24E-03 | 2.36E-05 | 6.17E-08 | 1.66E-04 | 7.90E-04 | NCC | 9.80E-04 |
| ***Polychlorinated Biphenyls and Pesticides*** | | | | | | | | | | | |
| Aldrin | 1.59E-03 | NCC | 6.89E-04 | 1.16E-04 | 1.30E-04 | 1.01E-04 | 6.27E-07 | 2.34E-06 | 1.12E-05 | NCC | 1.15E-04 |
| delta-BHC | 4.41E-03 | 5.58E-06 | 2.85E-03 | 5.21E-04 | 3.61E-04 | 4.16E-04 | 2.81E-06 | 6.50E-06 | 3.09E-05 | 2.51E-07 | 4.56E-04 |
| Aroclor 1232 | 3.83E-02 | NCC | 2.75E-05 | 2.42E-06 | 3.14E-03 | 4.01E-06 | 1.31E-08 | 5.64E-05 | 2.69E-04 | NCC | 3.29E-04 |
| Aroclor 1242 | 3.67E-02 | NCC | 5.95E-03 | 4.23E-04 | 3.00E-03 | 8.67E-04 | 2.28E-06 | 5.41E-05 | 2.58E-04 | NCC | 1.18E-03 |
| Aroclor 1254 | 4.54E-02 | NCC | 2.64E-02 | 1.81E-03 | 3.72E-03 | 3.84E-03 | 9.79E-06 | 6.69E-05 | 3.19E-04 | NCC | 4.24E-03 |
| DDD | 6.35E-03 | NCC | 4.06E-03 | 5.18E-04 | 5.20E-04 | 5.91E-04 | 2.80E-06 | 9.36E-06 | 4.46E-05 | NCC | 6.48E-04 |
| DDE | 4.75E-03 | NCC | 4.60E-03 | 8.87E-04 | 3.89E-04 | 6.71E-04 | 4.79E-06 | 7.00E-06 | 3.33E-05 | NCC | 7.16E-04 |
| DDT | 8.64E-03 | NCC | 4.92E-03 | 5.56E-04 | 7.07E-04 | 7.18E-04 | 3.00E-06 | 1.27E-05 | 6.06E-05 | NCC | 7.94E-04 |
| Total Chlordanes | 5.16E-03 | NCC | 2.88E-03 | 3.86E-04 | 4.23E-04 | 4.20E-04 | 2.08E-06 | 7.62E-06 | 3.63E-05 | NCC | 4.66E-04 |
| Methoxychlor | 9.25E-03 | NCC | 2.35E-04 | 2.99E-05 | 7.57E-04 | 3.43E-05 | 1.62E-07 | 1.36E-05 | 6.49E-05 | NCC | 1.13E-04 |
| Total Endosulfans | 4.28E-03 | NCC | 7.59E-06 | 1.14E-06 | 3.50E-04 | 1.11E-06 | 6.15E-09 | 6.31E-06 | 3.00E-05 | NCC | 3.75E-05 |
| ***Metals*** | | | | | | | | | | | |
| Aluminum | 1.26E+04 | 2.56E-01 | 2.56E-01 | 2.56E-01 | 2.56E-01 | 3.74E-02 | 1.38E-03 | 4.61E-03 | 8.86E+01 | 1.15E-02 | 8.87E+01 |
| Arsenic | 3.93E+00 | 1.17E-03 | 5.13E-02 | 5.13E-02 | 5.96E+00 | 7.48E-03 | 2.77E-04 | 1.07E-01 | 2.76E-02 | 5.25E-05 | 1.43E-01 |
| Barium | 7.34E+01 | 7.50E-02 | 7.50E-02 | 7.50E-02 | 1.79E+00 | 1.09E-02 | 4.05E-04 | 3.22E-02 | 5.15E-01 | 3.38E-03 | 5.62E-01 |
| Beryllium | 1.27E+01 | 3.83E-04 | 1.61E-02 | 1.61E-02 | 6.74E-01 | 2.34E-03 | 8.68E-05 | 1.21E-02 | 8.90E-02 | 1.72E-05 | 1.04E-01 |
| Cadmium | 1.81E+00 | 2.25E-04 | 1.82E-02 | 1.82E-02 | 1.95E+00 | 2.66E-03 | 9.84E-05 | 3.51E-02 | 1.27E-02 | 1.01E-05 | 5.06E-02 |
| Chromium | 1.20E+01 | 1.99E-03 | 3.19E-02 | 3.19E-02 | 1.06E-04 | 4.65E-03 | 1.72E-04 | 1.92E-06 | 8.40E-02 | 8.97E-05 | 8.90E-02 |
| Copper | 2.05E+01 | 4.02E-03 | 8.04E-01 | 8.04E-01 | 8.04E-01 | 1.17E-01 | 4.34E-03 | 1.45E-02 | 1.44E-01 | 1.81E-04 | 2.80E-01 |
| Iron | 1.45E+04 | 1.53E+00 | 1.53E+00 | NCC | NCC | 2.23E-01 | #VALUE! | #VALUE! | 1.02E+02 | 6.89E-02 | #VALUE! |
| Manganese | 4.81E+02 | 3.25E+00 | 3.25E+00 | 3.25E+00 | 3.25E+00 | 4.74E-01 | 1.76E-02 | 5.85E-02 | 3.38E+00 | 1.46E-01 | 4.08E+00 |
| Nickel | 1.36E+01 | 7.98E-03 | 3.75E-01 | 3.75E-01 | 9.85E+00 | 5.47E-02 | 2.03E-03 | 1.77E-01 | 9.56E-02 | 3.59E-04 | 3.30E-01 |
| Selenium | 1.04E+00 | 2.20E-03 | 3.53E-02 | 3.53E-02 | 3.31E+00 | 5.14E-03 | 1.90E-04 | 5.96E-02 | 7.27E-03 | 9.91E-05 | 7.23E-02 |
| Thallium | NCC | 2.82E-03 | 2.82E-03 | 2.82E-03 | 2.82E-03 | 4.11E-04 | 1.52E-05 | 5.07E-05 | NCC | 1.27E-04 | 6.04E-04 |
| Vanadium | 3.90E+01 | 3.32E-03 | 3.32E-03 | 3.32E-03 | 3.32E-03 | 4.84E-04 | 1.79E-05 | 5.98E-05 | 2.74E-01 | 1.50E-04 | 2.75E-01 |
| Zinc | 1.44E+02 | 1.93E-02 | 5.00E+00 | 5.00E+00 | 1.09E+02 | 7.29E-01 | 2.70E-02 | 1.96E+00 | 1.01E+00 | 8.67E-04 | 3.73E+00 |

Notes:

| | |
|---|---|
| Contaminated Fraction of Feeding Area = | 1 |
| Total Daily Food Intake (kg/kg-day) = | 0.18 (EPA, 1993) |
| Total Daily Water Intake (kg/kg-day) = | 0.045 (EPA, 1993) |
| Fraction Composed of Fish = | 0.81 (EPA, 1993) |
| Fraction Composed of Amphibians = | 0.03 (EPA, 1993) |
| Fraction Composed of Invertebrates= | 0.1 (EPA, 1993) |
| Fraction Incidentally Ingested Sediment = | 0.039 (EPA, 1993) |

**TABLE I-29**

UPPER SIMMONS RESERVOIR NORTH BASIN
CALCULATION OF DAILY DOSES FOR GREAT BLUE HERON
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Contaminant | Sediment EPC mg/kg | Water EPC mg/L | Fish Body Burden mg/kg | Amphibian Body Burden mg/kg | Benthic Invertebrate Body Burden mg/kg | Estimated Daily Doses mg/kg-day | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Via Fish Ingestion | Via Amphibian Ingestion | Via Invertebrate Ingestion | Via Incidental Soil Ingestion | Via Water Ingestion | Total Daily Dose |
| *Volatile Organic Compounds* | | | | | | | | | | | |
| Acetone | 7.17E-02 | 2.92E-03 | 1.25E-02 | 7.37E-04 | 3.12E+01 | 1.83E-03 | 3.98E-06 | 5.62E-01 | 5.03E-04 | 1.31E-04 | 5.65E-01 |
| carbon disulfide | 4.00E-03 | NCC | 6.74E-07 | 9.11E-08 | 3.27E-04 | 9.83E-08 | 4.92E-10 | 5.89E-06 | 2.81E-05 | NCC | 3.41E-05 |
| 1,2-dichlorobenzene | NCC | 7.50E-04 | 1.24E-01 | 2.28E-02 | 4.93E-02 | 1.81E-02 | 1.23E-04 | 8.87E-04 | NCC | 3.38E-05 | 1.91E-02 |
| 1,4-dichlorobenzene | NCC | 1.33E-03 | 2.19E-01 | 4.03E-02 | 4.93E-02 | 3.20E-02 | 2.18E-04 | 8.88E-04 | NCC | 6.00E-05 | 3.32E-02 |
| chlorobenzene | 2.28E-02 | 2.08E-02 | 5.96E-01 | 1.09E-01 | 9.91E-03 | 8.69E-02 | 5.91E-04 | 1.78E-04 | 1.60E-04 | 9.34E-04 | 8.88E-02 |
| *Semivolatile Organic Compounds* | | | | | | | | | | | |
| acenaphthylene | 4.03E-02 | NCC | 3.74E-04 | 2.44E-05 | 1.75E-02 | 5.46E-05 | 1.32E-07 | 3.15E-04 | 2.83E-04 | NCC | 6.53E-04 |
| butylbenzylphthalate | 2.73E-01 | NCC | 2.09E+00 | 3.93E-01 | 1.19E-01 | 3.04E-01 | 2.12E-03 | 2.14E-03 | 1.92E-03 | NCC | 3.10E-01 |
| benzo(a)anthracene | 3.84E-01 | NCC | 1.99E-01 | 1.38E-02 | 1.67E-01 | 2.91E-02 | 7.44E-05 | 3.00E-03 | 2.70E-03 | NCC | 3.49E-02 |
| benzo(a)pyrene | 3.23E-01 | NCC | 3.29E-01 | 2.74E-02 | 1.40E-01 | 4.80E-02 | 1.48E-04 | 2.53E-03 | 2.26E-03 | NCC | 5.29E-02 |
| benzo(b)flouranthene | 4.42E-01 | NCC | 4.49E-01 | 3.72E-02 | 1.92E-01 | 6.55E-02 | 2.01E-04 | 3.46E-03 | 3.10E-03 | NCC | 7.23E-02 |
| carbozole | 1.13E-01 | NCC | 7.91E-04 | 4.81E-05 | 4.91E-02 | 1.15E-04 | 2.59E-07 | 8.84E-04 | 7.90E-04 | NCC | 1.79E-03 |
| *Polychlorinated Biphenyls and Pesticides* | | | | | | | | | | | |
| Aldrin | 1.29E-03 | NCC | 1.29E-03 | 1.78E-04 | 5.67E-04 | 1.88E-04 | 9.64E-07 | 1.02E-05 | 9.08E-06 | NCC | 2.08E-04 |
| delta-BHC | 4.46E-03 | 6.17E-06 | 3.32E-03 | 5.97E-04 | 1.96E-03 | 4.84E-04 | 3.22E-06 | 3.53E-05 | 3.13E-05 | 2.78E-07 | 5.54E-04 |
| Aroclor 1232 | 3.22E-02 | NCC | 1.01E-04 | 6.66E-06 | 1.40E-02 | 1.47E-05 | 3.59E-08 | 2.53E-04 | 2.26E-04 | NCC | 4.93E-04 |
| Aroclor 1242 | 3.00E-02 | NCC | 2.35E-02 | 1.36E-03 | 1.31E-02 | 3.43E-03 | 7.36E-06 | 2.36E-04 | 2.11E-04 | NCC | 3.88E-03 |
| Aroclor 1254 | 4.31E-02 | NCC | 1.30E-01 | 8.19E-03 | 1.88E-02 | 1.90E-02 | 4.42E-05 | 3.38E-04 | 3.03E-04 | NCC | 1.97E-02 |
| DDD | 6.04E-03 | NCC | 1.69E-02 | 1.68E-03 | 2.62E-03 | 2.46E-03 | 9.06E-06 | 4.71E-05 | 4.24E-05 | NCC | 2.56E-03 |
| DDE | 5.33E-03 | NCC | 2.39E-02 | 3.77E-03 | 2.31E-03 | 3.49E-03 | 2.04E-05 | 4.16E-05 | 3.74E-05 | NCC | 3.59E-03 |
| DDT | 4.23E-03 | NCC | 1.29E-02 | 1.47E-03 | 1.83E-03 | 1.88E-03 | 7.92E-06 | 3.30E-05 | 2.97E-05 | NCC | 1.95E-03 |
| Total Chlordanes | 6.05E-03 | NCC | 1.28E-02 | 1.18E-03 | 2.66E-03 | 1.87E-03 | 6.38E-06 | 4.79E-05 | 4.25E-05 | NCC | 1.97E-03 |
| Methoxychlor | 7.08E-03 | NCC | 5.67E-04 | 4.98E-05 | 3.10E-03 | 8.27E-05 | 2.69E-07 | 5.57E-05 | 4.97E-05 | NCC | 1.88E-04 |
| Total Endosulfans | 4.50E-03 | NCC | 1.69E-05 | 1.68E-06 | 1.96E-03 | 2.46E-06 | 9.08E-09 | 3.53E-05 | 3.16E-05 | NCC | 6.94E-05 |
| *Metals* | | | | | | | | | | | |
| Aluminum | 1.25E+04 | 3.47E-01 | 3.47E-01 | 3.47E-01 | 3.47E-01 | 5.06E-02 | 1.87E-03 | 6.25E-03 | 8.78E+01 | 1.56E-02 | 8.79E+01 |
| Arsenic | 5.08E+00 | 1.03E-03 | 4.55E-02 | 4.55E-02 | 7.71E+00 | 6.63E-03 | 2.46E-04 | 1.39E-01 | 3.57E-02 | 4.65E-05 | 1.81E-01 |
| Barium | 8.64E+01 | 1.02E-01 | 1.02E-01 | 1.02E-01 | 2.11E+00 | 1.49E-02 | 5.53E-04 | 3.79E-02 | 6.06E-01 | 4.61E-03 | 6.64E-01 |
| Beryllium | 3.68E+00 | 5.08E-04 | 2.14E-02 | 2.14E-02 | 1.95E-01 | 3.11E-03 | 1.15E-04 | 3.52E-03 | 2.58E-02 | 2.29E-05 | 3.26E-02 |
| Cadmium | 1.16E+00 | 3.57E-04 | 2.89E-02 | 2.89E-02 | 1.25E+00 | 4.21E-03 | 1.56E-04 | 2.25E-02 | 8.12E-03 | 1.61E-05 | 3.50E-02 |
| Copper | 1.95E+01 | 3.78E-03 | 7.55E-01 | 7.55E-01 | 7.55E-01 | 1.10E-01 | 4.08E-03 | 1.36E-02 | 1.37E-01 | 1.70E-04 | 2.65E-01 |
| Iron | 2.21E+04 | 2.30E+00 | 2.30E+00 | 2.30E+00 | 2.30E+00 | 3.35E-01 | 1.24E-02 | 4.13E-02 | 1.55E+02 | 1.03E-01 | 1.55E+02 |
| Manganese | 5.31E+02 | 5.59E+00 | 5.59E+00 | 5.59E+00 | 5.59E+00 | 8.15E-01 | 3.02E-02 | 1.01E-01 | 3.73E+00 | 2.52E-01 | 4.92E+00 |
| Nickel | 2.40E+01 | 1.25E-02 | 5.89E-01 | 5.89E-01 | 1.73E+01 | 8.59E-02 | 3.18E-03 | 3.12E-01 | 1.68E-01 | 5.64E-04 | 5.70E-01 |
| Selenium | 4.50E-01 | 2.39E-03 | 3.83E-02 | 3.83E-02 | 3.83E-02 | 5.58E-03 | 2.07E-04 | 6.89E-04 | 3.16E-03 | 1.08E-04 | 9.74E-03 |
| Thallium | 5.58E-01 | 4.67E-03 | 4.67E-03 | 4.67E-03 | 7.86E-03 | 6.80E-04 | 2.52E-05 | 1.42E-04 | 3.92E-03 | 2.10E-04 | 4.98E-03 |
| Vanadium | 7.29E+01 | 4.23E-03 | 4.23E-03 | 4.23E-03 | 4.23E-03 | 6.17E-04 | 2.28E-05 | 7.61E-05 | 5.11E-01 | 1.90E-04 | 5.12E-01 |
| Zinc | 1.96E+02 | 1.54E-02 | 7.24E-01 | 7.24E-01 | 1.49E+02 | 1.06E-01 | 3.91E-03 | 2.68E+00 | 1.38E+00 | 6.93E-04 | 4.16E+00 |

Notes:

| | |
|---|---|
| Contaminated Fraction of Feeding Area = | 1 |
| Total Daily Food Intake (kg/kg-day) = | 0.18 (EPA, 1993) |
| Total Daily Water Intake (kg/kg-day) = | 0.045 (EPA, 1993) |
| Fraction Composed of Fish = | 0.81 (EPA, 1993) |
| Fraction Composed of Amphibians = | 0.03 (EPA, 1993) |
| Fraction Composed of Invertebrates= | 0.1 (EPA, 1993) |
| Fraction Incidentally Ingested Sediment = | 0.039 (EPA, 1993) |

**TABLE I-30**

LOWER SIMMONS RESERVOIR
CALCULATION OF DAILY DOSES FOR GREAT BLUE HERON
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Contaminant | Sediment EPC mg/kg | Water EPC mg/L | Fish Body Burden mg/kg | Amphibian Body Burden mg/kg | Benthic Invertebrate Body Burden mg/kg | Estimated Daily Doses mg/kg-day: Via Fish Ingestion | Via Amphibian Ingestion | Via Invertebrate Ingestion | Via Incidental Soil Ingestion | Via Water Ingestion | Total Daily Dose |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Volatile Organic Compounds* | | | | | | | | | | | |
| Acetone | 0.1263 | 0.0034 | 9.13E-05 | 1.55E-05 | 2.56E-02 | 1.33E-05 | 8.35E-08 | 4.61E-04 | 8.87E-04 | 1.53E-04 | 1.51E-03 |
| chloromethane | 0.0035 | NCC | 2.59E-04 | 4.60E-05 | 2.63E-02 | 3.78E-05 | 2.49E-07 | 4.74E-04 | 2.46E-05 | NCC | 5.36E-04 |
| *Semivolatile Organic Compounds* | | | | | | | | | | | |
| 4-chloro-3-methylphenol | 0.057 | NCC | 1.93E-04 | 1.19E-05 | 3.49E-02 | 2.81E-05 | 6.41E-08 | 6.28E-04 | 4.00E-04 | NCC | 1.06E-03 |
| *Polychlorinated Biphenyls and Pesticides* | | | | | | | | | | | |
| Aldrin | 1.90E-03 | 1.17E-05 | 9.41E-02 | 1.79E-02 | 3.86E-04 | 1.37E-02 | 9.67E-05 | 6.95E-06 | 1.33E-05 | 5.25E-07 | 1.38E-02 |
| delta-BHC | 3.51E-03 | NCC | 8.82E-05 | 1.16E-05 | 7.14E-04 | 1.29E-05 | 6.28E-08 | 1.28E-05 | 2.46E-05 | NCC | 5.04E-05 |
| DDD | 3.96E-03 | NCC | 7.19E-03 | 1.04E-03 | 8.05E-04 | 1.05E-03 | 5.62E-06 | 1.45E-05 | 2.78E-05 | NCC | 1.10E-03 |
| DDE | 5.55E-03 | NCC | 1.44E-02 | 3.06E-03 | 1.13E-03 | 2.11E-03 | 1.65E-05 | 2.03E-05 | 3.90E-05 | NCC | 2.18E-03 |
| DDT | 3.03E-03 | 3.17E-05 | 1.23E+00 | 3.21E-01 | 6.16E-04 | 1.79E-01 | 1.73E-03 | 1.11E-05 | 2.13E-05 | 1.43E-06 | 1.81E-01 |
| Total Chlordanes | 2.51E-03 | NCC | 4.46E-03 | 6.97E-04 | 5.10E-04 | 6.50E-04 | 3.76E-06 | 9.19E-06 | 1.76E-05 | NCC | 6.81E-04 |
| Total Endosulfans | 2.16E-03 | 9.20E-06 | 5.17E-04 | 9.45E-05 | 4.39E-04 | 7.54E-05 | 5.10E-07 | 7.90E-06 | 1.52E-05 | 4.14E-07 | 9.94E-05 |
| *Metals* | | | | | | | | | | | |
| Aluminum | 1.18E+04 | 3.60E-01 | 3.60E-01 | 3.60E-01 | 3.60E-01 | 5.25E-02 | 1.95E-03 | 6.48E-03 | 8.31E+01 | 1.62E-02 | 8.32E+01 |
| Arsenic | 9.72E+00 | 2.11E-03 | 9.28E-02 | 9.28E-02 | 1.47E+01 | 1.35E-02 | 5.01E-04 | 2.65E-01 | 6.82E-02 | 9.49E-05 | 3.48E-01 |
| Barium | 1.73E+02 | 6.55E-02 | 6.55E-02 | 6.55E-02 | 4.21E+00 | 9.55E-03 | 3.54E-04 | 7.59E-02 | 1.21E+00 | 2.95E-03 | 1.30E+00 |
| Beryllium | 9.54E+00 | 4.05E-04 | 1.70E-02 | 1.70E-02 | 5.07E-01 | 2.48E-03 | 9.19E-05 | 9.13E-03 | 6.70E-02 | 1.82E-05 | 7.87E-02 |
| Cadmium | 4.43E+00 | NCC | 4.43E-01 | 4.43E-01 | 4.78E+00 | 6.45E-02 | 2.39E-03 | 8.60E-02 | 3.11E-02 | NCC | 1.84E-01 |
| Chromium | 1.90E+01 | 1.80E-03 | 2.88E-02 | 2.88E-02 | 1.68E-04 | 4.20E-03 | 1.56E-04 | 3.03E-06 | 1.33E-01 | 8.10E-05 | 1.37E-01 |
| Copper | 2.21E+01 | 5.37E-03 | 1.07E+00 | 1.07E+00 | 1.07E+00 | 1.56E-01 | 5.80E-03 | 1.93E-02 | 1.55E-01 | 2.42E-04 | 3.37E-01 |
| Iron | 2.47E+04 | 1.41E+00 | 1.41E+00 | 1.41E+00 | 1.41E+00 | 2.05E-01 | 7.59E-03 | 2.53E-02 | 1.73E+02 | 6.32E-02 | 1.73E+02 |
| Manganese | 8.42E+03 | 1.84E+00 | 1.84E+00 | 1.84E+00 | 1.84E+00 | 2.68E-01 | 9.92E-03 | 3.31E-02 | 5.91E+01 | 8.27E-02 | 5.95E+01 |
| Nickel | 1.64E+01 | 3.98E-03 | 1.87E-01 | 1.87E-01 | 1.19E+01 | 2.72E-02 | 1.01E-03 | 2.14E-01 | 1.15E-01 | 1.79E-04 | 3.57E-01 |
| Selenium | 2.86E+00 | 4.38E-03 | 7.01E-02 | 7.01E-02 | 9.15E+00 | 1.02E-02 | 3.78E-04 | 1.65E-01 | 2.01E-02 | 1.97E-04 | 1.96E-01 |
| Silver | NCC | 1.63E-03 | 3.32E-01 | 3.32E-01 | 3.32E-01 | 4.83E-02 | 1.79E-03 | 5.97E-03 | NCC | 7.31E-05 | 5.62E-02 |
| Thallium | 1.01E+01 | ND | 1.42E-01 | 1.42E-01 | 1.42E-01 | 2.08E-02 | 7.69E-04 | 2.56E-03 | 7.10E-02 | NCC | 9.51E-02 |
| Vanadium | 4.08E+01 | 3.46E-03 | 3.46E-03 | 3.46E-03 | 3.46E-03 | 5.05E-04 | 1.87E-05 | 6.23E-05 | 2.86E-01 | 1.56E-04 | 2.87E-01 |
| Zinc | 2.68E+02 | 1.38E-02 | 4.89E+00 | 4.89E+00 | 2.03E+02 | 7.13E-01 | 2.64E-02 | 3.66E+00 | 1.88E+00 | 6.21E-04 | 6.29E+00 |

Notes:

| | |
|---|---|
| Contaminated Fraction of Feeding Area = | 1 |
| Total Daily Food Intake (kg/kg-day) = | 0.18 (EPA, 1993) |
| Total Daily Water Intake (kg/kg-day) = | 0.045 (EPA, 1993) |
| Fraction Composed of Fish = | 0.81 (EPA, 1993) |
| Fraction Composed of Amphibians = | 0.03 (EPA, 1993) |
| Fraction Composed of Invertebrates= | 0.1 (EPA, 1993) |
| Fraction Incidentally Ingested Sediment = | 0.039 (EPA, 1993) |

**TABLE I-31**

SEDIMENTATION POND 2 AND 3
CALCULATION OF DAILY DOSE FOR GREAT BLUE HERON
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Contaminant | Sediment EPC mg/kg | Water EPC mg/L | Fish Body Burden mg/kg | Amphibian Body Burden mg/kg | Benthic Invertebrate Body Burden mg/kg | Estimated Daily Doses mg/kg-day | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Via Fish Ingestion | Via Amphibian Ingestion | Via Invertebrate Ingestion | Via Incidental Soil Ingestion | Via Water Ingestion | Total Daily Dose |
| *Volatile Organic Compounds* | | | | | | | | | | | |
| Acetone | 4.29E-02 | NCC | 1.05E-05 | 6.10E-07 | 2.63E-02 | 1.53E-06 | 3.30E-09 | 4.74E-04 | 3.01E-04 | NCC | 7.76E-04 |
| *Semivolatile Organic Compounds* | | | | | | | | | | | |
| phenol | 9.40E-02 | 3.86E-03 | 4.65E-03 | 8.48E-04 | 5.75E-02 | 6.77E-04 | 4.58E-06 | 1.04E-03 | 6.60E-04 | 1.74E-04 | 2.55E-03 |
| 4-methylphenol | 2.26E-01 | 2.81E-03 | 1.02E-02 | 1.87E-03 | 1.38E-01 | 1.49E-03 | 1.01E-05 | 2.49E-03 | 1.58E-03 | 1.26E-04 | 5.70E-03 |
| benzo(a)anthracene | 3.08E-01 | NCC | 7.84E+00 | 5.33E-01 | 6.60E+00 | 1.14E+00 | 2.88E-03 | 1.19E-01 | 2.16E-03 | NCC | 1.27E+00 |
| benzo(a)pyrene | 2.94E-01 | NCC | 2.00E+01 | 1.63E+00 | 8.59E+00 | 2.92E+00 | 8.79E-03 | 1.55E-01 | 2.06E-03 | NCC | 3.08E+00 |
| benzo(b)flouranthene | 4.44E-01 | NCC | 6.36E-01 | 5.27E-02 | 2.72E-01 | 9.27E-02 | 2.84E-04 | 4.89E-03 | 3.11E-03 | NCC | 1.01E-01 |
| carbozole | 7.60E-02 | NCC | 7.50E-04 | 4.57E-05 | 4.65E-02 | 1.09E-04 | 2.47E-07 | 8.37E-04 | 5.34E-04 | NCC | 1.48E-03 |
| pyrene | 5.81E-01 | NCC | 1.01E-01 | 6.13E-03 | 3.56E-01 | 1.47E-02 | 3.31E-05 | 6.40E-03 | 4.08E-03 | NCC | 2.53E-02 |
| *Polychlorinated Biphenyls and Pesticides* | | | | | | | | | | | |
| Aldrin | 3.51E-03 | 1.00E-05 | 9.05E-02 | 1.70E-02 | 2.13E-03 | 1.32E-02 | 9.19E-05 | 3.84E-05 | 2.46E-05 | 4.50E-07 | 1.34E-02 |
| Total Chlordanes | 4.24E-03 | NCC | 1.38E-02 | 1.48E-03 | 2.56E-03 | 2.01E-03 | 7.98E-06 | 4.60E-05 | 2.98E-05 | NCC | 2.09E-03 |
| *Metals* | | | | | | | | | | | |
| Aluminum | 1.38E+04 | 6.30E-01 | 6.30E-01 | 6.30E-01 | 6.30E-01 | 9.19E-02 | 3.40E-03 | 1.13E-02 | 9.71E+01 | 2.84E-02 | 9.72E+01 |
| Arsenic | 4.44E+00 | 1.34E-03 | 5.90E-02 | 5.90E-02 | 6.74E+00 | 8.60E-03 | 3.18E-04 | 1.21E-01 | 3.12E-02 | 6.03E-05 | 1.62E-01 |
| Barium | 1.45E+02 | 5.50E-02 | 5.50E-02 | 5.50E-02 | 3.54E+00 | 8.02E-03 | 2.97E-04 | 6.37E-02 | 1.02E+00 | 2.47E-03 | 1.09E+00 |
| Beryllium | 2.27E+00 | 1.17E-03 | 4.91E-02 | 4.91E-02 | 1.21E-01 | 7.16E-03 | 2.65E-04 | 2.17E-03 | 1.59E-02 | 5.27E-05 | 2.56E-02 |
| Chromium | 3.19E+01 | 1.20E-03 | 1.92E-02 | 1.92E-02 | 2.83E-04 | 2.80E-03 | 1.04E-04 | 5.10E-06 | 2.24E-01 | 5.40E-05 | 2.27E-01 |
| Copper | 3.73E+01 | 3.27E-03 | 6.54E-01 | 6.54E-01 | 6.54E-01 | 9.54E-02 | 3.53E-03 | 1.18E-02 | 2.62E-01 | 1.47E-04 | 3.72E-01 |
| Iron | 2.42E+04 | 2.65E+00 | 2.65E+00 | 2.65E+00 | 2.65E+00 | 3.86E-01 | 1.43E-02 | 4.77E-02 | 1.70E+02 | 1.19E-01 | 1.71E+02 |
| Manganese | 6.73E+02 | 1.53E+00 | 1.53E+00 | 1.53E+00 | 1.53E+00 | 2.24E-01 | 8.28E-03 | 2.76E-02 | 4.72E+00 | 6.90E-02 | 5.05E+00 |
| Mercury | 1.74E-01 | 3.00E-04 | 1.65E+00 | 1.65E+00 | 3.20E-01 | 2.41E-01 | 8.91E-03 | 5.75E-03 | 1.22E-03 | NCC | 2.56E-01 |
| Nickel | 1.14E+01 | 3.13E-03 | 1.47E-01 | 1.47E-01 | 8.25E+00 | 2.14E-02 | 7.94E-04 | 1.48E-01 | 8.00E-02 | 1.41E-04 | 2.51E-01 |
| Selenium | NCC | 2.03E-03 | 3.25E-02 | 3.25E-02 | 3.25E-02 | 4.74E-03 | 1.75E-04 | 5.85E-04 | NCC | 9.14E-05 | 5.59E-03 |
| Vanadium | 2.51E+01 | 2.65E-03 | 2.65E-03 | 2.65E-03 | 2.65E-03 | 3.86E-04 | 1.43E-05 | 4.77E-05 | 1.76E-01 | 1.19E-04 | 1.77E-01 |
| Zinc | 2.24E+02 | 7.22E-02 | 3.39E+00 | 3.39E+00 | 1.70E+02 | 4.95E-01 | 1.83E-02 | 3.06E+00 | 1.58E+00 | 3.25E-03 | 5.15E+00 |

Notes:

| | |
|---|---|
| Contaminated Fraction of Feeding Area = | 1 |
| Total Daily Food Intake (kg/kg-day) = | 0.18 (EPA, 1993) |
| Total Daily Water Intake (kg/kg-day) = | 0.045 (EPA, 1993) |
| Fraction Composed of Fish = | 0.81 (EPA, 1993) |
| Fraction Composed of Amphibians = | 0.03 (EPA, 1993) |
| Fraction Composed of Invertebrates= | 0.1 (EPA, 1993) |
| Fraction Incidentally Ingested Sediment = | 0.039 (EPA, 1993) |

**TABLE I-32**

SEDIMENTATION POND 4
CALCULATION OF DAILY DOSES FOR GREAT BLUE HERON
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Contaminant | Sediment EPC mg/kg | Water EPC mg/L | Fish Body Burden mg/kg | Amphibian Body Burden mg/kg | Benthic Invertebrate Body Burden mg/kg | Estimated Daily Doses mg/kg-day | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Via Fish Ingestion | Via Amphibian Ingestion | Via Invertebrate Ingestion | Via Incidental Sed Ingestion | Via Water Ingestion | Total Daily Dose |
| *Semivolatile Organic Compounds* | | | | | | | | | | | |
| butylbenzylphthalate | 0.205 | 0.01 | 1.07E+01 | 2.00E+00 | 1.02E+00 | 1.56E+00 | 1.08E-02 | 1.83E-02 | 1.44E-03 | 4.50E-04 | 1.59E+00 |
| *Metals* | | | | | | | | | | | |
| Barium | 9.80E+01 | 3.83E-02 | 3.83E-02 | 3.83E-02 | 2.39E+00 | 5.58E-03 | 2.07E-04 | 4.30E-02 | 6.88E-01 | 1.72E-03 | 7.38E-01 |

Notes:

| | | |
|---|---|---|
| Contaminated Fraction of Feeding Area = | 1 | |
| Total Daily Food Intake (kg/kg-day) = | 0.18 | (EPA, 1993) |
| Total Daily Water Intake (kg/kg-day) = | 0.045 | (EPA, 1993) |
| Fraction Composed of Fish = | 0.81 | (EPA, 1993) |
| Fraction Composed of Amphibians = | 0.03 | (EPA, 1993) |
| Fraction Composed of Invertebrates= | 0.1 | (EPA, 1993) |
| Fraction Incidentally Ingested Sediment = | 0.039 | (EPA, 1993) |

**TABLE I-33**

ENTIRE CENTRAL LANDFILL DRAINAGE AREA
GREAT BLUE HERON
ESTIMATED DAILY DOSES COMPARED TO TOXICOLOGICAL REFERENCE DOSES
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Contaminant | | Estimated Daily Dose (mg/kg-day) | Benchmark Dose (mg/kg-day) | | Toxicity Quotients Based On | |
|---|---|---|---|---|---|---|
| | | | LOAEL | NOAEL | LOAEL | NOAEL |
| *Volatile Organic Compounds* | | | | | | |
| Acetone | 4 | 6.01E-02 | 5 | 1 | 1.20E-02 | 6.01E-02 |
| carbon disulfide | | 9.22E-05 | NA | NA | NA | NA |
| chloromethane | 4 | 3.47E-04 | 5 | 0.59 | 6.94E-05 | 5.93E-04 |
| 1,2-dichlorobenzene | 4,10 | 7.99E-03 | 15 | NA | 5.33E-04 | NA |
| 1,4-dichlorobenzene | 4,10 | 1.16E-02 | 15 | NA | 7.74E-04 | NA |
| chlorobenzene | 4,11 | 1.42E-02 | 12 | 6 | 1.18E-03 | 2.36E-03 |
| styrene | | 1.62E-05 | NA | NA | NA | NA |
| *Semivolatile Organic Compounds* | | | | | | |
| acenaphthylene | 7 | 2.01E-04 | 1 | 0.1 | 2.01E-04 | 2.01E-03 |
| butylbenzylphthalate | 8 | 2.12E-01 | 1.1 | 0.11 | 1.93E-01 | 1.93E+00 |
| phenol | 9 | 1.38E-04 | NA | 219.2 | NA | 6.32E-07 |
| 4-chloro-3-methylphenol | 9 | 5.97E-04 | NA | 219.2 | NA | 2.72E-06 |
| 4-methylphenol | 9 | 3.10E-04 | NA | 219.2 | NA | 1.41E-06 |
| benzo(a)anthracene | 7 | 8.24E-02 | 1 | 0.1 | 8.24E-02 | 8.24E-01 |
| benzo(a)pyrene | 6 | 1.93E-01 | 1 | 0.1 | 1.93E-01 | 1.93E+00 |
| benzo(b)flouranthene | 7 | 4.11E-02 | 1 | 0.1 | 4.11E-02 | 4.11E-01 |
| carbozole | | 6.34E-04 | NA | NA | NA | NA |
| pyrene | 7 | 8.40E-03 | 1 | 0.1 | 8.40E-03 | 8.40E-02 |
| *Polychlorinated Biphenyls and Pesticides* | | | | | | |
| Aldrin | 2 | 8.61E-03 | NA | 0.077 | NA | 1.12E-01 |
| delta-BHC | | 2.57E-04 | 2.25 | 0.56 | 1.14E-04 | 4.59E-04 |
| Aroclor 1232 | 3 | 1.75E-04 | 1.8 | 0.18 | 9.70E-05 | 9.70E-04 |
| Aroclor 1242 | | 8.47E-04 | NA | 0.41 | NA | 2.07E-03 |
| Aroclor 1254 | | 3.64E-03 | 1.8 | 0.18 | 2.02E-03 | 2.02E-02 |
| DDD | | 1.13E-03 | 0.028 | 0.003 | 4.03E-02 | 3.76E-01 |
| DDE | | 1.87E-03 | 0.028 | 0.003 | 6.69E-02 | 6.25E-01 |
| DDT | | 1.03E-01 | 0.028 | 0.003 | 3.66E+00 | 3.42E+01 |
| Total DDTR | | 1.06E-01 | 0.028 | 0.003 | 3.77E+00 | 3.52E+01 |
| Total Chlordanes | | 8.78E-04 | 10.7 | 2.1 | 8.20E-05 | 4.18E-04 |
| Methoxychlor | 4 | 6.20E-05 | NA | 14.5 | NA | 4.27E-06 |
| Total Endosulfans | | 7.74E-05 | NA | 10 | NA | 7.74E-06 |
| Hazard Quotient for Organic Compounds | | | | | 4.30E+00 | 4.06E+01 |
| *Metals* | | | | | | |
| Aluminum | | 9.49E+01 | NA | 109.7 | NA | 8.65E-01 |
| Arsenic | | 2.78E-01 | 7.4 | 2.5 | 3.75E-02 | 1.11E-01 |
| Barium | | 1.08E+00 | 41.7 | 20.8 | 2.59E-02 | 5.19E-02 |
| Beryllium | 6 | 8.80E-02 | NA | 0.066 | NA | 1.33E+00 |
| Cadmium | | 1.27E-01 | 20 | 1.45 | 6.33E-03 | 8.73E-02 |
| Chromium | | 1.33E-01 | 5 | 1 | 2.66E-02 | 1.33E-01 |
| Copper | | 3.45E-01 | 61.7 | 47 | 5.60E-03 | 7.35E-03 |
| Iron | | 1.62E+02 | NA | NA | NA | NA |
| Manganese | | 3.59E+01 | NA | 977 | NA | 3.68E-02 |
| Mercury | *(assumed methyl)* | 2.84E-02 | 0.064 | 0.006 | 4.44E-01 | 4.74E+00 |
| Nickel | | 3.99E-01 | 107 | 77.4 | 3.73E-03 | 5.15E-03 |
| Selenium | | 1.39E-01 | 0.8 | 0.4 | 1.74E-01 | 3.47E-01 |
| Silver | 5 | 3.17E-02 | NA | 18.1 | NA | 1.75E-03 |
| Thallium | 6 | 5.44E-02 | 0.0074 | 0.00074 | 7.36E+00 | 7.36E+01 |
| Vanadium | | 3.29E-01 | NA | 11.4 | NA | 2.88E-02 |
| Zinc | | 5.67E+00 | 131 | 14.5 | 4.33E-02 | 3.91E-01 |
| Hazard Quotient for Inorganic Compounds | | | | | 8.12E+00 | 8.17E+01 |
| **Total Hazard Quotient (Organic + Inorganic)** | | | | | **1.24E+01** | **1.22E+02** |

Notes:

1. Except where noted, toxicological benchmark doses were obtained from Oak Ridge National Laboratory (Sample et al., 1996).
2. The toxicity of aldrin was assumed to equal dieldrin as per ATSDR
3. The toxicity of Aroclor 1232 was assumed to equal Aroclor 1254.
4. This toxicological benchmark dose was obtained from EXTOXNET, and divided by an uncertainty factor of 10
5. This toxicological benchmark dose is the NOAEL reported from a chronic study of silver exposed mice, presented in Rattie, 1999.
6. Because there were no available benchmarks for birds, we used the LOAEL and NOAEL reported for the rat in Sample et al., 1996, divided by an uncertainty factor of 10.
7. Because there were no available benchmarks for these PAHs we used the NOAEL and LOAEL for benzo(a)pyrene reported in Sample et al., 1996
8. Because there were no available benchmarks for butylbenzylphthalate we used the benchmark for Di-N-butylphthalate.
9. Because there were no available benchmarks for 4-methylphenol (p-cresol) and 4-chloro-3-methylphenol (p-chloro-m-cresol) we used the benchmark for 2-mehtylphenol (o-cresol)
10. Because there were no available LOAELs for 1,2-dichlorobenze and 1,4-dichlorobenzene in Sample et al., 1996, we used the the lowest LOAEL for 1,4-dichlorobenzene reported in ATSDR Toxicological Profile for 1,4-dichlorobenzene, 1999, divided by an uncertainty factor of 10.
11. Because there were no available benchmarks for chlorobenzene in Sample et al., 1999, we used the the lowest LOAEL and NOAEL for chlorobenzene reported in ATSDR Toxicological Profile

**TABLE I-34**

**UPPER SIMMONS RESERVOIR**
**GREAT BLUE HERON**
**ESTIMATED DAILY DOSES COMPARED TO TOXICOLOGICAL REFERENCE DOSES**
**Central Landfill - OU2 Remedial Investigation**
**Johnston, Rhode Island**

| Contaminant | | Estimated Daily Dose (mg/kg-day) | Benchmark Dose (mg/kg-day) | | Toxicity Quotients Based On | |
|---|---|---|---|---|---|---|
| | | | LOAELc | NOAEL[a] | LOAEL | NOAEL |
| *Volatile Organic Compounds* | | | | | | |
| Acetone | 6 | 8.85E-04 | 5 | 1 | 1.77E-04 | 8.85E-04 |
| carbon disulfide | | 2.37E-04 | NA | NA | | |
| 1,2-dichlorobenzene | 8,10 | 1.50E-02 | 15 | | 9.97E-04 | |
| 1,4-dichlorobenzene | 8,10 | 2.06E-02 | 15 | | 1.37E-03 | |
| chlorobenzene | 6,11 | 1.10E-02 | 12 | 6 | 9.18E-04 | 1.84E-03 |
| styrene | | 4.32E-05 | NA | NA | | |
| *Semivolatile Organic Compounds* | | | | | | |
| acenaphthylene | 7 | 3.55E-04 | 1 | 0.1 | 3.55E-04 | 3.55E-03 |
| butylbenzylphthalate | 8 | 3.93E-01 | 1.1 | 0.11 | 3.57E-01 | 3.57E+00 |
| benzo(a)anthracene | 7 | 8.34E-03 | 1 | 0.1 | 8.34E-03 | 8.34E-02 |
| benzo(a)pyrene | 6 | 1.15E-02 | 1 | 0.1 | 1.15E-02 | 1.15E-01 |
| benzo(b)fluoranthene | 7 | 1.46E-02 | 1 | 0.1 | 1.46E-02 | 1.46E-01 |
| carbozole | | 9.80E-04 | NA | NA | | |
| *Polychlorinated Biphenyls and Pesticides* | | | | | | |
| Aldrin | 2 | 1.15E-04 | NA | 0.077 | NA | 1.49E-03 |
| delta-BHC | | 4.56E-04 | 2.25 | 0.56 | 2.03E-04 | 8.15E-04 |
| Aroclor 1232 | 3 | 3.29E-04 | 1.8 | 0.18 | 1.83E-04 | 1.83E-03 |
| Aroclor 1242 | | 1.18E-03 | NA | 0.41 | NA | 2.88E-03 |
| Aroclor 1254 | | 4.24E-03 | 1.8 | 0.18 | 2.35E-03 | 2.35E-02 |
| DDD | | 6.48E-04 | 0.028 | 0.003 | 2.31E-02 | 2.16E-01 |
| DDE | | 7.16E-04 | 0.028 | 0.003 | 2.56E-02 | 2.39E-01 |
| DDT | | 7.94E-04 | 0.028 | 0.003 | 2.84E-02 | 2.65E-01 |
| Total DDTR | | 2.16E-03 | 0.028 | 0.003 | 7.71E-02 | 7.19E-01 |
| Total Chlordanes | | 4.66E-04 | 10.7 | 2.1 | 4.36E-05 | 2.22E-04 |
| Methoxychlor | 4 | 1.13E-04 | NA | 14.5 | NA | 7.79E-06 |
| Total Endosulfans | | 3.75E-05 | NA | 10 | NA | 3.75E-06 |
| Hazard Quotient for Organic Compounds | | | | | 4.76E-01 | 4.68E+00 |
| *Metals* | | | | | | |
| Aluminum | | 8.87E+01 | NA | 109.7 | | 8.08E-01 |
| Arsenic | | 1.43E-01 | 7.4 | 2.5 | 1.93E-02 | 5.70E-02 |
| Barium | | 5.62E-01 | 41.7 | 20.8 | 1.35E-02 | 2.70E-02 |
| Beryllium | 6 | 1.04E-01 | NA | 0.066 | NA | 1.57E+00 |
| Cadmium | | 5.06E-02 | 20 | 1.45 | 2.53E-03 | 3.49E-02 |
| Chromium | | 8.90E-02 | 5 | 1 | 1.78E-02 | 8.90E-02 |
| Copper | | 2.80E-01 | 61.7 | 47 | 4.54E-03 | 5.97E-03 |
| Iron | | #VALUE! | NA | NA | | |
| Manganese | | 4.08E+00 | NA | 977 | | 4.17E-03 |
| Nickel | | 3.30E-01 | 107 | 77.4 | 3.08E-03 | 4.26E-03 |
| Selenium | | 7.23E-02 | 0.8 | 0.4 | 9.04E-02 | 1.81E-01 |
| Thallium | 6 | 6.04E-04 | 0.0074 | 0.00074 | 8.16E-02 | 8.16E-01 |
| Vanadium | | 2.75E-01 | NA | 11.4 | | 2.41E-02 |
| Zinc | | 3.73E+00 | 131 | 14.5 | 2.85E-02 | 2.57E-01 |
| Hazard Quotient for Inorganic Compounds | | | | | 2.61E-01 | 3.88E+00 |
| **Total Hazard Quotient (Organic + Inorganic)** | | | | | 7.37E-01 | 8.55E+00 |

Notes

1. Except where noted, toxicological benchmark doses were obtained from Oak Ridge National Laboratory (Sample et al., 199
2. The toxicity of aldrin was assumed to equal dieldrin as per ATSDR.
3. The toxicity of Aroclor 1232 was assumed to equal Aroclor 1254.
4. This toxicological benchmark dose was obtained from EXTOXNET, and divided by an uncertainty factor of 10.
5. This toxicological benchmark dose is the NOAEL reported from a chronic study of silver exposed mice, presented in Rattle.
6. Because there were no available benchmarks for birds, we used the LOAEL and NOAEL reported for the rat in Sample et al divided by an uncertaintly factor of 10.
7. Because there were no available benchmarks for these PAHs we used the NOAEL and LOAEL for benzo(a)pyrene reported in Sample et al., 1996
8. Because there were no available benchmarks for butylbenzylphthalate we used the benchmark for Di-N-butylphthalate
9. Because there were no available benchmarks for 4-methylphenol (p-cresol) and 4-chloro-3-methylphenol (p-chloro-m-cresol) we used the benchmark for 2-methylphenol (o-cresol)
10. Because there were no available LOAELs for 1,2-dichlorobenze and 1,4-dichlorobenzene in Sample et al., 1996, we used the the lowest LOAEL for 1,4-dichlorobenzene reported in ATSDR Toxicological Profile for 1,4-dichlorobenzene, 1999, divided by an uncertainty factor of 10.
11. Because there were no available benchmarks for chlorobenzene in Sample et al., 1999, we used the the lowest LOAEL and NOAEL for chlorobenzene reported in ATSDR Toxicological Profile for chlorobenzene, 1999, divided by an uncertainty factor of 10.

**TABLE 8-35**

**UPPER SIMMONS RESERVOIR NORTH BASIN**
**GREAT BLUE HERON**
**ESTIMATED DAILY DOSES COMPARED TO TOXICOLOGICAL REFERENCE DOSES**
**Central Landfill - OU2 Remedial Investigation**
**Johnston, Rhode Island**

| Contaminant | | Estimated Daily Dose (mg/kg-day) | Benchmark Dose (mg/kg-day) | | Toxicity Quotients Based On | |
|---|---|---|---|---|---|---|
| | | | LOAELs | NOAELs | LOAEL | NOAEL |
| Volatile Organic Compounds | | | | | | |
| Acetone | 4 | 5.65E-01 | 5 | 1 | 1.13E-01 | 5.65E-01 |
| carbon disulfide | | 3.41E-05 | NA | NA | | |
| 1,2-dichlorobenzene | 4,10 | 1.91E-02 | 15 | | 1.28E-03 | |
| 1,4-dichlorobenzene | 4,10 | 3.32E-02 | 15 | | 2.21E-03 | |
| chlorobenzene | 4,11 | 8.88E-02 | 12 | 6 | 7.40E-03 | 1.48E-02 |
| *Semivolatile Organic Compounds* | | | | | | |
| acenaphthylene | 7 | 6.53E-04 | 1 | 0.1 | 6.53E-04 | 6.53E-03 |
| butylbenzylphthalate | 8 | 3.10E-01 | 1.1 | 0.11 | 2.82E-01 | 2.82E+00 |
| benzo(a)anthracene | 7 | 3.49E-02 | 1 | 0.1 | 3.49E-02 | 3.49E-01 |
| benzo(a)pyrene | 6 | 5.29E-02 | 1 | 0.1 | 5.29E-02 | 5.29E-01 |
| benzo(b)flouranthene | 7 | 7.23E-02 | 1 | 0.1 | 7.23E-02 | 7.23E-01 |
| carbozole | | 1.79E-03 | NA | NA | | |
| *Polychlorinated Biphenyls and Pesticides* | | | | | | |
| Aldrin | 2 | 2.08E-04 | NA | 0.077 | | 2.70E-03 |
| delta-BHC | | 5.54E-04 | 2.25 | 0.56 | 2.46E-04 | 9.90E-04 |
| Aroclor 1232 | 3 | 4.93E-04 | 1.8 | 0.18 | 2.74E-04 | 2.74E-03 |
| Aroclor 1242 | | 3.88E-03 | NA | 0.41 | NA | 9.47E-03 |
| Aroclor 1254 | | 1.97E-02 | 1.8 | 0.18 | 1.09E-02 | 1.09E-01 |
| DDD | | 2.56E-03 | 0.028 | 0.003 | 9.14E-02 | 8.53E-01 |
| DDE | | 3.59E-03 | 0.028 | 0.003 | 1.28E-01 | 1.20E+00 |
| DDT | | 1.95E-03 | 0.028 | 0.003 | 6.95E-02 | 6.49E-01 |
| Total DDTR | | 8.10E-03 | 0.028 | 0.003 | 2.89E-01 | 2.70E+00 |
| Total Chlordanes | | 1.97E-03 | 10.7 | 2.1 | 1.84E-04 | 9.37E-04 |
| Methoxychlor | 4 | 1.88E-04 | NA | 14.5 | NC | 1.30E-05 |
| Total Endosulfans | | 6.94E-05 | NA | 10 | NC | 6.94E-06 |
| Hazard Quotient for Organic Compounds | | | | | 8.68E-01 | 7.83E+00 |
| *Metals* | | | | | | |
| Aluminum | | 8.79E+01 | NA | 109.7 | NC | 8.01E-01 |
| Arsenic | | 1.81E-01 | 7.4 | 2.5 | 2.45E-02 | 7.25E-02 |
| Barium | 6 | 6.64E-01 | 41.7 | 20.8 | 1.59E-02 | 3.19E-02 |
| Beryllium | 6 | 3.26E-02 | NA | 0.066 | NC | 4.94E-01 |
| Cadmium | | 3.50E-02 | 20 | 1.45 | 1.75E-03 | 2.41E-02 |
| Copper | | 2.65E-01 | 61.7 | 47 | 4.29E-03 | 5.63E-03 |
| Iron | | 1.55E+02 | NA | NA | NC | NC |
| Manganese | | 4.92E+00 | NA | 977 | NC | 5.04E-03 |
| Nickel | | 5.70E-01 | 107 | 77.4 | 5.33E-03 | 7.36E-03 |
| Selenium | 5 | 9.74E-03 | 0.8 | 0.4 | 1.22E-02 | 2.44E-02 |
| Thallium | | 4.98E-03 | 0.0074 | 0.00074 | 6.73E-01 | 6.73E+00 |
| Vanadium | | 5.12E-01 | NA | 11.4 | NC | 4.49E-02 |
| Zinc | | 4.16E+00 | 131 | 14.5 | 3.18E-02 | 2.87E-01 |
| Hazard Quotient for Inorganic Compounds | | | | | 7.68E-01 | 8.52E+00 |
| **Total Hazard Quotient (Organic + Inorganic)** | | | | | **1.64E+00** | **1.64E+01** |

Notes:

1. Except where noted, toxicological benchmark doses were obtained from Oak Ridge National Laboratory '(Sample et a
2. The toxicity of aldrin was assumed to equal dieldrin as per ATSDR.
3. The toxicity of Aroclor 1232 was assumed to equal Aroclor 1254
4. This toxicological benchmark dose was obtained from EXTOXNET, and divided by an uncertainty factor of 10
5. This toxicological benchmark dose is the NOAEL reported from a chronic study of silver exposed mice, 'presented in l
6. Because there were no available benchmarks for birds, we used the LOAEL and NOAEL reported for the rat in Sample et al., 1996, divided by an uncertainty factor of 10.
7. Because there were no available benchmarks for these PAHs we used the NOAEL and LOAEL for benzo(a)pyrene reported in Sample et al., 1996.
8. Because there were no available benchmarks for butylbenzylphthalate we used the benchmark for Di-N-butylphthalate
9. Because there were no available benchmarks for 4-methylphenol (p-cresol) and 4-chloro-3-methylphenol (p-chloro-m-cresol) we used the benchmark for 2-methylphenol (o-cresol)
10. Because there were no available LOAELs for 1,2-dichlorobenze and 1,4-dichlorobenzene in Sample et al., 1996, we used the the lowest LOAEL for 1,4-dichlorobenzene reported in ATSDR Toxicological Profile for 1,4-dichlorobenzene, 1999, divided by an uncertainty factor of 10.
11. Because there were no available benchmarks for chlorobenzene in Sample et al., 1999, we used the the lowest LOAEL and NOAEL for chlorobenzene reported in ATSDR Toxicological Profile for chlorobenzene, 1999, divided by an uncertainty factor of 10.

**TABLE I-36**

**LOWER SIMMONS RESERVOIR**
**GREAT BLUE HERON**
**ESTIMATED DAILY DOSES COMPARED TO TOXICOLOGICAL REFERENCE DOSES**
**Central Landfill - OU2 Remedial Investigation**
**Johnston, Rhode Island**

| Contaminant | Estimated Daily Dose (mg/kg-day) | Benchmark Dose (mg/kg-day) LOAEL[2] | Benchmark Dose (mg/kg-day) NOAEL[3] | Toxicity Quotients Based On LOAEL | Toxicity Quotients Based On NOAEL |
|---|---|---|---|---|---|
| *Volatile Organic Compounds* | | | | | |
| Acetone [4] | 1.51E-03 | 5 | 1 | 3.03E-04 | 1.51E-03 |
| chloromethane [4] | 5.36E-04 | 5 | 0.585 | 1.07E-04 | 9.17E-04 |
| *Semivolatile Organic Compounds* | | | | | |
| 4-chloro-3-methylphenol [9] | 1.06E-03 | NA | 219.2 | NA | 4.82E-06 |
| *Polychlorinated Biphenyls and Pesticides* | | | | | |
| Aldrin [1] | 1.38E-02 | NA | 0.077 | NA | 1.80E-01 |
| delta-BHC | 5.04E-05 | 2.25 | 0.56 | 2.24E-05 | 9.00E-05 |
| DDD | 1.10E-03 | 0.028 | 0.003 | 3.91E-02 | 3.65E-01 |
| DDE | 2.18E-03 | 0.028 | 0.003 | 7.79E-02 | 7.27E-01 |
| DDT | 1.81E-01 | 0.028 | 0.003 | 6.45E+00 | 6.02E+01 |
| Total DDTR | 1.84E-01 | 0.028 | 0.003 | 6.57E+00 | 6.13E+01 |
| Total Chlordanes | 6.81E-04 | 10.7 | 2.1 | 6.36E-05 | 3.24E-04 |
| Total Endosulfans | 9.94E-05 | NA | 10 | NA | 9.94E-06 |
| Hazard Quotient for Organic Compounds | | | | 6.57E+00 | 6.15E+01 |
| *Metals* | | | | | |
| Aluminum | 8.32E+01 | NA | 109.7 | | 7.59E-01 |
| Arsenic | 3.48E-01 | 7.4 | 2.5 | 4.70E-02 | 1.39E-01 |
| Barium | 1.30E+00 | 41.7 | 20.8 | 3.12E-02 | 6.26E-02 |
| Beryllium [6] | 7.87E-02 | NA | 0.066 | | 1.19E+00 |
| Cadmium | 1.84E-01 | 20 | 1.45 | 9.20E-03 | 1.27E-01 |
| Chromium | 1.37E-01 | 5 | 1 | 2.75E-02 | 1.37E-01 |
| Copper | 3.37E-01 | 61.7 | 47 | 5.46E-03 | 7.17E-03 |
| Iron | 1.73E+02 | NA | NA | | |
| Manganese | 5.95E+01 | NA | 977 | | 6.09E-02 |
| Nickel | 3.57E-01 | 107 | 77.4 | 3.34E-03 | 4.61E-03 |
| Selenium | 1.96E-01 | 0.8 | 0.4 | 2.45E-01 | 4.89E-01 |
| Silver [5] | 5.62E-02 | NA | 18.1 | | 3.10E-03 |
| Thallium [6] | 9.51E-02 | 0.0074 | 0.00074 | 1.28E+01 | 1.28E+02 |
| Vanadium | 2.87E-01 | NA | 11.4 | | 2.52E-02 |
| Zinc | 6.29E+00 | 131 | 14.5 | 4.80E-02 | 4.34E-01 |
| Hazard Quotient for Inorganic Compounds | | | | 1.33E+01 | 1.32E+02 |
| **Total Hazard Quotient (Organic + Inorganic)** | | | | **1.98E+01** | **1.93E+02** |

Notes

1. Except where noted, toxicological benchmark doses were obtained from Oak Ridge National Laboratory (Sample et al.,
2. The toxicity of aldrin was assumed to equal dieldrin as per ATSDR.
3. The toxicity of Aroclor 1232 was assumed to equal Aroclor 1254.
4. This toxicological benchmark dose was obtained from EXTOXNET, and divided by an uncertainty factor of 10
5. This toxicological benchmark dose is the NOAEL reported from a chronic study of silver exposed mice, presented in Ra
6. Because there were no available benchmarks for birds, we used the LOAEL and NOAEL reported for the rat in Sample et al., 1996, divided by an uncertainty factor of 10.
7. Because there were no available benchmarks for these PAHs we used the NOAEL and LOAEL for benzo(a)pyrene reported in Sample et al., 1996.
8. Because there were no available benchmarks for butylbenzylphthalate we used the benchmark for Di-N-butylphthalate
9. Because there were no available benchmarks for 4-methylphenol (p-cresol) and 4-chloro-3-methylphenol (p-chloro-m-cresol) we used the benchmark for 2-mehtylphenol (o-cresol).
10. Because there were no available LOAELs for 1,2-dichlorobenze and 1,4-dichlorobenzene in Sample et al., 1996, we used the the lowest LOAEL for 1,4-dichlorobenzene reported in ATSDR Toxicological Profile for 1,4-dichlorobenzene, 1999, divided by an uncertainty factor of 10.
11. Because there were no available benchmarks for chlorobenzene in Sample et al., 1999, we used the the lowest LOAEL and NOAEL for chlorobenzene reported in ATSDR Toxicological Profile for chlorobenzene, 1999, divided by an uncertainty factor of 10

**TABLE I-37**

**SEDIMENTATION PONDS 2 AND 3**
**GREAT BLUE HERON**
**ESTIMATED DAILY DOSES COMPARED TO TOXICOLOGICAL REFERENCE DOSES**
**Central Landfill - OU2 Remedial Investigation**
**Johnston, Rhode Island**

| Contaminant | | Estimated Daily Dose (mg/kg-day) | Benchmark Dose (mg/kg-day) | | Toxicity Quotients Based On | |
|---|---|---|---|---|---|---|
| | | | LOAELs | NOAELs | LOAEL | NOAEL |
| *Volatile Organic Compounds* | | | | | | |
| Acetone | 6 | 7.76E-04 | 5 | 1 | 1.55E-04 | 7.76E-04 |
| *Semivolatile Organic Compounds* | | | | | | |
| phenol | 9 | 2.55E-03 | NA | 219.2 | NA | 1.16E-05 |
| 4-methylphenol | 9 | 5.70E-03 | NA | 219.2 | NA | 2.60E-05 |
| benzo(a)anthracene | 7 | 1.27E+00 | 1 | 0.1 | 1.27E+00 | 1.27E+01 |
| benzo(a)pyrene | 6 | 3.08E+00 | 1 | 0.1 | 3.08E+00 | 3.08E+01 |
| benzo(b)flouranthene | 7 | 1.01E-01 | 1 | 0.1 | 1.01E-01 | 1.01E+00 |
| carbozole | | 1.48E-03 | NA | NA | NA | NA |
| pyrene | 7 | 2.53E-02 | 1 | 0.1 | 2.53E-02 | 2.53E-01 |
| *Polychlorinated Biphenyls and Pesticides* | | | | | | |
| Aldrin | 2 | 1.34E-02 | NA | 0.077 | NA | 1.73E-01 |
| Total Chlordanes | | 2.09E-03 | 10.7 | 2.1 | 1.96E-04 | 9.97E-04 |
| Hazard Quotient for Organic Compounds | | | | | 4.48E+00 | 4.49E+01 |
| *Metals* | | | | | | |
| Aluminum | | 9.72E+01 | NA | 109.7 | NA | 8.86E-01 |
| Arsenic | | 1.62E-01 | 7.4 | 2.5 | 2.18E-02 | 6.46E-02 |
| Barium | | 1.09E+00 | 41.7 | 20.8 | 2.62E-02 | 5.25E-02 |
| Beryllium | 6 | 2.56E-02 | NA | 0.066 | NA | 3.87E-01 |
| Chromium | | 2.27E-01 | 5 | 1 | 4.54E-02 | 2.27E-01 |
| Copper | | 3.72E-01 | 61.7 | 47 | 6.04E-03 | 7.92E-03 |
| Iron | | 1.71E+02 | NA | NA | NA | NA |
| Manganese | | 5.05E+00 | NA | 977 | NA | 5.17E-03 |
| Mercury | *(assumed methyl)* | 2.56E-01 | 0.064 | 0.006 | 4.01E+00 | 4.27E+01 |
| Nickel | | 2.51E-01 | 107 | 77.4 | 2.34E-03 | 3.24E-03 |
| Selenium | | 5.59E-03 | 0.8 | 0.4 | 6.98E-03 | 1.40E-02 |
| Vanadium | | 1.77E-01 | NA | 11.4 | NA | 1.55E-02 |
| Zinc | | 5.15E+00 | 131 | 14.5 | 3.93E-02 | 3.55E-01 |
| Hazard Quotient for Inorganic Compounds | | | | | 4.20E+00 | 4.48E+01 |
| **Total Hazard Quotient (Organic + Inorganic)** | | | | | 8.68E+00 | 8.97E+01 |

Notes:

1. Except where noted, toxicological benchmark doses were obtained from Oak Ridge National Laboratory (Sample et a
2. The toxicity of aldrin was assumed to equal dieldrin as per ATSDR.
3. The toxicity of Aroclor 1232 was assumed to equal Aroclor 1254.
4. This toxocological benchmark dose was obtained from EXTOXNET, and divided by an uncertainty factor of 10.
5. This toxocological benchmark dose is the NOAEL reported from a chronic study of silver exposed mice, presented in1
6. Because there were no available benchmarks for birds, we used the LOAEL and NOAEL reported for the rat in Sample et al., 1996, divided by an uncertaintly factor of 10.
7. Because there were no available benchmarks for these PAHs we used the NOAEL and LOAEL for benzo(a)pyrene reported in Sample et al., 1996
8. Because there were no available benchmarks for butylbenzylphthalate we used the benchmark for Di-N-butylphthalate
9. Because there were no available benchmarks for 4-methylphenol (p-cresol) and 4-chloro-3-methylphenol (p-chloro-m-cresol) we used the benchmark for 2-mehtylphenol (o-cresol)
10. Because there were no available LOAELs for 1,2-dichlorobenze and 1,4-dichlorobenzene in Sample et al., 1996, we used the the lowest LOAEL for 1,4-dichlorobenzene reported in ATSDR Toxicological Profile for 1,4-dichlorobenzene, 1999, divided by an uncertainty factor of 10.
11. Because there were no available benchmarks for chlorobenzene in Sample et al., 1999, we used the the lowest LOAEL and NOAEL for chlorobenzene reported in ATSDR Toxicological Profile for chlorobenzene, 1999, divided by an uncertainty factor of 10.

**TABLE I-38**

SEDIMENTATION POND 4
GREAT BLUE HERON
ESTIMATED DAILY DOSES COMPARED TO TOXICOLOGICAL REFERENCE DOSES
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Contaminant | Estimated Daily Dose (mg/kg-day) | Benchmark Dose (mg/kg-day) | | Toxicity Quotients Based On: | |
|---|---|---|---|---|---|
| | | LOAELs | NOAELs | LOAEL | NOAEL |
| *Semivolatile Organic Compounds* | | | | | |
| butylbenzylphthalate [8] | 1.59E+00 | 1.1 | 0.11 | 1.44E+00 | 1.44E+01 |
| Hazard Quotient for Organic Compounds | | | | 1.44E+00 | 1.44E+01 |
| *Metals* | | | | | |
| Barium | 7.38E-01 | 41.7 | 20.8 | 1.77E-02 | 3.55E-02 |
| Hazard Quotient for Inorganic Compounds | | | | 1.77E-02 | 3.55E-02 |
| **Total Hazard Quotient (Organic + Inorganic)** | | | | **1.46E+00** | **1.45E+01** |

Notes:

1. Except where noted, toxicological benchmark doses were obtained from Oak Ridge National Laboratory (Sample et al., 1996).
2. The toxicity of aldrin was assumed to equal dieldrin as per ATSDR.
3. The toxicity of Aroclor 1232 was assumed to equal Aroclor 1254.
4. This toxicological benchmark dose was obtained from EXTOXNET, and divided by an uncertainty factor of 10.
5. This toxicological benchmark dose is the NOAEL reported from a chronic study of silver exposed mice, presented in Ratte, 1999.
6. Because there were no available benchmarks for birds, we used the LOAEL and NOAEL reported for the rat in Sample et al., 1996, divided by an uncertaintly factor of 10.
7. Because there were no available benchmarks for these PAHs we used the NOAEL and LOAEL for benzo(a)pyrene reported in Sample et al., 1996.
8. Because there were no available benchmarks for butylbenzylphthalate we used the benchmark for Di-N-butylphthalate.

**TABLE I-39**

GREAT BLUE HERON FOOD WEB ASSESSMENT
SUMMARY OF TOXICITY QUOTIENTS AND TOTAL HAZARD QUOTIENTS
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Contaminant | Entire CLF Drainage Area | | Upper Simmons Reservoir | | Upper Simmons Reservoir North Basin | | Lower Simmons Reservoir | | Sedimentation Ponds 2 & 3 and Stream Channels | | Sedimentation Pond 4 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LOEL TQ | NOEL TQ | LOEL TQ | NOEL TQ | LOEL TQ | NOEL TQ | LOEL TQ | NOEL TQ | LOEL TQ | NOEL TQ | LOEL TQ | NOEL TQ |
| Benzo(a)anthracene | | | | | | | | | 1.27 | 12.7 | | |
| Benzo(a)pyrene | | 1.9 | | | | | | | 3.1 | 30.8 | | |
| Butylbenzylphthalate | | 1.9 | | 3.6 | | 2.8 | | | | | 1.4 | 14.4 |
| DDE | | | | | | 1.2 | | | | | | |
| DDT | 3.7 | 34.2 | | | | | 6.5 | 60.2 | | | | |
| Total DDTR | 3.8 | 35.2 | | | | 2.7 | 6.6 | 61.3 | | | | |
| Beryllium | | 1.3 | | 1.6 | | | | 1.2 | | | | |
| Mercury (assumed methyl) | | 4.7 | | | | | | | 4.0 | 42.7 | | |
| Thallium | 7.4 | 74 | | | | 6.7 | 12.8 | 128 | | | | |
| Hazard Quotient (organic) | 4.3 | 40.6 | | 4.7 | | 7.8 | 6.6 | 61.5 | 4.48 | 44.9 | 1.4 | 14.4 |
| Hazard Quotient (inorganic) | 8.1 | 81.7 | | 3.9 | | 8.5 | 13.3 | 132 | 4.2 | 44.8 | | |
| Total Hazard Quotient (organic + inorganic) | 12.4 | 122 | | 8.6 | 1.6 | 16.4 | 19.8 | 193 | 8.7 | 89.7 | 1.5 | 14 |

Notes:

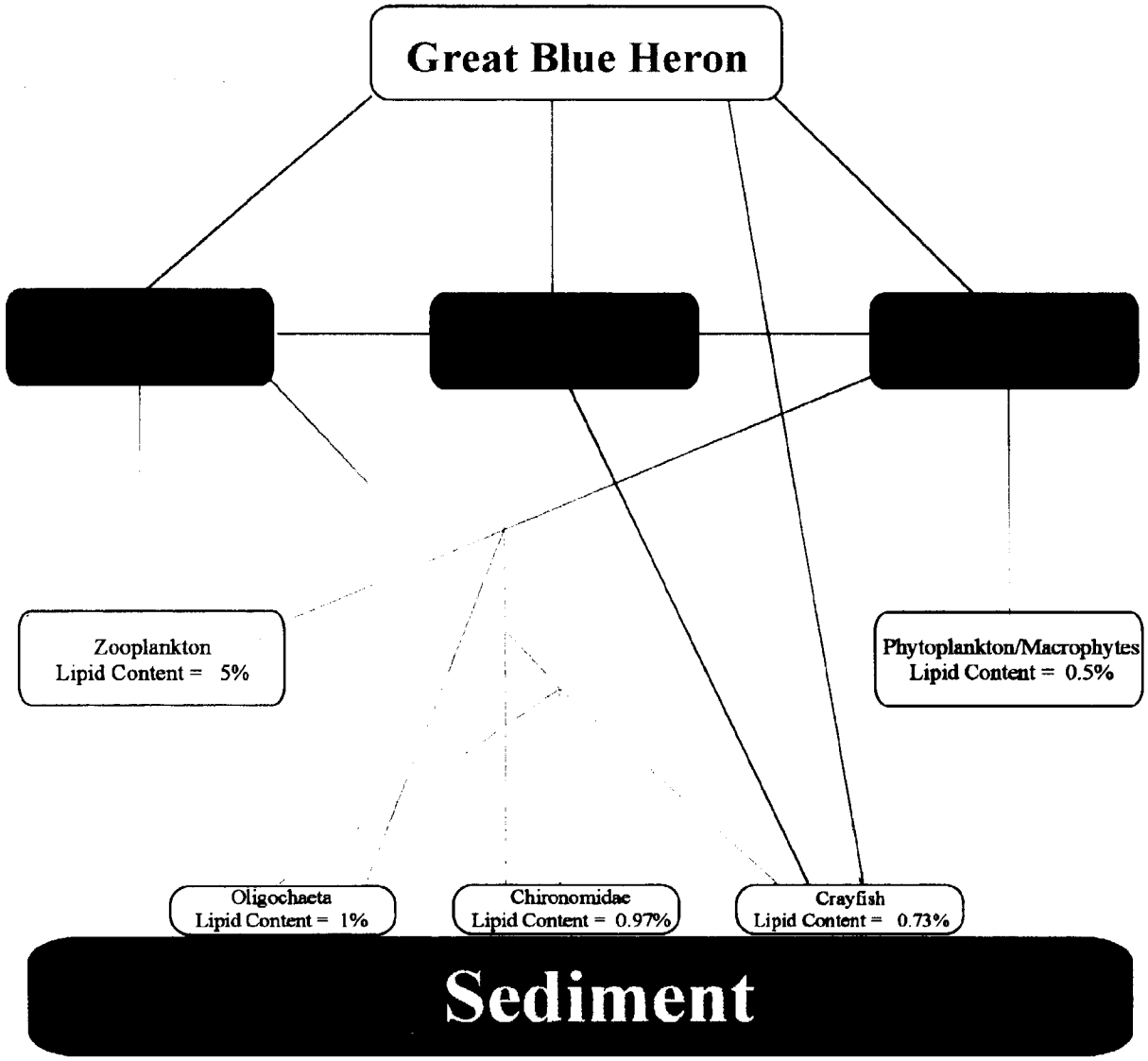
1. The LOEL and NOEL Toxicity Quotients (TQ) are the Estimated Daily Dose for the contaminant divided by the LOEL and NOEL benchmark, resepectively.
2. The Total Hazard Quotient (HQ) for organics is the sum of the individual toxicity quotients for organic COCs; Total Hazard Quotient for inorganics is the sum of the individual toxicity quotients for inorganic COCs; and the Total Hazard Quotient is the sum of the Total Hazard Quotient for organics and the Total Hazard Quotient for inorganics.
3. Only exceedances (Toxicity Quotients or Hazard Quotients that are greater than one) are presented in this table; The Hazard Quotients may be greater than the TQs less than 1 are included in the HQs.
4. The Total Hazard Quotient (HQ) for organics do not include the individual toxicity quotient for Total DDTR.
5. Total DDTR is the sum of DDE, DDD, and DDT.

**TABLE I-40**

EFFECT OF TOTAL ORGANIC CARBON CONTENT IN TOTAL SUSPENDED SOLIDS
ON CALCULATED TISSUE CONTAMINANT CONCENTRATIONS
Upper Simmons Reservoir Delta
Central Landfill - OU2 Remedial Investigation
Johnston, Rhode Island

| Calculation Endpoint | | Aroclor 1254 | | | DDD | | |
|---|---|---|---|---|---|---|---|
| | | (A) TSS TOC = Sed TOC 0.02065 | (B) TSS TOC = 10x Sed TOC 0.2065 | Ratio A/B | (A) TSS TOC = Sed TOC 0.02065 | (B) TSS TOC = 10x Sed TOC 0.2065 | Ratio A/B |
| Total concentration in the water : | [g/l] | 2.00E-07 | 2.00E-07 | 1.00E+00 | 2.00E-08 | 2.00E-08 | 1.00 |
| Bioavailability in water (fraction): | [ASF] | 7.17E-01 | 2.02E-01 | 3.55E+00 | 3.89E-01 | 5.98E-02 | 6.50 |
| Freely dissolved concentration in the water : | [g/l] | 1.43E-07 | 4.04E-08 | 3.55E+00 | 7.78E-09 | 1.20E-09 | 6.50 |
| Concentration in sediment solids (dry weight sediments): | [g/kg] | 3.17E-05 | 3.17E-05 | 1.00E+00 | 6.27E-06 | 6.27E-06 | 1.00 |
| Concentration in phytoplankton (wet weight): | [g/kgPhytoplankton] | 2.85E-04 | 8.05E-05 | 3.55E+00 | 6.16E-05 | 9.49E-06 | 6.50 |
| Concentration in zooplankton (wet weight): | [g/kgZooplankton] | 2.85E-03 | 8.05E-04 | 3.55E+00 | 6.16E-04 | 9.49E-05 | 6.50 |
| Concentration in Chironomidae (wet weight): | [g/kg] | 1.49E-05 | 1.49E-05 | 1.00E+00 | 2.95E-06 | 2.95E-06 | 1.00 |
| Concentration in Oligochaetes (wet weight): | [g/kg] | 1.54E-05 | 1.54E-05 | 1.00E+00 | 3.04E-06 | 3.04E-06 | 1.00 |
| Concentration in Crayfish (wet weight): | [g/kg] | 1.12E-05 | 1.12E-05 | 1.00E+00 | 2.22E-06 | 2.22E-06 | 1.00 |
| Concentration in Pumpkinseed (wet weight): | [g/kg] | 2.73E-03 | 7.89E-04 | 3.47E+00 | 5.49E-04 | 9.37E-05 | 5.85 |
| Concentration in Largemouth bass (wet weight): | [g/kg] | 2.91E-03 | 8.36E-04 | 3.48E+00 | 8.11E-04 | 1.38E-04 | 5.87 |
| Concentration in Bullfrog tadpoles (wet weight): | [g/kg] | 5.65E-04 | 1.60E-04 | 3.53E+00 | 1.76E-04 | 2.77E-05 | 6.37 |

| Calculation Endpoint | | DDE | | | DDT | | |
|---|---|---|---|---|---|---|---|
| | | (A) TSS TOC = Sed TOC 0.02065 | (B) TSS TOC = 10x Sed TOC 0.2065 | Ratio A/B | (A) TSS TOC = Sed TOC 0.02065 | (B) TSS TOC = 10x Sed TOC 0.2065 | Ratio A/B |
| Total concentration in the water : | [g/l] | 2.00E-08 | 2.00E-08 | 1.00 | 2.00E-08 | 2.00E-08 | 1.00 |
| Bioavailability in water (fraction): | [ASF] | 9.16E-02 | 9.99E-03 | 9.18 | 3.94E-01 | 6.12E-02 | 6.45 |
| Freely dissolved concentration in the water : | [g/l] | 1.83E-09 | 2.00E-10 | 9.18 | 7.89E-09 | 1.22E-09 | 6.45 |
| Concentration in sediment solids (dry weight sediments): | [g/kg] | 3.97E-06 | 3.97E-06 | 1.00 | 3.57E-06 | 3.57E-06 | 1.00 |
| Concentration in phytoplankton (wet weight): | [g/kgPhytoplankton] | 9.16E-05 | 9.99E-06 | 9.18 | 6.11E-05 | 9.47E-06 | 6.45 |
| Concentration in zooplankton (wet weight): | [g/kgZooplankton] | 9.16E-04 | 9.99E-05 | 9.18 | 6.11E-04 | 9.47E-05 | 6.45 |
| Concentration in Chironomidae (wet weight): | [g/kg] | 1.86E-06 | 1.86E-06 | 1.00 | 1.68E-06 | 1.68E-06 | 1.00 |
| Concentration in Oligochaetes (wet weight): | [g/kg] | 1.92E-06 | 1.92E-06 | 1.00 | 1.73E-06 | 1.73E-06 | 1.00 |
| Concentration in Crayfish (wet weight): | [g/kg] | 1.41E-06 | 1.41E-06 | 1.00 | 1.27E-06 | 1.27E-06 | 1.00 |
| Concentration in Pumpkinseed (wet weight): | [g/kg] | 6.72E-04 | 8.18E-05 | 8.22 | 5.40E-04 | 8.90E-05 | 6.07 |
| Concentration in Largemouth bass (wet weight): | [g/kg] | 1.12E-03 | 1.38E-04 | 8.14 | 7.95E-04 | 1.31E-04 | 6.08 |
| Concentration in Bullfrog tadpoles (wet weight): | [g/kg] | 3.92E-04 | 4.34E-05 | 9.01 | 1.73E-04 | 2.72E-05 | 6.38 |

# FIGURE 1

## AQUATIC FOOD WEB CONSIDERED FOR EXPOSURE OF GREAT BLUE HERON TO CONTAMINANTS IN SURFACE WATER AND SEDIMENT