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## **RESRAD-Biota Assessment**

Tennessee Valley Authority  
Ash Recovery Project  
Kingston, Tennessee

May 2012



**RESRAD-Biota  
Assessment**

Tennessee Valley Authority  
Ash Recovery Project  
Kingston, Tennessee

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**Acronyms**

BERA	baseline ecological risk assessment
COPEC	constituent of potential ecological concern
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ER	Emory River
ERA	ecological risk assessment
HI	hazard index
HQ	hazard quotient
mGy	milligray
RBE	relative biological effectiveness
RWF	radiation weighting factor
TVA	Tennessee Valley Authority



## **1. Introduction**

This appendix presents the assessment of radiological risks to non-human biota in the three rivers associated with the Tennessee Valley Authority (TVA) Kingston Ash Recovery Project: Emory, Clinch, and Tennessee Rivers. The radiological ecological risk assessment (ERA) is presented separately because some of the exposure scenarios and effects analyses are unlike those used for chemical risk assessments. The U.S. Department of Energy's (DOE) RESRAD-Biota software was used to evaluate the radiological risks to non-human biota. The RESRAD-Biota software was developed by the DOE with support from the U.S. Environmental Protection Agency (EPA) and the Nuclear Regulatory Commission.

RESRAD-Biota is based on the DOE Technical Standard “A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota” (Graded Approach) (DOE 2002). The Graded Approach is a comprehensive and systematic method for assessing the potential effects of ionizing radiation in the environment on non-human organisms. The Graded Approach is consistent with the standard ERA framework, and is organized in a series of successively realistic tiers or levels. A brief discussion of radiation-specific considerations is provided below for each component of the ERA framework, followed by a description of the analyses and assumptions used to evaluate radiological risks for the TVA Kingston Ash Recovery Project.

## **2. Radiological-Specific Considerations**

The ERA framework is widely used to evaluate potential risk to non-human biota from chemical and radiological exposure. The three primary elements of the ERA methodology are:

- Problem formulation,
- Exposure and effects analysis, and
- Risk characterization.

ERAs are typically done in successively rigorous tiers (e.g., Tier I, Tier II, Tier III), each of which includes the three general elements of an ERA (Suter, Efroymson, et al. 2000). The first tier is a simple scoping assessment to determine whether an ERA is warranted. The second tier is a screening level ERA in which relatively simple and conservative assumptions are used. The third tier is a definitive ERA in which relatively detailed and realistic estimates are made of the nature and magnitude of exposure and effects.

The DOE's Graded Approach also moves from a simple and relatively conservative screening phase to a more detailed and realistic assessment phase. Each Tier or Level in the Graded Approach addresses all three of the primary elements of an ERA, either explicitly or implicitly. That is, the Graded Approach (DOE 2002) is a framework for organizing the successively rigorous ERA tiers, with particular emphasis on radiological issues.

### **2.1 Problem Formulation – Radiological Risk Evaluation**

Many aspects of the problem formulation for radiological risk assessments are similar to those for chemical risk assessments. An important distinction is that the stressor evaluated in a radiological ERA is ionizing radiation resulting from the decay of unstable isotopes, rather than the isotopes themselves. This accounts for many of the distinct methods and assumptions used to estimate exposure and effects in a radiological ERA, as described in more detail below. One such method is the use of exposure models based on generic shapes (e.g., an ellipsoid or sphere). An important assumption is that the potential for adverse effects is appropriately based on only two effects values, one for aquatic animals and one for terrestrial plants and animals.

It is because of these standard methods and assumptions that the RESRAD-Biota model and Graded Approach include only four basic receptors: terrestrial animals, terrestrial plants, riparian animals, and aquatic animals. RESRAD-Biota includes tools for adjusting these models to be more representative of specific organisms, but these models are still limited by the relative lack of dosimetry data for non-human biota.

## **2.2 Exposure Analysis – Radiological Risk Evaluation**

Exposure is defined as the contact or co-occurrence of a stressor with a receptor. The exposure analysis estimates the magnitude of exposure in terms of intensity, space, and time in units that can be combined with the effects analysis (Jones, Domotor, et al. 2003). As noted above, ionizing radiation is the stressor evaluated in a radiological ERA. The ionizing radiations of primary concern in environmental assessments include alpha particles, electrons (often incorrectly referred to as beta particles), and photons (often referred to as gamma rays or x-rays). Each isotope may be associated with more than one of these three ionizing radiations.

Radiation exposure is calculated as the relevant quantities of the energy imparted to tissue by a radiation field, otherwise known as an absorbed dose. Weighted absorbed dose rates, which account for the varying relative biological effectiveness of the three primary types of radiation, are additive. For comparison with standard radiation effects values, radiation exposure models must account for all pathways and sources of ionizing radiation. This includes internal and external exposures to all three types of ionizing radiation from all co-located radionuclides. The total ( $D_{Total}$ ), total internal ( $D_{internal, total}$ ), and total external ( $D_{external, total}$ ) radiation dose rates are represented by the following equations (Jones, Domotor, et al. 2003):

$$D_{Total} = D_{internal, total} + D_{external, total}$$

$$D_{internal, total} = D_{internal, alpha} + D_{internal, electrons} + D_{internal, photons}$$

$$D_{external, total} = D_{external, electrons} + D_{external, photons}$$

Internal radiation exposures arise from the respiration and consumption of contaminated media and food items. Internal exposure is based on the amount of a radionuclide incorporated into the organism. Biological uptake and environmental fate of radionuclides is generally determined by elemental properties, rather than isotopic characteristics. That is, uptake of radioactive uranium by an aquatic animal will be essentially the same as the uptake of stable uranium. Conservative default uptake factors are provided for the radionuclides included in RESRAD-Biota. Site-specific uptake factors or measured organism concentrations can be substituted for the default parameters if available.

External radiation exposures are those from radionuclides in ambient media to which the receptor is in proximity (e.g., immersed, touching, or nearby). External exposure accounts for all of the radiation that has the potential to break the surface barrier of the organism (e.g., skin, fur, shell, or chitin). Alpha particles are too massive to penetrate skin or outer layers of tissue. Therefore, external exposure is generally estimated only for electrons and photons, because these radiations are generally capable of penetrating an organism sufficiently to reach radiosensitive target tissues (reproductive organs and cells).

There are some limitations associated with calculating an absorbed dose for non-human biota. For example, dosimetric models for non-human biota do not account for metabolic behavior of the radionuclide, the penetration of various emitted radiations in a variety of tissues, and the actual geometry of the organism

(Jones, Domotor, et al. 2003). Most dosimetric models also don't explicitly account for the non-uniform distribution of radionuclides inside an organism and in the surrounding environment. The RESRAD-Biota models assume uniform internal distribution of the radionuclide for purposes of estimating internal dose. External dose is estimated assuming a uniform distribution of the radionuclide in ambient media. These simplified models are considered reasonably conservative because reproductive tissues are not generally expected to be a biological sink for radionuclides (Kaye and Dunaway 1962; Garten 1981; Garten, Bondiotti, et al. 1987).

Another distinction between chemical and radiation exposure analyses is the quantification of short-lived radioactive decay products and their emitted radiations. This is accomplished by assuming that the parent and progeny radionuclides are in secular equilibrium, meaning that the daughter products are assumed to be at the same activity level as the parent. Thus, the environmental fate and biological uptake are estimated based only on the elemental characteristics of the parent radionuclide. The definition of a "short-lived" isotope varies, but often includes progeny with a half-life of 30 days or less. RESRAD-Biota includes two options for the definition of short-lived:

- Half-life  $\leq$  100 Years, or
- Half-life  $\leq$  180 Days.

Both options are conservative in that they assume near instantaneous buildup in an organism of all decay products. However, the 100-years cut-off may result in double counting the dose from what are otherwise considered long-lived radionuclides. For example, thorium-228 is one of the daughter products of radium-228 radioactive decay. Thorium-228 has a half-life of 1.9 years and is included in the Method Analytical Group for the river system investigation. Including both radium-228 and thorium-228 as parent isotopes in RESRAD-Biota will effectively double count the dose rate from thorium-228 (and that of its short-lived progeny) when the cut-off for short-lived progeny is set to 100-years. Thus, in this case the 100-years cut-off is excessively conservative for radium-228 and other similar isotopes.

### **2.3 Effect Analysis – Radiological Risk Evaluation**

The effects analysis estimates the nature and magnitude of effects based on the type and duration of exposure. As noted above, ionizing radiation is the stressor of concern in a radiological ERA. Ionizing radiation is defined as radiated energy that is energetic enough to eject one or more orbital electrons from the target atom or molecule. Ionization can produce free radicals, which are chemically unstable atoms or molecules that have an odd number of electrons. These highly reactive products scavenge electrons by breaking chemical bonds, including those in cell membranes and deoxyribonucleic acid (DNA) molecules. Thus, ionizing radiation can cause cell death and mutations (i.e., cancer).

As with ERAs for chemicals, radiological ERAs evaluate potential risks to receptor populations and communities, rather than individual organisms. Reduced reproduction is one of the most relevant chronic

effects for populations (EPA 1998; Suter, Efroymson, et al. 2000) and reproductive tissues are more sensitive to irradiation than are non-reproductive tissues (NCRP 1991; IAEA 1992). Thus, impairment of reproductive capability appears to be a critical biological effect for radiation exposures of aquatic and terrestrial biota (NCRP 1991; IAEA 1992). It also follows that populations and communities will not be adversely affected if the most sensitive organisms are not reproductively impaired.

An organism's sensitivity to ionizing radiation is referred to as radiosensitivity, which varies among species and life stages. The scientific literature on this subject indicates that more biologically complex organisms tend to be more radiosensitive (Jones, Domotor, et al. 2003). The life stage of an organism also determines its radiosensitivity; organisms in the early stages of development are known to be more radiosensitive due to the high activity of cell division and differentiation. However, considerable uncertainty remains in the field of radiosensitivity for non-human biota. For example, radiosensitivity has been shown to vary by several orders of magnitude among similar species exposed to the same radionuclides (Jones, Domotor, et al. 2003).

The DOE Technical Standard (DOE 2002), or Graded Approach, provides the following "Dose Rate Guidelines" for the protection of populations of plants and animals from exposure to ionizing radiation:

- Aquatic animals and terrestrial plants — 1 rad/d [10 milligray per day (mGy/day)] absorbed dose; and
- Terrestrial animals — 0.1 rad/d (1 mGy/day) absorbed dose.

These guidelines are not intended to serve as a "bright line" that, if exceeded, would trigger a mandatory regulatory or remedial action (DOE 2002). Rather, they are the dose rates to populations of plants and animals that may warrant further evaluation or action. These dose rates are based on detailed reviews of the scientific knowledge regarding effects of ionizing radiation on plants and animals (NCRP 1991; IAEA 1992). These reviews identified the "safe levels" of exposure based on the understanding that the population will be adequately protected if the dose rate to the maximally exposed individual does not exceed that level of exposure. An expert review panel evaluated the available effects data for aquatic and terrestrial organisms and concluded that existing data support the application of the expected safe levels of exposure to representative rather than maximally exposed individuals (Barnhouse 1995). That is, exposure below the recommended dose limits would not cause adverse effects at the population level, even though some individuals within the population might be adversely affected.

Characterization of radiological risk to an organism must consider the cumulative effect of all radiation exposures. However, the three primary types of ionizing radiation do not all have the same biological effectiveness. Thus, relative biological effectiveness (RBE) is included in the dose models so that the quantities of absorbed doses from each type of radiation can be summed to a total absorbed dose. This is accomplished by applying a radiation weighting factor (RWF) for each type of radiation. For example, alpha particles are considered 20 times more tissue damaging than electrons and photons when estimating potential risks of increased cancer incidence in humans.

However, the effects on reproduction in non-human biota from radiation exposure are believed to be deterministic in nature, not stochastic (UNSCEAR 1996). Deterministic effects are those for which the severity is a function of dose, and for which an apparent threshold usually exists. Stochastic effects are those for which the probability of occurrence is a function of dose, without an apparent threshold, but the severity of the effect is independent of dose (i.e., the incidence of cancer). The true RBE for deterministic effects of alpha particles is estimated to be approximately a factor of 3 to 4, based on measured dose-effects data (Kocher and Trabalka 2000). Even so, the Graded Approach and RESRAD-Biota use a conservative default RWF of 20 for alpha particles; the default RWF is 1 for electrons and protons.

## **2.4 Risk Characterization – Radiological Risk Evaluation**

The risk characterization phase involves combining the results of the exposure and the effects analysis to provide an estimate of the probability and magnitude of adverse effects. As with the exposure and effects analyses, risk characterization is an iterative process beginning with a screening level followed by increasingly realistic and reasonable tiers.

Radiological risks are characterized using the hazard ratio, or hazard quotient (HQ), methodology whereby estimated exposure rates are divided by a threshold effects value. If the exposure rate exceeds the threshold, then the HQ (i.e., hazard ratio) will be greater than 1. The accepted guidelines for effects of radiation on non-human biota are based on total absorbed dose. Therefore, the sum of the hazard ratios for all isotopes and pathways must be calculated for each receptor. This sum of ratios (DOE 2002) is traditionally referred to as a hazard index (HI) in risk assessments for chemicals. Given the conservatism of the effects guidelines and RESRAD-Biota exposure estimates, an HI less than or equal to 1 provides strong evidence that ionizing radiation does not pose an unacceptable risk to the receptor in question. Similarly, a HI greater than 1 (to one significant figure) suggests that risks are possible, though not necessarily probable.

### **3.0 Radiological ERA for TVA Kingston BERA**

Potential radiological ecological risks for the River System Baseline Ecological Risk Assessment (BERA) were evaluated using the DOE RESRAD-Biota program, which is based on the DOE Technical Standard "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota" (DOE 2002). As noted above, RESRAD-Biota and the Graded Approach include only four basic receptors: terrestrial animals, terrestrial plants, riparian animals, and aquatic animals. This simplified list of receptors is reflective of the relative lack of radiological exposure and effects data for non-human biota. That is, the consensus "safe levels" of exposure to ionizing radiation (NCRP 1991; IAEA 1992) are specified only for "terrestrial animals" (0.1 rad/d), "terrestrial plants" (1 rad/d), and "aquatic animals" (0.1 rad/d). The standard exposure models are also relatively simple.

In contrast, the River System BERA for chemical exposures included 17 specific receptors representing nine general receptor groups. The exhibit below shows how the BERA receptor groups are mapped against the four generic RESRAD-Biota receptors.

<b>BERA Receptors</b>	<b>RESRAD-Biota Receptors</b>
Fish	Aquatic Animal
Benthic macroinvertebrates	Aquatic Animal
Aquatic- and riparian-feeding birds	Terrestrial Animal and Riparian Animal
Aquatic- and riparian-feeding mammals	Terrestrial Animal and Riparian Animal
Aerial-feeding birds	Terrestrial Animal and Riparian Animal
Aerial-feeding mammals	Terrestrial Animal and Riparian Animal
Aquatic and riparian plants	Terrestrial Plant
Amphibians	Aquatic Animal
Reptiles	Aquatic Animal

Radiological data are available for three types of ambient media: surface water, seasonally-exposed sediment, and submerged sediment. The following table shows the media used for the risk evaluation for each RESRAD-Biota receptor.

<b>RESRAD-Biota Receptor</b>	<b>Applied Media</b>
Terrestrial Animal	Surface Water, Seasonally-Exposed Sediment (as soil)
Terrestrial Plant	Surface Water, Seasonally-Exposed Sediment (as soil)
Aquatic Animal	Surface Water, Submerged Sediment
Riparian Animal	Surface Water, Submerged Sediment

Potential radiological risks to these receptors were evaluated by reach for each of the three rivers. This is consistent with the approach used throughout the BERA.

### **3.1 Radiological Risk Characterization: Levels 1 and 2**

Consistent with the DOE Graded Approach, the RESRAD-Biota software includes a very simplified Level 1 scoping analysis. The Level 1 evaluation was neither necessary nor informative, given the availability of radiological data and the dose modeling needed to satisfy the objectives of the BERA. Therefore, the assessment of radiological ecological risks proceeded directly to RESRAD-Biota Level 2.

Exposures were calculated using the maximum detected concentration, by reach, for radionuclides detected at least once across all reaches in a given medium. For reaches in which only non-detects are available, the maximum detection limit was carried through the exposure model. This conservative approach is likely to overestimate potential risks for infrequently detected radionuclides.

A HQ was calculated for each radionuclide by medium and receptor. Specifically, the total absorbed dose rate for each radionuclide in a medium was calculated as the sum of the internal and external exposures to all three types of radiation from the parent isotope and all short-lived progeny. Internal exposures were based on ingestion or respiration of the parent isotope via dietary and direct exposure pathways. The denominator of the HQ was the consensus Dose Rate Guideline (“safe level”) of exposure to ionizing radiation (NCRP 1991; IAEA 1992) for the appropriate type of organism (i.e., 1 rad/d for aquatic animals and terrestrial plants; 0.1 rad/d for terrestrial and riparian animals). A HI (sum of hazard ratios) was calculated for each receptor type by reach as the sum of the HQs for all radionuclides and media. Receptor and reach combinations with a HI greater than 1 were carried forward to Level 3 for further evaluation.

Table 1 presents the Level 2 HQs and HIs for each reach and organism combination. The corresponding RESRAD-Biota Input Parameter Reports and Dose Reports are included in Attachments A and B,

respectively. The estimated HIs were less than 1.0 for all receptors in all reaches of the Clinch and Tennessee Rivers. Reaches A, B, and C of the Emory River had HIs greater than 1 for riparian animals. These three reaches were consequently carried forward into the Level 3 analysis. Level 2 results are briefly described below for each of the RESRAD-Biota receptors.

### 3.2.1 Aquatic Animal

All reaches in all rivers had HIs less than 1 for aquatic animals (Table 1). Consequently, this organism was not carried forward into a Level 3 evaluation.

### 3.2.2 Riparian Animal

For the riparian animal, three reaches had a Level 2 HI greater than 1.0, as shown in Tables 1 and 2 and summarized below:

- Emory River Reach A has a HI of 1.31; radium-228 accounted for 53 percent of the HI, while potassium-40 and radium-226 each accounted for 19 percent of the absorbed dose rate.
- Emory River Reach B has a HI of 1.86; radium-228 accounted for 57 percent of the HI, while potassium-40 and radium-226 accounted for 12 percent and 24 percent of the absorbed dose rate, respectively.
- Emory River Reach C has a HI of 1.70; radium-228 accounted for 74 percent of the HI, while potassium-40 accounted for 13 percent of the absorbed dose rate.

These results indicate that radium-228 and, to a lesser extent, radium-226 are the primary radiological constituents of potential ecological concern (COPECs) at the site. It is important to note that radium-228 was not detected in surface water of Emory River (ER) reaches ER\_A and ER\_B. Therefore, the estimated water ingestion and food chain dose rates for those reaches are conservatively based on the maximum detection limit value in surface water. It is those pathways that drive the risk estimates for riparian animals.

### 3.2.3 Terrestrial Animal

All reaches in all rivers had HIs less than 1 for terrestrial animals (Table 1). Consequently, this organism was not carried forward into a Level 3 evaluation.

### 3.2.4 Terrestrial Plant

All reaches in all rivers had HIs less than 1 for terrestrial plants (Table 1). Consequently, this organism was not carried forward into a Level 3 evaluation.

### **3.2 Radiological Risk Characterization: Level 3**

As noted above, the Level 2 HIs for riparian animals exceeded 1.0 for ER\_A, ER\_B, and ER\_C and radium-228 in surface water was the risk driver in all three reaches. In a Level 2 evaluation RESRAD-Biota defaults to a 100-years half-life threshold for short-lived decay products. Assuming that all decay products with half-lives up to 100 years are in secular equilibrium with (i.e., at the same concentration as) the parent radionuclide is considered excessively conservative and only useful in the most simplistic screening evaluations. The half-lives of all major decay products for radium-226 and radium-228 are shown in Table 3. The radium-228 decay series includes nine progeny, the second one of which is thorium-228. With a half-life of 1.9 years, thorium-228 is typically evaluated as a parent isotope, rather than a “short-lived” daughter product. Thorium-228 was in fact included in the radiological analyses of surface water and sediment at the site; the maximum detected concentrations and maximum detection limits were used in this assessment. As such, the RESRAD-Biota Level 2 evaluation for the site double counted the estimated dose rates from thorium-228 and its seven short-lived decay products.

Therefore, the Level 3 evaluation focused on refining the assumptions for including daughter products in the dose rate estimate for long-lived parent radionuclides. This was done by setting the half-life threshold that defines short-lived decay products to 180-days. Table 1 also presents the Level 3 HQs and HIs for a riparian animal in ER\_A, ER\_B, and ER\_C of the Emory River. The corresponding RESRAD-Biota Input Parameter Reports and Dose Reports for the Level 3 evaluation are included in Attachments C and D, respectively. The estimated HIs were less than 1.0 for all receptors in all reaches of the Emory River.

#### **4.0 Radiological Risk Characterization: Weight-of-Evidence**

Comparison of estimated exposures to literature-derived effects values is the primary line of evidence available for assessing radiological risk to ecological receptors. The results for this line of evidence indicate that radionuclides at the site do not pose a significant risk to aquatic or terrestrial biota. This is based on a conservative two-tiered evaluation using RESRAD-Biota. The first tier analysis was performed using default assumptions for Level 2 of RESRAD-Biota. These include 100 percent exposure at maximum concentrations for all parent radionuclides and “short-lived” decay products. The conservatively estimated exposures were compared with widely accepted Dose Rate Guidelines for populations of non-human biota. The results of the Level 2 evaluation indicated that all but three reaches of the river system could be eliminated from further consideration. The three non-reference reaches of the Emory River (ER\_A, ER\_B, and ER\_C) had estimated total dose rates that were marginally above the standard “safe levels” for ionizing radiation (i.e., HIs between 1.0 and 2.0). These reaches were further evaluated using RESRAD-Biota Level 3.

Conservative assumptions were also used in the Level 3 evaluation; however, the definition of “short-lived” progeny was changed to prevent double counting of exposures from radionuclides that are already included as parent isotopes. This was accomplished by changing the half-life cut-off value from 100 years to 180 days, which excludes isotopes commonly evaluated as parent radionuclides, such as thorium-228 (1.9 years) and lead-210 (22 years). The results of the Level 3 evaluation indicated that radionuclides in all three non-reference reaches of the Emory River could also be eliminated from further consideration.

With all analyzed radionuclides eliminated as COPECs, there is no explicit evidence that radionuclides pose a significant risk to ecological receptors at the site. That is, there is not a credible causal link between radionuclide concentrations in the river system and adverse effects observed in other lines of evidence for the site (e.g., sediment toxicity tests and tree swallow reproduction studies).

## **5.0 Uncertainties**

The RESRAD-Biota HQs and HIs were derived based on the Dose Rate Guidelines of 1 rad/d for terrestrial plants and aquatic animals and 0.1 rad/d for riparian animals and terrestrial animals. These guidelines are considered protective of plant and animal populations when compared with average exposure rates. However, the RESRAD-Biota results are conservatively based on a maximally exposed individual. This includes using the maximum detection limit for radionuclides not detected in a given reach or medium.

Assumptions for default RESRAD-Biota scenarios (DOE 2002) and the Level 3 evaluation include the following:

- All ionizing radiation from all decay processes were conservatively assumed to be absorbed by the organism.
  - There is no pass-through and no self-shielding assumed for external sources of ionizing radiation.
  - All internal ionizing radiation is retained in the organism (i.e., no pass-through).
- The radiosensitive tissues of concern lie on the surface of a very small organism, thus maximizing exposure to external isotopes.
- For external exposure to soil, the source was assumed to be infinite.
- For external exposure to sediment and water, the source was assumed to be semi-infinite.
- The exposure medium contained uniform concentrations of radionuclides.
- All radionuclides were assumed to be homogeneously distributed in the tissue of the receptor organism, which is unlikely to underestimate internal exposures to radiosensitive tissues.
- Short-lived decay products (progeny) were included in the dose rate for their long-lived parent isotopes.
  - A half-life of 100 years was used as the cut-off for short-lived decay products in the Level 1 and Level 2 evaluations.
  - For Level 3, the cut-off was set at 180 days.
  - Both assumptions are conservative, but the 100-years cut-off may result in double counting the dose from what are otherwise considered long-lived radionuclides.
- A RWF of 20 was used for alpha particles; this is considered conservative because the true value for deterministic effects is closer to 3 to 4, based on dose-effects data.
- The Level 2 and Level 3 analyses were based on bioaccumulation constants, which are based on default ingestion values.
- The default area use factor of 1 was used for the Level 2 and Level 3 evaluations; thus, the model conservatively assumes that the organism receives the modeled dose for its entire life, even though maximum detected concentrations and detection limits were used.

Based on these assumptions, the exposures estimated in this assessment are unlikely to underestimate the actual exposures to ionizing radiation in the river system.

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**Table 1. Summary of RESRAD-Biota Level 2 and Level 3 Hazard Ratios by Medium and Reach**  
**Radiological Risk Assessment**  
**Ash Recovery Project**  
**Tennessee Valley Authority**      **Kingston, Tennessee**

River Reach	Organism Type	Level 2 Results*			Level 3 Results**		
		Hazard Ratios by Media		Hazard Ratios by Organism	Hazard Ratios by Media		Hazard Ratios by Organism
		Water	Soil		Sediment		
ER_R	Aquatic Animal	2.41E-01		5.80E-04	0.24		
	Riparian Animal	7.27E-01		6.02E-02	0.79		
	Terrestrial Animal	4.20E-04	1.33E-01		0.13		
	Terrestrial Plant	7.16E-06	1.91E-02		0.02		
ER_C	Aquatic Animal	5.70E-01		1.78E-03	0.57		
	Riparian Animal	<b>1.51E+00</b>		1.88E-01	<b>1.70</b>	3.43E-02	1.44E-02
	Terrestrial Animal	8.35E-04	1.60E-01		0.16		
	Terrestrial Plant	7.12E-06	2.20E-02		0.02		
ER_B	Aquatic Animal	6.35E-01		2.11E-03	0.64		
	Riparian Animal	<b>1.69E+00</b>		1.67E-01	<b>1.86</b>	6.09E-02	1.18E-02
	Terrestrial Animal	9.21E-04	5.94E-01		0.59		
	Terrestrial Plant	7.66E-06	6.88E-02		0.07		
ER_A	Aquatic Animal	4.08E-01		1.75E-03	0.41		
	Riparian Animal	<b>1.16E+00</b>		1.54E-01	<b>1.31</b>	4.67E-02	1.90E-02
	Terrestrial Animal	6.10E-04	3.34E-01		0.33		
	Terrestrial Plant	6.07E-06	3.76E-02		0.04		
CR_R	Aquatic Animal	2.35E-01		6.65E-04	0.24		
	Riparian Animal	6.94E-01		6.11E-02	0.76		
	Terrestrial Animal	4.00E-04	1.33E-01		0.13		
	Terrestrial Plant	6.41E-06	1.91E-02		0.02		
CR_B	Aquatic Animal	2.45E-01		1.60E-03	0.25		
	Riparian Animal	7.14E-01		1.39E-01	0.85		
	Terrestrial Animal	4.23E-04	5.09E-01		0.51		
	Terrestrial Plant	6.90E-06	4.55E-02		0.05		
CR_A	Aquatic Animal	2.55E-01		1.83E-03	0.26		
	Riparian Animal	7.52E-01		1.73E-01	0.93		
	Terrestrial Animal	4.48E-04	4.37E-01		0.44		
	Terrestrial Plant	8.29E-06	5.18E-02		0.05		
TR_R	Aquatic Animal	2.53E-01		8.86E-04	0.25		
	Riparian Animal	7.43E-01		8.19E-02	0.82		
	Terrestrial Animal	4.33E-04	1.33E-01		0.13		
	Terrestrial Plant	7.00E-06	1.91E-02		0.02		
TR_B	Aquatic Animal	2.59E-01		1.62E-03	0.26		
	Riparian Animal	7.54E-01		1.49E-01	0.90		
	Terrestrial Animal	4.31E-04	4.37E-01		0.44		
	Terrestrial Plant	5.99E-06	5.18E-02		0.05		
TR_A	Aquatic Animal	2.59E-01		1.56E-03	0.26		
	Riparian Animal	7.54E-01		1.45E-01	0.90		
	Terrestrial Animal	4.31E-04	4.37E-01		0.44		
	Terrestrial Plant	5.99E-06	5.18E-02		0.05		

Rivers: Emory River (ER), Clinch River (CR), Tennessee River (TR); "R" indicates Reference Reach.

Hazard Ratio = absorbed dose rate (rad/d) divided by standard threshold level (1.0 rad/d for plants and aquatic animals; 0.1 rad/d for riparian and terrestrial animals).

**Bold** indicates hazard ratios that exceed 1.00.

\* Level 2 results calculated using 100-year half-life cut-off for decay products included in dose estimate for parent radionuclides.

\*\* Level 3 results calculated using 180-day half-life cut-off for decay products included in dose estimate for parent radionuclides.

**Table 2. Emory River RESRAD-Biota Level 2 Hazard Ratios and Relative Risks for Riparian Animal by Radionuclide Radiological Risk Assessment**  
**Ash Recovery Project**  
**Tennessee Valley Authority      Kingston, Tennessee**

River Reach	Radionuclide	Water		Sediment	
		Hazard Ratios	Relative Risk	Hazard Ratios	Relative Risk
ER_A	Am-241	1.43E-02	1.23%	9.27E-02	60.01%
	Co-60	1.20E-03	0.10%	4.75E-05	0.03%
	Cs-137	9.96E-02	8.59%	1.42E-04	0.09%
	K-40	2.19E-01	18.88%	5.26E-03	3.40%
	Ra-226	2.16E-01	18.62%	2.34E-02	15.15%
	<b>Ra-228</b>	<b>6.14E-01</b>	52.93%	2.45E-02	15.86%
	Th-228	6.07E-05	0.01%	2.63E-03	1.70%
	Th-230	1.23E-05	0.00%	2.47E-04	0.16%
	Th-232	5.52E-05	0.00%	1.59E-03	1.03%
	Th-234	5.10E-05	0.00%	2.15E-03	1.39%
	U-234	3.88E-04	0.03%	5.61E-04	0.36%
	U-235	2.08E-04	0.02%	7.16E-05	0.05%
	U-238	2.27E-04	0.02%	1.18E-03	0.76%
	<b>Sub-Totals</b>	<b>1.16E+00</b>	100%	<b>1.54E-01</b>	100%
ER_B	<b>Total Summed Hazard Ratios</b>		<b>1.31</b>		
	Am-241	1.82E-02	1.08%	7.54E-02	45.16%
	Co-60	8.19E-04	0.05%	7.65E-05	0.05%
	Cs-137	9.75E-02	5.77%	1.05E-04	0.06%
	K-40	2.05E-01	12.13%	9.66E-03	5.79%
	Ra-226	4.02E-01	23.79%	3.64E-02	21.80%
	<b>Ra-228</b>	<b>9.65E-01</b>	57.12%	3.46E-02	20.72%
	Th-228	6.22E-05	0.00%	3.80E-03	2.28%
	Th-230	9.51E-06	0.00%	3.94E-04	0.24%
	Th-232	3.37E-05	0.00%	2.48E-03	1.49%
	Th-234	6.99E-05	0.00%	1.62E-03	0.97%
	U-234	2.53E-04	0.01%	7.23E-04	0.43%
	U-235	2.06E-04	0.01%	7.00E-05	0.04%
	U-238	3.96E-04	0.02%	1.63E-03	0.98%
	<b>Sub-Totals</b>	<b>1.69E+00</b>	100%	<b>1.67E-01</b>	100%
ER_C	<b>Total Summed Hazard Ratios</b>		<b>1.86</b>		
	Am-241	1.86E-02	1.23%	1.13E-01	60.01%
	Co-60	7.50E-04	0.05%	5.79E-05	0.03%
	Cs-137	8.74E-02	5.79%	7.86E-05	0.04%
	K-40	2.01E-01	13.32%	4.61E-03	2.45%
	Ra-226	9.04E-02	5.99%	3.12E-02	16.57%
	<b>Ra-228</b>	<b>1.11E+00</b>	73.55%	3.14E-02	16.68%
	Th-228	5.34E-05	0.00%	3.01E-03	1.60%
	Th-230	5.35E-06	0.00%	5.00E-04	0.27%
	Th-232	2.74E-05	0.00%	2.04E-03	1.08%
	Th-234	6.52E-05	0.00%	5.46E-04	0.29%
	U-234	3.99E-04	0.03%	6.26E-04	0.33%
	U-235	1.80E-04	0.01%	3.49E-05	0.02%
	U-238	3.33E-04	0.02%	1.20E-03	0.64%
	<b>Sub-Totals</b>	<b>1.51E+00</b>	100%	<b>1.88E-01</b>	100%
	<b>Total Summed Hazard Ratios</b>	<b>1.70</b>			

Hazard Ratio = absorbed dose rate (rad/d) divided by standard threshold level of 0.1 rad/d for riparian animals.

**Bold** indicates hazard ratios that exceed 1.00.

\* Level 2 results calculated using 100-year half-life cut-off for decay products included in dose estimate for parent radionuclides.

**Table 3. Radioactive Decay Series and Properties of Key Radium Isotopes****Radiological Risk Assessment****Ash Recovery Project****Tennessee Valley Authority****Kingston, Tennessee**

Isotope	Half-Life	Natural Abundance (%)	Specific Activity (Ci/g)	Decay Mode	Radiation Energy (MeV)		
					Alpha (α)	Beta (β)	Gamma (γ)
<b>Ra-226</b>	<b>1600 (yr)</b>	<b>&gt;99</b>	<b>1.0</b>	<b>α</b>	<b>4.8</b>	<b>0.0036</b>	<b>0.0067</b>
<i>Rn-222</i>	3.8 (days)		160,000	α	5.5	<	<
<i>Po-218</i>	3.1 (min)		290 million	α	6	<	<
<i>Pb-214</i>	27 (min)		33 million	β	-	0.29	0.25
<i>Bi-214</i>	20 (min)		45 million	β	-	0.66	1.5
<i>Po-214</i>	0.00016 (sec)		330 trillion	α	7.7	<	<
<i>Pb-210</i>	22 (yr)		77	β	-	0.038	0.0048
<i>Bi-210</i>	5 (days)		130,000	β	-	0.39	-
<i>Po-210</i>	140 (days)		4,500	α	5.3	<	<
<b>Ra-228</b>	<b>5.8 (yr)</b>	<b>&lt;&lt;1</b>	<b>280</b>	<b>β</b>	-	<b>0.017</b>	<
<i>Ac-228</i>	6.1 (hr)		2.3 million	β	-	0.48	0.97
<i>Th-228</i>	1.9 (yr)		830	α	5.4	0.021	0.0033
<i>Ra-224</i>	3.7 (days)		160,000	α	5.7	0.0022	0.01
<i>Rn-220</i>	56 (sec)		930 million	α	6.3	<	<
<i>Po-216</i>	0.15 (sec)		350 billion	α	6.8	<	<
<i>Pb-212</i>	11 (hr)		1.4 million	β	-	0.18	0.15
<i>Bi-212</i>	61 (min)		15 million	α, β	2.2	0.47	0.19
<i>Po-212 (64%)</i>	0.00000031 (sec)		180,000 trillion	α	8.8	-	-
<i>Tl-208 (36%)</i>	3.1 (min)		300 million	β	-	0.6	3.4

Source: Argonne National Laboratory, EVS Human Health Fact Sheet, August 2005 (<http://www.evs.anl.gov/pub/doc/Radium.pdf>).

Ci = curie, g = gram, and MeV = million electron volts; a “<” means the radiation energy is less than 0.001 MeV, and a dash means the entry is not applicable. (See the companion fact sheet on Radioactive Properties, Internal Distribution, and Risk Coefficients for an explanation of terms and interpretation of radiation energies.) Bismuth-212 decays by both emitting an alpha particle (36%) and a beta particle (64%). Certain properties of additional radionuclides are included here because they accompany the radium decays. Values are given to two significant figures.

**ARCADIS**

**Attachment A**

Level 2 Input Parameter Reports

# RESRAD-BIOTA Input Parameter Report

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## General Case Information

Title:	CR_A_aq
Ecosystem:	Aquatic
Level:	2
Units:	Traditional

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## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	0	24.4	558
Co-60	0	4.03	0.0967
Cs-137	0	3.73	2.79
K-40	0	53.8	21.6
Ra-226	0	0.61	2.6
Ra-228	0	0.951	2.19
Th-228	0	0.141	2.51
Th-230	0	0.0964	3.11
Th-232	0	0.0732	2
Th-234	0	298	5.65
U-234	0	0.206	2.6
U-235	0	0.151	0.206
U-238	0	0.0915	2.28

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Aquatic Animal	1	1	Default	Default
Riparian Animal	0.1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Aquatic Animal	Am-241	0.00E+00	4.00E+02	0.00E+00
Aquatic Animal	Co-60	0.00E+00	2.00E+03	0.00E+00
Aquatic Animal	Cs-137	0.00E+00	2.20E+04	0.00E+00
Aquatic Animal	K-40	0.00E+00	1.00E+04	0.00E+00
Aquatic Animal	Ra-226	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Ra-228	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Th-228	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-230	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-232	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-234	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	U-234	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-235	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-238	0.00E+00	1.00E+03	0.00E+00
Riparian Animal	Am-241	0.00E+00	1.20E+01	3.15E-03
Riparian Animal	Co-60	0.00E+00	1.57E+02	9.94E-03
Riparian Animal	Cs-137	0.00E+00	5.40E+04	2.70E-01
Riparian Animal	K-40	0.00E+00	1.16E+04	1.55E-01
Riparian Animal	Ra-226	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Ra-228	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Th-228	0.00E+00	1.46E+00	1.90E-03
Riparian Animal	Th-230	0.00E+00	1.48E+00	1.90E-03
Riparian Animal	Th-232	0.00E+00	1.45E+00	2.00E-03
Riparian Animal	Th-234	0.00E+00	6.78E-02	1.11E-04
Riparian Animal	U-234	0.00E+00	2.95E+01	3.76E-03
Riparian Animal	U-235	0.00E+00	2.95E+01	3.76E-03

Riparian Animal	U-238	0.00E+00	2.95E+01	3.76E-03
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No tissue concentration values were entered for this organism.

# RESRAD-BIOTA Input Parameter Report

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## General Case Information

Title:	CR_A_ter
Ecosystem:	Aquatic
Level:	2
Units:	Traditional

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## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	451	24.4	0
Co-60	0.0749	4.03	0
Cs-137	1.07	3.73	0
K-40	21.6	53.8	0
Ra-226	1.63	0.61	0
Ra-228	2.02	0.951	0
Th-228	2.51	0.141	0
Th-230	1.61	0.0964	0
Th-232	1.84	0.0732	0
Th-234	3.38	298	0
U-234	1.52	0.206	0
U-235	0.206	0.151	0
U-238	1.42	0.0915	0

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

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## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Terrestrial Animal	0.1	1	Default	Default
Terrestrial Plant	1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Terrestrial Animal	Am-241	4.00E-03	8.65E-02	0.00E+00
Terrestrial Animal	Co-60	8.00E-02	1.26E-01	0.00E+00
Terrestrial Animal	Cs-137	1.10E+02	3.38E+00	0.00E+00
Terrestrial Animal	K-40	2.34E+01	1.00E+00	0.00E+00
Terrestrial Animal	Ra-226	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Ra-228	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Th-228	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-230	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-232	1.60E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-234	1.12E-04	6.78E-04	0.00E+00
Terrestrial Animal	U-234	3.80E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-235	3.70E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-238	3.73E-03	4.98E-02	0.00E+00
Terrestrial Plant	Am-241	7.64E-03	0.00E+00	0.00E+00
Terrestrial Plant	Co-60	2.20E-01	0.00E+00	0.00E+00
Terrestrial Plant	Cs-137	9.50E+00	0.00E+00	0.00E+00
Terrestrial Plant	K-40	2.00E+01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-226	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-228	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Th-228	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-230	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-232	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-234	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-234	3.78E-03	0.00E+00	0.00E+00

Terrestrial Plant	U-235	3.78E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-238	3.78E-03	0.00E+00	0.00E+00

**No tissue concentration values were entered for this organism.**

# RESRAD-BIOTA Input Parameter Report

## General Case Information

Title:	CR_B_aq
Ecosystem:	Aquatic
Level:	2
Units:	Traditional

## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	0	25.4	421
Co-60	0	3.75	0.0871
Cs-137	0	3.75	3.3
K-40	0	51.4	28.1
Ra-226	0	0.499	2.25
Ra-228	0	0.943	1.9
Th-228	0	0.138	1.85
Th-230	0	0.0626	2.47
Th-232	0	0.0624	1.82
Th-234	0	241	2.73
U-234	0	0.159	1.78
U-235	0	0.291	0.0999
U-238	0	0.172	1.89

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Aquatic Animal	1	1	Default	Default
Riparian Animal	0.1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Aquatic Animal	Am-241	0.00E+00	4.00E+02	0.00E+00
Aquatic Animal	Co-60	0.00E+00	2.00E+03	0.00E+00
Aquatic Animal	Cs-137	0.00E+00	2.20E+04	0.00E+00
Aquatic Animal	K-40	0.00E+00	1.00E+04	0.00E+00
Aquatic Animal	Ra-226	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Ra-228	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Th-228	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-230	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-232	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-234	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	U-234	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-235	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-238	0.00E+00	1.00E+03	0.00E+00
Riparian Animal	Am-241	0.00E+00	1.20E+01	3.15E-03
Riparian Animal	Co-60	0.00E+00	1.57E+02	9.94E-03
Riparian Animal	Cs-137	0.00E+00	5.40E+04	2.70E-01
Riparian Animal	K-40	0.00E+00	1.16E+04	1.55E-01
Riparian Animal	Ra-226	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Ra-228	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Th-228	0.00E+00	1.46E+00	1.90E-03
Riparian Animal	Th-230	0.00E+00	1.48E+00	1.90E-03
Riparian Animal	Th-232	0.00E+00	1.45E+00	2.00E-03
Riparian Animal	Th-234	0.00E+00	6.78E-02	1.11E-04

Riparian Animal	U-234	0.00E+00	2.95E+01	3.76E-03
Riparian Animal	U-235	0.00E+00	2.95E+01	3.76E-03
Riparian Animal	U-238	0.00E+00	2.95E+01	3.76E-03

No tissue concentration values were entered for this organism.

# RESRAD-BIOTA Input Parameter Report

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## General Case Information

Title:	CR_B_ter
Ecosystem:	Terrestrial
Level:	2
Units:	Traditional

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## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	268	25.4	0
Co-60	0.0719	3.75	0
Cs-137	2.84	3.75	0
K-40	28.1	51.4	0
Ra-226	0.925	0.499	0
Ra-228	1.88	0.943	0
Th-228	1.42	0.138	0
Th-230	1.24	0.0626	0
Th-232	1.36	0.0624	0
Th-234	2.08	241	0
U-234	1.2	0.159	0
U-235	0.145	0.291	0
U-238	1.15	0.172	0

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

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## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Terrestrial Animal	0.1	1	Default	Default
Terrestrial Plant	1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Terrestrial Animal	Am-241	4.00E-03	8.65E-02	0.00E+00
Terrestrial Animal	Co-60	8.00E-02	1.26E-01	0.00E+00
Terrestrial Animal	Cs-137	1.10E+02	3.38E+00	0.00E+00
Terrestrial Animal	K-40	2.34E+01	1.00E+00	0.00E+00
Terrestrial Animal	Ra-226	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Ra-228	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Th-228	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-230	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-232	1.60E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-234	1.12E-04	6.78E-04	0.00E+00
Terrestrial Animal	U-234	3.80E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-235	3.70E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-238	3.73E-03	4.98E-02	0.00E+00
Terrestrial Plant	Am-241	7.64E-03	0.00E+00	0.00E+00
Terrestrial Plant	Co-60	2.20E-01	0.00E+00	0.00E+00
Terrestrial Plant	Cs-137	9.50E+00	0.00E+00	0.00E+00
Terrestrial Plant	K-40	2.00E+01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-226	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-228	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Th-228	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-230	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-232	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-234	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-234	3.78E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-235	3.78E-03	0.00E+00	0.00E+00

Terrestrial Plant	U-238	3.78E-03	0.00E+00	0.00E+00
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No tissue concentration values were entered for this organism.

# RESRAD-BIOTA Input Parameter Report

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## General Case Information

Title:	CR_R_aq
Ecosystem:	Aquatic
Level:	2
Units:	Traditional

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## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	0	22.2	210
Co-60	0	3.79	0.0481
Cs-137	0	3.62	2.23
K-40	0	48.8	8.57
Ra-226	0	0.496	0.689
Ra-228	0	0.929	0.746
Th-228	0	0.124	0.874
Th-230	0	0.0947	0.79
Th-232	0	0.0944	0.72
Th-234	0	222	1.27
U-234	0	0.365	0.497
U-235	0	0.27	0.0648
U-238	0	0.143	0.515

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

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## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Aquatic Animal	1	1	Default	Default
Riparian Animal	0.1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Aquatic Animal	Am-241	0.00E+00	4.00E+02	0.00E+00
Aquatic Animal	Co-60	0.00E+00	2.00E+03	0.00E+00
Aquatic Animal	Cs-137	0.00E+00	2.20E+04	0.00E+00
Aquatic Animal	K-40	0.00E+00	1.00E+04	0.00E+00
Aquatic Animal	Ra-226	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Ra-228	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Th-228	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-230	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-232	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-234	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	U-234	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-235	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-238	0.00E+00	1.00E+03	0.00E+00
Riparian Animal	Am-241	0.00E+00	1.20E+01	3.15E-03
Riparian Animal	Co-60	0.00E+00	1.57E+02	9.94E-03
Riparian Animal	Cs-137	0.00E+00	5.40E+04	2.70E-01
Riparian Animal	K-40	0.00E+00	1.16E+04	1.55E-01
Riparian Animal	Ra-226	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Ra-228	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Th-228	0.00E+00	1.46E+00	1.90E-03
Riparian Animal	Th-230	0.00E+00	1.48E+00	1.90E-03
Riparian Animal	Th-232	0.00E+00	1.45E+00	2.00E-03
Riparian Animal	Th-234	0.00E+00	6.78E-02	1.11E-04
Riparian Animal	U-234	0.00E+00	2.95E+01	3.76E-03

Riparian Animal	U-235	0.00E+00	2.95E+01	3.76E-03
Riparian Animal	U-238	0.00E+00	2.95E+01	3.76E-03

**No tissue concentration values were entered for this organism.**

# RESRAD-BIOTA Input Parameter Report

## General Case Information

Title:	CR_R_ter
Ecosystem:	Terrestrial
Level:	2
Units:	Traditional

## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	210	22.2	0
Co-60	0.0362	3.79	0
Cs-137	0.049	3.62	0
K-40	5.1	48.8	0
Ra-226	0.689	0.496	0
Ra-228	0.734	0.929	0
Th-228	0.874	0.124	0
Th-230	0.516	0.0947	0
Th-232	0.72	0.0944	0
Th-234	1.27	222	0
U-234	0.497	0.365	0
U-235	0.0648	0.27	0
U-238	0.515	0.143	0

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Terrestrial Animal	0.1	1	Default	Default
Terrestrial Plant	1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Terrestrial Animal	Am-241	4.00E-03	8.65E-02	0.00E+00
Terrestrial Animal	Co-60	8.00E-02	1.26E-01	0.00E+00
Terrestrial Animal	Cs-137	1.10E+02	3.38E+00	0.00E+00
Terrestrial Animal	K-40	2.34E+01	1.00E+00	0.00E+00
Terrestrial Animal	Ra-226	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Ra-228	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Th-228	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-230	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-232	1.60E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-234	1.12E-04	6.78E-04	0.00E+00
Terrestrial Animal	U-234	3.80E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-235	3.70E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-238	3.73E-03	4.98E-02	0.00E+00
Terrestrial Plant	Am-241	7.64E-03	0.00E+00	0.00E+00
Terrestrial Plant	Co-60	2.20E-01	0.00E+00	0.00E+00
Terrestrial Plant	Cs-137	9.50E+00	0.00E+00	0.00E+00
Terrestrial Plant	K-40	2.00E+01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-226	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-228	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Th-228	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-230	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-232	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-234	1.02E-03	0.00E+00	0.00E+00

Terrestrial Plant	U-234	3.78E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-235	3.78E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-238	3.78E-03	0.00E+00	0.00E+00

No tissue concentration values were entered for this organism.

# RESRAD-BIOTA Input Parameter Report

## General Case Information

Title:	ER_A_aq
Ecosystem:	Aquatic
Level:	2
Units:	Traditional

## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	0	20.9	478
Co-60	0	5.72	0.0695
Cs-137	0	4.25	0.443
K-40	0	54.6	23.3
Ra-226	0	0.88	2.37
Ra-228	0	2.08	2.15
Th-228	0	0.124	2.09
Th-230	0	0.171	2.58
Th-232	0	0.0933	1.95
Th-234	0	194	9.28
U-234	0	0.265	2.96
U-235	0	0.153	0.267
U-238	0	0.172	2.95

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Aquatic Animal	1	1	Default	Default
Riparian Animal	0.1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Aquatic Animal	Am-241	0.00E+00	4.00E+02	0.00E+00
Aquatic Animal	Co-60	0.00E+00	2.00E+03	0.00E+00
Aquatic Animal	Cs-137	0.00E+00	2.20E+04	0.00E+00
Aquatic Animal	K-40	0.00E+00	1.00E+04	0.00E+00
Aquatic Animal	Ra-226	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Ra-228	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Th-228	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-230	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-232	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-234	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	U-234	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-235	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-238	0.00E+00	1.00E+03	0.00E+00
Riparian Animal	Am-241	0.00E+00	1.20E+01	3.15E-03
Riparian Animal	Co-60	0.00E+00	1.57E+02	9.94E-03
Riparian Animal	Cs-137	0.00E+00	5.40E+04	2.70E-01
Riparian Animal	K-40	0.00E+00	1.16E+04	1.55E-01
Riparian Animal	Ra-226	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Ra-228	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Th-228	0.00E+00	1.46E+00	1.90E-03
Riparian Animal	Th-230	0.00E+00	1.48E+00	1.90E-03
Riparian Animal	Th-232	0.00E+00	1.45E+00	2.00E-03
Riparian Animal	Th-234	0.00E+00	6.78E-02	1.11E-04
Riparian Animal	U-234	0.00E+00	2.95E+01	3.76E-03
Riparian Animal	U-235	0.00E+00	2.95E+01	3.76E-03

Riparian Animal	U-238	0.00E+00	2.95E+01	3.76E-03
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No tissue concentration values were entered for this organism.

# RESRAD-BIOTA Input Parameter Report

## General Case Information

Title:	ER_A_ter
Ecosystem:	Aquatic
Level:	2
Units:	Traditional

## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	203	20.9	0
Co-60	0.0589	5.72	0
Cs-137	0.406	4.25	0
K-40	23.3	54.6	0
Ra-226	1.08	0.88	0
Ra-228	1.68	2.08	0
Th-228	1.8	0.124	0
Th-230	1.55	0.171	0
Th-232	1.61	0.0933	0
Th-234	0.981	194	0
U-234	1.31	0.265	0
U-235	0.167	0.153	0
U-238	1.26	0.172	0

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Terrestrial Animal	0.1	1	Default	Default
Terrestrial Plant	1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Terrestrial Animal	Am-241	4.00E-03	8.65E-02	0.00E+00
Terrestrial Animal	Co-60	8.00E-02	1.26E-01	0.00E+00
Terrestrial Animal	Cs-137	1.10E+02	3.38E+00	0.00E+00
Terrestrial Animal	K-40	2.34E+01	1.00E+00	0.00E+00
Terrestrial Animal	Ra-226	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Ra-228	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Th-228	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-230	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-232	1.60E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-234	1.12E-04	6.78E-04	0.00E+00
Terrestrial Animal	U-234	3.80E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-235	3.70E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-238	3.73E-03	4.98E-02	0.00E+00
Terrestrial Plant	Am-241	7.64E-03	0.00E+00	0.00E+00
Terrestrial Plant	Co-60	2.20E-01	0.00E+00	0.00E+00
Terrestrial Plant	Cs-137	9.50E+00	0.00E+00	0.00E+00
Terrestrial Plant	K-40	2.00E+01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-226	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-228	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Th-228	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-230	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-232	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-234	1.02E-03	0.00E+00	0.00E+00

Terrestrial Plant	U-234	3.78E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-235	3.78E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-238	3.78E-03	0.00E+00	0.00E+00

No tissue concentration values were entered for this organism.

# RESRAD-BIOTA Input Parameter Report

## General Case Information

Title:	ER_B_aq
Ecosystem:	Aquatic
Level:	2
Units:	Traditional

## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	0	26.6	389
Co-60	0	3.92	0.112
Cs-137	0	4.16	0.328
K-40	0	51.1	42.8
Ra-226	0	1.64	3.68
Ra-228	0	3.27	3.03
Th-228	0	0.127	3.02
Th-230	0	0.132	4.11
Th-232	0	0.0569	3.03
Th-234	0	266	6.99
U-234	0	0.173	3.81
U-235	0	0.152	0.261
U-238	0	0.3	4.05

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Aquatic Animal	1	1	Default	Default
Riparian Animal	0.1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Aquatic Animal	Am-241	0.00E+00	4.00E+02	0.00E+00
Aquatic Animal	Co-60	0.00E+00	2.00E+03	0.00E+00
Aquatic Animal	Cs-137	0.00E+00	2.20E+04	0.00E+00
Aquatic Animal	K-40	0.00E+00	1.00E+04	0.00E+00
Aquatic Animal	Ra-226	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Ra-228	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Th-228	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-230	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-232	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-234	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	U-234	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-235	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-238	0.00E+00	1.00E+03	0.00E+00
Riparian Animal	Am-241	0.00E+00	1.20E+01	3.15E-03
Riparian Animal	Co-60	0.00E+00	1.57E+02	9.94E-03
Riparian Animal	Cs-137	0.00E+00	5.40E+04	2.70E-01
Riparian Animal	K-40	0.00E+00	1.16E+04	1.55E-01
Riparian Animal	Ra-226	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Ra-228	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Th-228	0.00E+00	1.46E+00	1.90E-03
Riparian Animal	Th-230	0.00E+00	1.48E+00	1.90E-03
Riparian Animal	Th-232	0.00E+00	1.45E+00	2.00E-03
Riparian Animal	Th-234	0.00E+00	6.78E-02	1.11E-04

Riparian Animal	U-234	0.00E+00	2.95E+01	3.76E-03
Riparian Animal	U-235	0.00E+00	2.95E+01	3.76E-03
Riparian Animal	U-238	0.00E+00	2.95E+01	3.76E-03

No tissue concentration values were entered for this organism.

# RESRAD-BIOTA Input Parameter Report

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## General Case Information

Title:	ER_B_ter
Ecosystem:	Terrestrial
Level:	2
Units:	Traditional

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## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	264	26.6	0
Co-60	0.0734	3.92	0
Cs-137	0.328	4.16	0
K-40	42.8	51.1	0
Ra-226	3.68	1.64	0
Ra-228	2.82	3.27	0
Th-228	2.64	0.127	0
Th-230	4.11	0.132	0
Th-232	3.03	0.0569	0
Th-234	4.37	266	0
U-234	2.94	0.173	0
U-235	0.13	0.152	0
U-238	3.53	0.3	0

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

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## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Terrestrial Animal	0.1	1	Default	Default
Terrestrial Plant	1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Terrestrial Animal	Am-241	4.00E-03	8.65E-02	0.00E+00
Terrestrial Animal	Co-60	8.00E-02	1.26E-01	0.00E+00
Terrestrial Animal	Cs-137	1.10E+02	3.38E+00	0.00E+00
Terrestrial Animal	K-40	2.34E+01	1.00E+00	0.00E+00
Terrestrial Animal	Ra-226	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Ra-228	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Th-228	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-230	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-232	1.60E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-234	1.12E-04	6.78E-04	0.00E+00
Terrestrial Animal	U-234	3.80E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-235	3.70E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-238	3.73E-03	4.98E-02	0.00E+00
Terrestrial Plant	Am-241	7.64E-03	0.00E+00	0.00E+00
Terrestrial Plant	Co-60	2.20E-01	0.00E+00	0.00E+00
Terrestrial Plant	Cs-137	9.50E+00	0.00E+00	0.00E+00
Terrestrial Plant	K-40	2.00E+01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-226	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-228	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Th-228	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-230	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-232	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-234	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-234	3.78E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-235	3.78E-03	0.00E+00	0.00E+00

Terrestrial Plant	U-238	3.78E-03	0.00E+00	0.00E+00
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No tissue concentration values were entered for this organism.

# RESRAD-BIOTA Input Parameter Report

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## General Case Information

Title:	ER_C_aq
Ecosystem:	Aquatic
Level:	2
Units:	Traditional

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## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	0	27.3	583
Co-60	0	3.59	0.0847
Cs-137	0	3.73	0.246
K-40	0	50	20.4
Ra-226	0	0.369	3.16
Ra-228	0	3.77	2.75
Th-228	0	0.109	2.39
Th-230	0	0.0743	5.21
Th-232	0	0.0463	2.49
Th-234	0	248	2.36
U-234	0	0.273	3.3
U-235	0	0.133	0.13
U-238	0	0.252	2.99

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Aquatic Animal	1	1	Default	Default
Riparian Animal	0.1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Aquatic Animal	Am-241	0.00E+00	4.00E+02	0.00E+00
Aquatic Animal	Co-60	0.00E+00	2.00E+03	0.00E+00
Aquatic Animal	Cs-137	0.00E+00	2.20E+04	0.00E+00
Aquatic Animal	K-40	0.00E+00	1.00E+04	0.00E+00
Aquatic Animal	Ra-226	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Ra-228	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Th-228	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-230	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-232	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-234	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	U-234	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-235	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-238	0.00E+00	1.00E+03	0.00E+00
Riparian Animal	Am-241	0.00E+00	1.20E+01	3.15E-03
Riparian Animal	Co-60	0.00E+00	1.57E+02	9.94E-03
Riparian Animal	Cs-137	0.00E+00	5.40E+04	2.70E-01
Riparian Animal	K-40	0.00E+00	1.16E+04	1.55E-01
Riparian Animal	Ra-226	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Ra-228	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Th-228	0.00E+00	1.46E+00	1.90E-03
Riparian Animal	Th-230	0.00E+00	1.48E+00	1.90E-03
Riparian Animal	Th-232	0.00E+00	1.45E+00	2.00E-03
Riparian Animal	Th-234	0.00E+00	6.78E-02	1.11E-04
Riparian Animal	U-234	0.00E+00	2.95E+01	3.76E-03
Riparian Animal	U-235	0.00E+00	2.95E+01	3.76E-03

Riparian Animal	U-238	0.00E+00	2.95E+01	3.76E-03
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No tissue concentration values were entered for this organism.

# RESRAD-BIOTA Input Parameter Report

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## General Case Information

Title:	ER_C_ter
Ecosystem:	Terrestrial
Level:	2
Units:	Traditional

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## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	185	27.3	0
Co-60	0.03	3.59	0
Cs-137	0.0496	3.73	0
K-40	7.43	50	0
Ra-226	0.945	0.369	0
Ra-228	1.07	3.77	0
Th-228	0.81	0.109	0
Th-230	5.21	0.0743	0
Th-232	0.961	0.0463	0
Th-234	2.36	248	0
U-234	0.871	0.273	0
U-235	0.0532	0.133	0
U-238	0.809	0.252	0

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

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## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Terrestrial Animal	0.1	1	Default	Default
Terrestrial Plant	1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Terrestrial Animal	Am-241	4.00E-03	8.65E-02	0.00E+00
Terrestrial Animal	Co-60	8.00E-02	1.26E-01	0.00E+00
Terrestrial Animal	Cs-137	1.10E+02	3.38E+00	0.00E+00
Terrestrial Animal	K-40	2.34E+01	1.00E+00	0.00E+00
Terrestrial Animal	Ra-226	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Ra-228	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Th-228	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-230	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-232	1.60E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-234	1.12E-04	6.78E-04	0.00E+00
Terrestrial Animal	U-234	3.80E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-235	3.70E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-238	3.73E-03	4.98E-02	0.00E+00
Terrestrial Plant	Am-241	7.64E-03	0.00E+00	0.00E+00
Terrestrial Plant	Co-60	2.20E-01	0.00E+00	0.00E+00
Terrestrial Plant	Cs-137	9.50E+00	0.00E+00	0.00E+00
Terrestrial Plant	K-40	2.00E+01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-226	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-228	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Th-228	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-230	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-232	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-234	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-234	3.78E-03	0.00E+00	0.00E+00

Terrestrial Plant	U-235	3.78E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-238	3.78E-03	0.00E+00	0.00E+00

**No tissue concentration values were entered for this organism.**

# RESRAD-BIOTA Input Parameter Report

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## General Case Information

Title:	ER_R_aq
Ecosystem:	Aquatic
Level:	2
Units:	Traditional

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## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	0	24.4	210
Co-60	0	4.18	0.0639
Cs-137	0	4.08	0.093
K-40	0	54.8	5.1
Ra-226	0	0.62	0.689
Ra-228	0	0.818	0.779
Th-228	0	0.144	0.874
Th-230	0	0.0976	0.642
Th-232	0	0.0973	0.72
Th-234	0	248	1.94
U-234	0	0.206	0.597
U-235	0	0.134	0.0648
U-238	0	0.147	0.573

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

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## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Aquatic Animal	1	1	Default	Default
Riparian Animal	0.1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Aquatic Animal	Am-241	0.00E+00	4.00E+02	0.00E+00
Aquatic Animal	Co-60	0.00E+00	2.00E+03	0.00E+00
Aquatic Animal	Cs-137	0.00E+00	2.20E+04	0.00E+00
Aquatic Animal	K-40	0.00E+00	1.00E+04	0.00E+00
Aquatic Animal	Ra-226	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Ra-228	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Th-228	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-230	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-232	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-234	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	U-234	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-235	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-238	0.00E+00	1.00E+03	0.00E+00
Riparian Animal	Am-241	0.00E+00	1.20E+01	3.15E-03
Riparian Animal	Co-60	0.00E+00	1.57E+02	9.94E-03
Riparian Animal	Cs-137	0.00E+00	5.40E+04	2.70E-01
Riparian Animal	K-40	0.00E+00	1.16E+04	1.55E-01
Riparian Animal	Ra-226	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Ra-228	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Th-228	0.00E+00	1.46E+00	1.90E-03
Riparian Animal	Th-230	0.00E+00	1.48E+00	1.90E-03
Riparian Animal	Th-232	0.00E+00	1.45E+00	2.00E-03
Riparian Animal	Th-234	0.00E+00	6.78E-02	1.11E-04
Riparian Animal	U-234	0.00E+00	2.95E+01	3.76E-03

Riparian Animal	U-235	0.00E+00	2.95E+01	3.76E-03
Riparian Animal	U-238	0.00E+00	2.95E+01	3.76E-03

**No tissue concentration values were entered for this organism.**

# RESRAD-BIOTA Input Parameter Report

## General Case Information

Title:	ER_R_ter
Ecosystem:	Terrestrial
Level:	2
Units:	Traditional

## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	210	24.4	0
Co-60	0.0362	4.18	0
Cs-137	0.049	4.08	0
K-40	5.1	54.8	0
Ra-226	0.689	0.62	0
Ra-228	0.734	0.818	0
Th-228	0.874	0.144	0
Th-230	0.516	0.0976	0
Th-232	0.72	0.0973	0
Th-234	1.27	248	0
U-234	0.497	0.206	0
U-235	0.0648	0.134	0
U-238	0.515	0.147	0

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Terrestrial Animal	0.1	1	Default	Default
Terrestrial Plant	1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Terrestrial Animal	Am-241	4.00E-03	8.65E-02	0.00E+00
Terrestrial Animal	Co-60	8.00E-02	1.26E-01	0.00E+00
Terrestrial Animal	Cs-137	1.10E+02	3.38E+00	0.00E+00
Terrestrial Animal	K-40	2.34E+01	1.00E+00	0.00E+00
Terrestrial Animal	Ra-226	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Ra-228	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Th-228	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-230	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-232	1.60E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-234	1.12E-04	6.78E-04	0.00E+00
Terrestrial Animal	U-234	3.80E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-235	3.70E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-238	3.73E-03	4.98E-02	0.00E+00
Terrestrial Plant	Am-241	7.64E-03	0.00E+00	0.00E+00
Terrestrial Plant	Co-60	2.20E-01	0.00E+00	0.00E+00
Terrestrial Plant	Cs-137	9.50E+00	0.00E+00	0.00E+00
Terrestrial Plant	K-40	2.00E+01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-226	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-228	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Th-228	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-230	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-232	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-234	1.02E-03	0.00E+00	0.00E+00

Terrestrial Plant	U-234	3.78E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-235	3.78E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-238	3.78E-03	0.00E+00	0.00E+00

No tissue concentration values were entered for this organism.

# RESRAD-BIOTA Input Parameter Report

## General Case Information

Title:	TR_A_aq
Ecosystem:	Aquatic
Level:	2
Units:	Traditional

## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	0	24.3	451
Co-60	0	3.79	0.124
Cs-137	0	4.27	1.53
K-40	0	48.1	22.5
Ra-226	0	0.609	2.1
Ra-228	0	0.992	2.16
Th-228	0	0.127	2.51
Th-230	0	0.235	1.82
Th-232	0	0.125	1.84
Th-234	0	203	3.38
U-234	0	0.199	1.52
U-235	0	0.269	0.206
U-238	0	0.218	1.54

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Aquatic Animal	1	1	Default	Default
Riparian Animal	0.1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Aquatic Animal	Am-241	0.00E+00	4.00E+02	0.00E+00
Aquatic Animal	Co-60	0.00E+00	2.00E+03	0.00E+00
Aquatic Animal	Cs-137	0.00E+00	2.20E+04	0.00E+00
Aquatic Animal	K-40	0.00E+00	1.00E+04	0.00E+00
Aquatic Animal	Ra-226	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Ra-228	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Th-228	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-230	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-232	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-234	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	U-234	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-235	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-238	0.00E+00	1.00E+03	0.00E+00
Riparian Animal	Am-241	0.00E+00	1.20E+01	3.15E-03
Riparian Animal	Co-60	0.00E+00	1.57E+02	9.94E-03
Riparian Animal	Cs-137	0.00E+00	5.40E+04	2.70E-01
Riparian Animal	K-40	0.00E+00	1.16E+04	1.55E-01
Riparian Animal	Ra-226	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Ra-228	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Th-228	0.00E+00	1.46E+00	1.90E-03
Riparian Animal	Th-230	0.00E+00	1.48E+00	1.90E-03
Riparian Animal	Th-232	0.00E+00	1.45E+00	2.00E-03
Riparian Animal	Th-234	0.00E+00	6.78E-02	1.11E-04

Riparian Animal	U-234	0.00E+00	2.95E+01	3.76E-03
Riparian Animal	U-235	0.00E+00	2.95E+01	3.76E-03
Riparian Animal	U-238	0.00E+00	2.95E+01	3.76E-03

**No tissue concentration values were entered for this organism.**

# RESRAD-BIOTA Input Parameter Report

## General Case Information

Title:	TR_A_ter
Ecosystem:	Terrestrial
Level:	2
Units:	Traditional

## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	451	24.3	0
Co-60	0.0749	3.79	0
Cs-137	1.07	4.27	0
K-40	21.6	48.1	0
Ra-226	1.63	0.609	0
Ra-228	2.02	0.992	0
Th-228	2.51	0.127	0
Th-230	1.61	0.235	0
Th-232	1.84	0.125	0
Th-234	3.38	203	0
U-234	1.52	0.199	0
U-235	0.206	0.269	0
U-238	1.42	0.218	0

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Terrestrial Animal	0.1	1	Default	Default
Terrestrial Plant	1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Terrestrial Animal	Am-241	4.00E-03	8.65E-02	0.00E+00
Terrestrial Animal	Co-60	8.00E-02	1.26E-01	0.00E+00
Terrestrial Animal	Cs-137	1.10E+02	3.38E+00	0.00E+00
Terrestrial Animal	K-40	2.34E+01	1.00E+00	0.00E+00
Terrestrial Animal	Ra-226	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Ra-228	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Th-228	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-230	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-232	1.60E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-234	1.12E-04	6.78E-04	0.00E+00
Terrestrial Animal	U-234	3.80E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-235	3.70E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-238	3.73E-03	4.98E-02	0.00E+00
Terrestrial Plant	Am-241	7.64E-03	0.00E+00	0.00E+00
Terrestrial Plant	Co-60	2.20E-01	0.00E+00	0.00E+00
Terrestrial Plant	Cs-137	9.50E+00	0.00E+00	0.00E+00
Terrestrial Plant	K-40	2.00E+01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-226	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-228	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Th-228	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-230	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-232	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-234	1.02E-03	0.00E+00	0.00E+00

Terrestrial Plant	U-234	3.78E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-235	3.78E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-238	3.78E-03	0.00E+00	0.00E+00

No tissue concentration values were entered for this organism.

# RESRAD-BIOTA Input Parameter Report

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## General Case Information

Title:	TR_B_aq
Ecosystem:	Aquatic
Level:	2
Units:	Traditional

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## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	0	24.3	451
Co-60	0	3.79	0.0823
Cs-137	0	4.27	1.07
K-40	0	48.1	21.6
Ra-226	0	0.609	2.35
Ra-228	0	0.992	2.22
Th-228	0	0.127	2.51
Th-230	0	0.235	3.93
Th-232	0	0.125	2.35
Th-234	0	203	5.18
U-234	0	0.199	2.52
U-235	0	0.269	0.21
U-238	0	0.218	2.45

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

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## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Aquatic Animal	1	1	Default	Default
Riparian Animal	0.1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Aquatic Animal	Am-241	0.00E+00	4.00E+02	0.00E+00
Aquatic Animal	Co-60	0.00E+00	2.00E+03	0.00E+00
Aquatic Animal	Cs-137	0.00E+00	2.20E+04	0.00E+00
Aquatic Animal	K-40	0.00E+00	1.00E+04	0.00E+00
Aquatic Animal	Ra-226	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Ra-228	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Th-228	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-230	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-232	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-234	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	U-234	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-235	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-238	0.00E+00	1.00E+03	0.00E+00
Riparian Animal	Am-241	0.00E+00	1.20E+01	3.15E-03
Riparian Animal	Co-60	0.00E+00	1.57E+02	9.94E-03
Riparian Animal	Cs-137	0.00E+00	5.40E+04	2.70E-01
Riparian Animal	K-40	0.00E+00	1.16E+04	1.55E-01
Riparian Animal	Ra-226	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Ra-228	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Th-228	0.00E+00	1.46E+00	1.90E-03
Riparian Animal	Th-230	0.00E+00	1.48E+00	1.90E-03
Riparian Animal	Th-232	0.00E+00	1.45E+00	2.00E-03
Riparian Animal	Th-234	0.00E+00	6.78E-02	1.11E-04
Riparian Animal	U-234	0.00E+00	2.95E+01	3.76E-03

Riparian Animal	U-235	0.00E+00	2.95E+01	3.76E-03
Riparian Animal	U-238	0.00E+00	2.95E+01	3.76E-03

**No tissue concentration values were entered for this organism.**

# RESRAD-BIOTA Input Parameter Report

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## General Case Information

Title:	TR_B_ter
Ecosystem:	Terrestrial
Level:	2
Units:	Traditional

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## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	451	24.3	0
Co-60	0.0749	3.79	0
Cs-137	1.07	4.27	0
K-40	21.6	48.1	0
Ra-226	1.63	0.609	0
Ra-228	2.02	0.992	0
Th-228	2.51	0.127	0
Th-230	1.61	0.235	0
Th-232	1.84	0.125	0
Th-234	3.38	203	0
U-234	1.52	0.199	0
U-235	0.206	0.269	0
U-238	1.42	0.218	0

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

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## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Terrestrial Animal	0.1	1	Default	Default
Terrestrial Plant	1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Terrestrial Animal	Am-241	4.00E-03	8.65E-02	0.00E+00
Terrestrial Animal	Co-60	8.00E-02	1.26E-01	0.00E+00
Terrestrial Animal	Cs-137	1.10E+02	3.38E+00	0.00E+00
Terrestrial Animal	K-40	2.34E+01	1.00E+00	0.00E+00
Terrestrial Animal	Ra-226	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Ra-228	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Th-228	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-230	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-232	1.60E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-234	1.12E-04	6.78E-04	0.00E+00
Terrestrial Animal	U-234	3.80E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-235	3.70E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-238	3.73E-03	4.98E-02	0.00E+00
Terrestrial Plant	Am-241	7.64E-03	0.00E+00	0.00E+00
Terrestrial Plant	Co-60	2.20E-01	0.00E+00	0.00E+00
Terrestrial Plant	Cs-137	9.50E+00	0.00E+00	0.00E+00
Terrestrial Plant	K-40	2.00E+01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-226	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-228	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Th-228	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-230	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-232	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-234	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-234	3.78E-03	0.00E+00	0.00E+00

Terrestrial Plant	U-235	3.78E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-238	3.78E-03	0.00E+00	0.00E+00

**No tissue concentration values were entered for this organism.**

# RESRAD-BIOTA Input Parameter Report

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## General Case Information

Title:	TR_R_aq
Ecosystem:	Aquatic
Level:	2
Units:	Traditional

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## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	0	24.2	250
Co-60	0	3.86	0.0458
Cs-137	0	4.09	0.049
K-40	0	50.4	16.1
Ra-226	0	0.575	0.974
Ra-228	0	0.967	1.45
Th-228	0	0.149	1.38
Th-230	0	0.163	0.678
Th-232	0	0.12	1.36
Th-234	0	245	1.27
U-234	0	0.297	0.63
U-235	0	0.158	0.0648
U-238	0	0.204	0.685

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

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## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Aquatic Animal	1	1	Default	Default
Riparian Animal	0.1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Aquatic Animal	Am-241	0.00E+00	4.00E+02	0.00E+00
Aquatic Animal	Co-60	0.00E+00	2.00E+03	0.00E+00
Aquatic Animal	Cs-137	0.00E+00	2.20E+04	0.00E+00
Aquatic Animal	K-40	0.00E+00	1.00E+04	0.00E+00
Aquatic Animal	Ra-226	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Ra-228	0.00E+00	3.20E+03	0.00E+00
Aquatic Animal	Th-228	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-230	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-232	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	Th-234	0.00E+00	8.00E+01	0.00E+00
Aquatic Animal	U-234	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-235	0.00E+00	1.00E+03	0.00E+00
Aquatic Animal	U-238	0.00E+00	1.00E+03	0.00E+00
Riparian Animal	Am-241	0.00E+00	1.20E+01	3.15E-03
Riparian Animal	Co-60	0.00E+00	1.57E+02	9.94E-03
Riparian Animal	Cs-137	0.00E+00	5.40E+04	2.70E-01
Riparian Animal	K-40	0.00E+00	1.16E+04	1.55E-01
Riparian Animal	Ra-226	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Ra-228	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Th-228	0.00E+00	1.46E+00	1.90E-03
Riparian Animal	Th-230	0.00E+00	1.48E+00	1.90E-03
Riparian Animal	Th-232	0.00E+00	1.45E+00	2.00E-03
Riparian Animal	Th-234	0.00E+00	6.78E-02	1.11E-04
Riparian Animal	U-234	0.00E+00	2.95E+01	3.76E-03
Riparian Animal	U-235	0.00E+00	2.95E+01	3.76E-03

Riparian Animal	U-238	0.00E+00	2.95E+01	3.76E-03
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No tissue concentration values were entered for this organism.

# RESRAD-BIOTA Input Parameter Report

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## General Case Information

Title:	TR_R_ter
Ecosystem:	Terrestrial
Level:	2
Units:	Traditional

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## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	210	24.2	0
Co-60	0.0362	3.86	0
Cs-137	0.049	4.09	0
K-40	5.1	50.4	0
Ra-226	0.689	0.575	0
Ra-228	0.734	0.967	0
Th-228	0.874	0.149	0
Th-230	0.516	0.163	0
Th-232	0.72	0.12	0
Th-234	1.27	245	0
U-234	0.497	0.297	0
U-235	0.0648	0.158	0
U-238	0.515	0.204	0

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	100 years

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## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Terrestrial Animal	0.1	1	Default	Default
Terrestrial Plant	1	1	Default	Default

BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Terrestrial Animal	Am-241	4.00E-03	8.65E-02	0.00E+00
Terrestrial Animal	Co-60	8.00E-02	1.26E-01	0.00E+00
Terrestrial Animal	Cs-137	1.10E+02	3.38E+00	0.00E+00
Terrestrial Animal	K-40	2.34E+01	1.00E+00	0.00E+00
Terrestrial Animal	Ra-226	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Ra-228	6.00E-02	4.00E-01	0.00E+00
Terrestrial Animal	Th-228	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-230	1.91E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-232	1.60E-03	4.54E-02	0.00E+00
Terrestrial Animal	Th-234	1.12E-04	6.78E-04	0.00E+00
Terrestrial Animal	U-234	3.80E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-235	3.70E-03	4.98E-02	0.00E+00
Terrestrial Animal	U-238	3.73E-03	4.98E-02	0.00E+00
Terrestrial Plant	Am-241	7.64E-03	0.00E+00	0.00E+00
Terrestrial Plant	Co-60	2.20E-01	0.00E+00	0.00E+00
Terrestrial Plant	Cs-137	9.50E+00	0.00E+00	0.00E+00
Terrestrial Plant	K-40	2.00E+01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-226	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Ra-228	1.09E-01	0.00E+00	0.00E+00
Terrestrial Plant	Th-228	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-230	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-232	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	Th-234	1.02E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-234	3.78E-03	0.00E+00	0.00E+00
Terrestrial Plant	U-235	3.78E-03	0.00E+00	0.00E+00

Terrestrial Plant	U-238	3.78E-03	0.00E+00	0.00E+00
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No tissue concentration values were entered for this organism.

**ARCADIS**

**Attachment B**

Level 2 Dose Reports

## Aquatic Dose Report for Level 2 in rad/d

Title: CR\_A\_aq

<b>Aquatic Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Sediment</b>	<b>Summed</b>
Am-241	5.57E-02	7.92E-04	5.65E-02
Co-60	1.07E-03	6.48E-06	1.08E-03
Cs-137	3.56E-03	5.66E-05	3.62E-03
K-40	1.86E-02	3.72E-04	1.89E-02
Ra-226	5.98E-02	1.79E-04	6.00E-02
Ra-228	1.12E-01	7.55E-05	1.12E-01
Th-228	3.77E-04	1.56E-04	5.34E-04
Th-230	3.75E-05	1.13E-06	3.87E-05
Th-232	2.39E-04	6.08E-07	2.39E-04
Th-234	1.12E-03	1.31E-04	1.25E-03
U-234	1.02E-03	8.43E-07	1.02E-03
U-235	6.94E-04	1.97E-06	6.96E-04
U-238	4.09E-04	5.32E-05	4.62E-04
Summed	2.55E-01	1.83E-03	2.57E-01

<b>Riparian Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Sediment</b>	<b>Summed</b>
Am-241	1.67E-03	1.08E-02	1.25E-02
Co-60	8.42E-05	6.61E-06	9.08E-05
Cs-137	8.74E-03	8.92E-05	8.83E-03
K-40	2.16E-02	4.88E-04	2.21E-02
Ra-226	1.50E-02	2.57E-03	1.75E-02
Ra-228	2.81E-02	2.50E-03	3.06E-02
Th-228	6.91E-06	3.16E-04	3.23E-04
Th-230	6.95E-07	2.98E-05	3.05E-05
Th-232	4.33E-06	1.64E-04	1.68E-04
Th-234	7.83E-06	1.31E-04	1.39E-04
U-234	3.01E-05	4.93E-05	7.94E-05
U-235	2.05E-05	5.53E-06	2.60E-05
U-238	1.21E-05	9.15E-05	1.04E-04

Summed	7.52E-02	1.73E-02	9.24E-02
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## Terrestrial Dose Report for Level 2 in rad/d

**Title:** CR\_A\_ter

<b>Terrestrial Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	1.21E-05	1.16E-02	1.16E-02
Co-60	3.37E-07	1.08E-05	1.12E-05
Cs-137	6.22E-07	5.15E-03	5.15E-03
K-40	2.78E-06	1.82E-02	1.82E-02
Ra-226	7.52E-06	3.22E-03	3.23E-03
Ra-228	1.41E-05	4.61E-03	4.63E-03
Th-228	2.23E-07	4.73E-04	4.73E-04
Th-230	2.13E-08	1.61E-05	1.62E-05
Th-232	1.35E-07	1.21E-04	1.21E-04
Th-234	6.90E-06	1.56E-04	1.63E-04
U-234	5.09E-08	2.96E-05	2.96E-05
U-235	3.60E-08	7.43E-06	7.47E-06
U-238	2.25E-08	8.99E-05	8.99E-05
Summed	4.48E-05	4.37E-02	4.37E-02

<b>Terrestrial Plant</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	3.46E-08	2.09E-02	2.09E-02
Co-60	2.70E-07	1.22E-05	1.25E-05
Cs-137	7.56E-08	4.84E-04	4.84E-04
K-40	9.27E-07	1.57E-02	1.57E-02
Ra-226	4.21E-08	5.66E-03	5.66E-03
Ra-228	3.28E-08	8.26E-03	8.26E-03
Th-228	8.79E-09	3.99E-04	3.99E-04
Th-230	3.51E-11	9.18E-06	9.18E-06
Th-232	2.23E-11	7.77E-05	7.77E-05
Th-234	6.89E-06	1.56E-04	1.63E-04
U-234	6.68E-11	2.94E-05	2.94E-05
U-235	1.44E-09	7.50E-06	7.51E-06
U-238	2.13E-09	9.02E-05	9.02E-05

Summed	8.29E-06	5.18E-02	5.18E-02
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## Aquatic Dose Report for Level 2 in rad/d

Title: CR\_B\_aq

Aquatic Animal			
Nuclide	Water	Sediment	Summed
Am-241	5.79E-02	5.97E-04	5.85E-02
Co-60	9.96E-04	5.84E-06	1.00E-03
Cs-137	3.58E-03	6.69E-05	3.65E-03
K-40	1.77E-02	4.84E-04	1.82E-02
Ra-226	4.89E-02	1.55E-04	4.91E-02
Ra-228	1.11E-01	6.55E-05	1.11E-01
Th-228	3.69E-04	1.15E-04	4.85E-04
Th-230	2.44E-05	9.00E-07	2.53E-05
Th-232	2.03E-04	5.53E-07	2.04E-04
Th-234	9.06E-04	6.31E-05	9.69E-04
U-234	7.87E-04	5.77E-07	7.88E-04
U-235	1.34E-03	9.53E-07	1.34E-03
U-238	7.69E-04	4.41E-05	8.14E-04
Summed	2.45E-01	1.60E-03	2.47E-01

Riparian Animal			
Nuclide	Water	Sediment	Summed
Am-241	1.74E-03	8.16E-03	9.90E-03
Co-60	7.83E-05	5.95E-06	8.43E-05
Cs-137	8.79E-03	1.06E-04	8.89E-03
K-40	2.06E-02	6.34E-04	2.12E-02
Ra-226	1.22E-02	2.22E-03	1.45E-02
Ra-228	2.78E-02	2.17E-03	3.00E-02
Th-228	6.76E-06	2.33E-04	2.39E-04
Th-230	4.51E-07	2.37E-05	2.41E-05
Th-232	3.69E-06	1.49E-04	1.53E-04
Th-234	6.34E-06	6.31E-05	6.95E-05
U-234	2.33E-05	3.38E-05	5.70E-05
U-235	3.95E-05	2.68E-06	4.22E-05
U-238	2.27E-05	7.59E-05	9.86E-05

Summed	7.14E-02	1.39E-02	8.53E-02
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## Terrestrial Dose Report for Level 2 in rad/d

**Title:** CR\_B\_ter

<b>Terrestrial Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	1.26E-05	6.87E-03	6.89E-03
Co-60	3.14E-07	1.04E-05	1.07E-05
Cs-137	6.26E-07	1.37E-02	1.37E-02
K-40	2.66E-06	2.37E-02	2.37E-02
Ra-226	6.15E-06	1.83E-03	1.83E-03
Ra-228	1.40E-05	4.29E-03	4.31E-03
Th-228	2.18E-07	2.68E-04	2.68E-04
Th-230	1.38E-08	1.24E-05	1.24E-05
Th-232	1.15E-07	8.95E-05	8.96E-05
Th-234	5.58E-06	9.62E-05	1.02E-04
U-234	3.93E-08	2.34E-05	2.34E-05
U-235	6.93E-08	5.23E-06	5.30E-06
U-238	4.23E-08	7.28E-05	7.29E-05
Summed	4.23E-05	5.09E-02	5.10E-02

<b>Terrestrial Plant</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	3.60E-08	1.24E-02	1.24E-02
Co-60	2.51E-07	1.17E-05	1.20E-05
Cs-137	7.60E-08	1.29E-03	1.29E-03
K-40	8.86E-07	2.04E-02	2.04E-02
Ra-226	3.44E-08	3.21E-03	3.21E-03
Ra-228	3.25E-08	7.68E-03	7.68E-03
Th-228	8.60E-09	2.26E-04	2.26E-04
Th-230	2.28E-11	7.07E-06	7.07E-06
Th-232	1.90E-11	5.75E-05	5.75E-05
Th-234	5.57E-06	9.63E-05	1.02E-04
U-234	5.16E-11	2.32E-05	2.32E-05
U-235	2.78E-09	5.28E-06	5.29E-06
U-238	4.01E-09	7.31E-05	7.31E-05

Summed	6.90E-06	4.55E-02	4.55E-02
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## Aquatic Dose Report for Level 2 in rad/d

Title: CR\_R\_aq

<b>Aquatic Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Sediment</b>	<b>Summed</b>
Am-241	5.06E-02	2.98E-04	5.09E-02
Co-60	1.01E-03	3.22E-06	1.01E-03
Cs-137	3.46E-03	4.52E-05	3.50E-03
K-40	1.68E-02	1.48E-04	1.70E-02
Ra-226	4.86E-02	4.76E-05	4.87E-02
Ra-228	1.10E-01	2.57E-05	1.10E-01
Th-228	3.32E-04	5.45E-05	3.86E-04
Th-230	3.69E-05	2.88E-07	3.72E-05
Th-232	3.08E-04	2.19E-07	3.08E-04
Th-234	8.35E-04	2.94E-05	8.64E-04
U-234	1.81E-03	1.61E-07	1.81E-03
U-235	1.24E-03	6.18E-07	1.24E-03
U-238	6.40E-04	1.20E-05	6.52E-04
Summed	2.35E-01	6.65E-04	2.36E-01

<b>Riparian Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Sediment</b>	<b>Summed</b>
Am-241	1.52E-03	4.07E-03	5.59E-03
Co-60	7.92E-05	3.29E-06	8.25E-05
Cs-137	8.48E-03	7.13E-05	8.55E-03
K-40	1.96E-02	1.93E-04	1.98E-02
Ra-226	1.22E-02	6.81E-04	1.28E-02
Ra-228	2.74E-02	8.52E-04	2.83E-02
Th-228	6.07E-06	1.10E-04	1.16E-04
Th-230	6.82E-07	7.58E-06	8.26E-06
Th-232	5.58E-06	5.89E-05	6.45E-05
Th-234	5.84E-06	2.94E-05	3.52E-05
U-234	5.34E-05	9.43E-06	6.28E-05
U-235	3.66E-05	1.74E-06	3.84E-05
U-238	1.89E-05	2.07E-05	3.96E-05

Summed	6.94E-02	6.11E-03	7.55E-02
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## Terrestrial Dose Report for Level 2 in rad/d

**Title:** CR\_R\_ter

<b>Terrestrial Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	1.10E-05	5.39E-03	5.40E-03
Co-60	3.17E-07	5.24E-06	5.55E-06
Cs-137	6.04E-07	2.36E-04	2.36E-04
K-40	2.53E-06	4.30E-03	4.30E-03
Ra-226	6.11E-06	1.36E-03	1.37E-03
Ra-228	1.37E-05	1.68E-03	1.69E-03
Th-228	1.96E-07	1.65E-04	1.65E-04
Th-230	2.09E-08	5.17E-06	5.19E-06
Th-232	1.75E-07	4.74E-05	4.75E-05
Th-234	5.14E-06	5.87E-05	6.39E-05
U-234	9.02E-08	9.68E-06	9.77E-06
U-235	6.43E-08	2.34E-06	2.40E-06
U-238	3.52E-08	3.26E-05	3.26E-05
Summed	4.00E-05	1.33E-02	1.33E-02

<b>Terrestrial Plant</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	3.15E-08	9.74E-03	9.74E-03
Co-60	2.54E-07	5.91E-06	6.16E-06
Cs-137	7.34E-08	2.22E-05	2.23E-05
K-40	8.41E-07	3.70E-03	3.70E-03
Ra-226	3.42E-08	2.39E-03	2.39E-03
Ra-228	3.20E-08	3.00E-03	3.00E-03
Th-228	7.73E-09	1.39E-04	1.39E-04
Th-230	3.45E-11	2.94E-06	2.94E-06
Th-232	2.87E-11	3.04E-05	3.04E-05
Th-234	5.13E-06	5.88E-05	6.39E-05
U-234	1.18E-10	9.62E-06	9.62E-06
U-235	2.58E-09	2.36E-06	2.36E-06
U-238	3.33E-09	3.27E-05	3.27E-05

Summed	6.41E-06	1.91E-02	1.91E-02
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## Aquatic Dose Report for Level 2 in rad/d

Title: ER\_A\_aq

Aquatic Animal			
Nuclide	Water	Sediment	Summed
Am-241	4.77E-02	6.78E-04	4.84E-02
Co-60	1.52E-03	4.66E-06	1.52E-03
Cs-137	4.06E-03	8.98E-06	4.07E-03
K-40	1.88E-02	4.02E-04	1.93E-02
Ra-226	8.63E-02	1.64E-04	8.64E-02
Ra-228	2.46E-01	7.41E-05	2.46E-01
Th-228	3.32E-04	1.30E-04	4.62E-04
Th-230	6.66E-05	9.40E-07	6.75E-05
Th-232	3.04E-04	5.93E-07	3.05E-04
Th-234	7.29E-04	2.15E-04	9.44E-04
U-234	1.31E-03	9.60E-07	1.31E-03
U-235	7.03E-04	2.55E-06	7.05E-04
U-238	7.69E-04	6.88E-05	8.38E-04
Summed	4.08E-01	1.75E-03	4.10E-01

Riparian Animal			
Nuclide	Water	Sediment	Summed
Am-241	1.43E-03	9.27E-03	1.07E-02
Co-60	1.20E-04	4.75E-06	1.24E-04
Cs-137	9.96E-03	1.42E-05	9.97E-03
K-40	2.19E-02	5.26E-04	2.24E-02
Ra-226	2.16E-02	2.34E-03	2.39E-02
Ra-228	6.14E-02	2.45E-03	6.39E-02
Th-228	6.07E-06	2.63E-04	2.69E-04
Th-230	1.23E-06	2.47E-05	2.60E-05
Th-232	5.52E-06	1.59E-04	1.65E-04
Th-234	5.10E-06	2.15E-04	2.20E-04
U-234	3.88E-05	5.61E-05	9.49E-05
U-235	2.08E-05	7.16E-06	2.79E-05
U-238	2.27E-05	1.18E-04	1.41E-04

Summed	1.16E-01	1.54E-02	1.32E-01
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## Terrestrial Dose Report for Level 2 in rad/d

**Title:** ER\_A\_ter

<b>Terrestrial Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	1.03E-05	5.21E-03	5.22E-03
Co-60	4.79E-07	8.52E-06	9.00E-06
Cs-137	7.09E-07	1.95E-03	1.95E-03
K-40	2.83E-06	1.96E-02	1.96E-02
Ra-226	1.08E-05	2.13E-03	2.15E-03
Ra-228	3.08E-05	3.84E-03	3.87E-03
Th-228	1.96E-07	3.39E-04	3.40E-04
Th-230	3.78E-08	1.55E-05	1.56E-05
Th-232	1.72E-07	1.06E-04	1.06E-04
Th-234	4.49E-06	4.54E-05	4.99E-05
U-234	6.55E-08	2.55E-05	2.56E-05
U-235	3.65E-08	6.02E-06	6.06E-06
U-238	4.23E-08	7.98E-05	7.98E-05
Summed	6.10E-05	3.34E-02	3.34E-02

<b>Terrestrial Plant</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	2.97E-08	9.42E-03	9.42E-03
Co-60	3.83E-07	9.61E-06	1.00E-05
Cs-137	8.62E-08	1.84E-04	1.84E-04
K-40	9.41E-07	1.69E-02	1.69E-02
Ra-226	6.07E-08	3.75E-03	3.75E-03
Ra-228	7.17E-08	6.87E-03	6.87E-03
Th-228	7.73E-09	2.86E-04	2.86E-04
Th-230	6.23E-11	8.84E-06	8.84E-06
Th-232	2.84E-11	6.80E-05	6.80E-05
Th-234	4.49E-06	4.54E-05	4.99E-05
U-234	8.60E-11	2.54E-05	2.54E-05
U-235	1.46E-09	6.08E-06	6.09E-06
U-238	4.01E-09	8.00E-05	8.01E-05

Summed	6.07E-06	3.76E-02	3.76E-02
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## Aquatic Dose Report for Level 2 in rad/d

Title: ER\_B\_aq

<b>Aquatic Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Sediment</b>	<b>Summed</b>
Am-241	6.07E-02	5.52E-04	6.12E-02
Co-60	1.04E-03	7.50E-06	1.05E-03
Cs-137	3.97E-03	6.65E-06	3.98E-03
K-40	1.76E-02	7.38E-04	1.84E-02
Ra-226	1.61E-01	2.54E-04	1.61E-01
Ra-228	3.86E-01	1.04E-04	3.86E-01
Th-228	3.40E-04	1.88E-04	5.28E-04
Th-230	5.14E-05	1.50E-06	5.29E-05
Th-232	1.85E-04	9.21E-07	1.86E-04
Th-234	1.00E-03	1.62E-04	1.16E-03
U-234	8.57E-04	1.24E-06	8.58E-04
U-235	6.98E-04	2.49E-06	7.01E-04
U-238	1.34E-03	9.44E-05	1.44E-03
Summed	6.35E-01	2.11E-03	6.37E-01

<b>Riparian Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Sediment</b>	<b>Summed</b>
Am-241	1.82E-03	7.54E-03	9.36E-03
Co-60	8.19E-05	7.65E-06	8.96E-05
Cs-137	9.75E-03	1.05E-05	9.76E-03
K-40	2.05E-02	9.66E-04	2.15E-02
Ra-226	4.02E-02	3.64E-03	4.38E-02
Ra-228	9.65E-02	3.46E-03	1.00E-01
Th-228	6.22E-06	3.80E-04	3.86E-04
Th-230	9.51E-07	3.94E-05	4.04E-05
Th-232	3.37E-06	2.48E-04	2.51E-04
Th-234	6.99E-06	1.62E-04	1.69E-04
U-234	2.53E-05	7.23E-05	9.76E-05
U-235	2.06E-05	7.00E-06	2.76E-05
U-238	3.96E-05	1.63E-04	2.02E-04

Summed	1.69E-01	1.67E-02	1.86E-01
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## Terrestrial Dose Report for Level 2 in rad/d

**Title:** ER\_B\_ter

<b>Terrestrial Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	1.32E-05	6.77E-03	6.78E-03
Co-60	3.28E-07	1.06E-05	1.09E-05
Cs-137	6.94E-07	1.58E-03	1.58E-03
K-40	2.64E-06	3.61E-02	3.61E-02
Ra-226	2.02E-05	7.27E-03	7.29E-03
Ra-228	4.84E-05	6.44E-03	6.49E-03
Th-228	2.01E-07	4.98E-04	4.98E-04
Th-230	2.92E-08	4.12E-05	4.12E-05
Th-232	1.05E-07	1.99E-04	1.99E-04
Th-234	6.16E-06	2.02E-04	2.08E-04
U-234	4.27E-08	5.72E-05	5.73E-05
U-235	3.62E-08	4.69E-06	4.73E-06
U-238	7.38E-08	2.24E-04	2.24E-04
Summed	9.21E-05	5.94E-02	5.94E-02

<b>Terrestrial Plant</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	3.78E-08	1.22E-02	1.22E-02
Co-60	2.63E-07	1.20E-05	1.22E-05
Cs-137	8.43E-08	1.48E-04	1.49E-04
K-40	8.81E-07	3.10E-02	3.10E-02
Ra-226	1.13E-07	1.28E-02	1.28E-02
Ra-228	1.13E-07	1.15E-02	1.15E-02
Th-228	7.92E-09	4.19E-04	4.19E-04
Th-230	4.81E-11	2.34E-05	2.34E-05
Th-232	1.73E-11	1.28E-04	1.28E-04
Th-234	6.15E-06	2.02E-04	2.08E-04
U-234	5.61E-11	5.69E-05	5.69E-05
U-235	1.45E-09	4.74E-06	4.74E-06
U-238	6.99E-09	2.24E-04	2.24E-04

Summed	7.66E-06	6.88E-02	6.88E-02
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## Aquatic Dose Report for Level 2 in rad/d

Title: ER\_C\_aq

<b>Aquatic Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Sediment</b>	<b>Summed</b>
Am-241	6.23E-02	8.27E-04	6.31E-02
Co-60	9.54E-04	5.68E-06	9.60E-04
Cs-137	3.56E-03	4.99E-06	3.57E-03
K-40	1.73E-02	3.52E-04	1.76E-02
Ra-226	3.62E-02	2.18E-04	3.64E-02
Ra-228	4.45E-01	9.48E-05	4.45E-01
Th-228	2.92E-04	1.49E-04	4.41E-04
Th-230	2.89E-05	1.90E-06	3.08E-05
Th-232	1.51E-04	7.57E-07	1.52E-04
Th-234	9.32E-04	5.46E-05	9.87E-04
U-234	1.35E-03	1.07E-06	1.35E-03
U-235	6.11E-04	1.24E-06	6.12E-04
U-238	1.13E-03	6.97E-05	1.20E-03
Summed	5.70E-01	1.78E-03	5.72E-01

<b>Riparian Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Sediment</b>	<b>Summed</b>
Am-241	1.86E-03	1.13E-02	1.32E-02
Co-60	7.50E-05	5.79E-06	8.08E-05
Cs-137	8.74E-03	7.86E-06	8.75E-03
K-40	2.01E-02	4.61E-04	2.05E-02
Ra-226	9.04E-03	3.12E-03	1.22E-02
Ra-228	1.11E-01	3.14E-03	1.14E-01
Th-228	5.34E-06	3.01E-04	3.06E-04
Th-230	5.35E-07	5.00E-05	5.05E-05
Th-232	2.74E-06	2.04E-04	2.06E-04
Th-234	6.52E-06	5.46E-05	6.11E-05
U-234	3.99E-05	6.26E-05	1.03E-04
U-235	1.80E-05	3.49E-06	2.15E-05
U-238	3.33E-05	1.20E-04	1.53E-04

Summed	1.51E-01	1.88E-02	1.70E-01
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## Terrestrial Dose Report for Level 2 in rad/d

**Title:** ER\_C\_ter

<b>Terrestrial Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	1.35E-05	4.75E-03	4.76E-03
Co-60	3.00E-07	4.34E-06	4.64E-06
Cs-137	6.22E-07	2.39E-04	2.39E-04
K-40	2.59E-06	6.26E-03	6.26E-03
Ra-226	4.55E-06	1.87E-03	1.87E-03
Ra-228	5.58E-05	2.44E-03	2.50E-03
Th-228	1.72E-07	1.53E-04	1.53E-04
Th-230	1.64E-08	5.22E-05	5.22E-05
Th-232	8.56E-08	6.32E-05	6.33E-05
Th-234	5.74E-06	1.09E-04	1.15E-04
U-234	6.74E-08	1.70E-05	1.70E-05
U-235	3.17E-08	1.92E-06	1.95E-06
U-238	6.20E-08	5.12E-05	5.13E-05
Summed	8.35E-05	1.60E-02	1.61E-02

<b>Terrestrial Plant</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	3.87E-08	8.58E-03	8.58E-03
Co-60	2.41E-07	4.90E-06	5.14E-06
Cs-137	7.56E-08	2.25E-05	2.25E-05
K-40	8.62E-07	5.39E-03	5.39E-03
Ra-226	2.55E-08	3.28E-03	3.28E-03
Ra-228	1.30E-07	4.37E-03	4.37E-03
Th-228	6.80E-09	1.29E-04	1.29E-04
Th-230	2.71E-11	2.97E-05	2.97E-05
Th-232	1.41E-11	4.06E-05	4.06E-05
Th-234	5.73E-06	1.09E-04	1.15E-04
U-234	8.86E-11	1.69E-05	1.69E-05
U-235	1.27E-09	1.94E-06	1.94E-06
U-238	5.88E-09	5.14E-05	5.14E-05

Summed	7.12E-06	2.20E-02	2.20E-02
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## Aquatic Dose Report for Level 2 in rad/d

Title: ER\_R\_aq

<b>Aquatic Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Sediment</b>	<b>Summed</b>
Am-241	5.57E-02	2.98E-04	5.60E-02
Co-60	1.11E-03	4.28E-06	1.11E-03
Cs-137	3.89E-03	1.89E-06	3.90E-03
K-40	1.89E-02	8.79E-05	1.90E-02
Ra-226	6.08E-02	4.76E-05	6.08E-02
Ra-228	9.66E-02	2.68E-05	9.66E-02
Th-228	3.85E-04	5.45E-05	4.40E-04
Th-230	3.80E-05	2.34E-07	3.82E-05
Th-232	3.17E-04	2.19E-07	3.17E-04
Th-234	9.32E-04	4.49E-05	9.77E-04
U-234	1.02E-03	1.94E-07	1.02E-03
U-235	6.15E-04	6.18E-07	6.16E-04
U-238	6.58E-04	1.34E-05	6.71E-04
Summed	2.41E-01	5.80E-04	2.42E-01

<b>Riparian Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Sediment</b>	<b>Summed</b>
Am-241	1.67E-03	4.07E-03	5.74E-03
Co-60	8.73E-05	4.37E-06	9.17E-05
Cs-137	9.56E-03	2.97E-06	9.56E-03
K-40	2.20E-02	1.15E-04	2.21E-02
Ra-226	1.52E-02	6.81E-04	1.59E-02
Ra-228	2.41E-02	8.89E-04	2.50E-02
Th-228	7.05E-06	1.10E-04	1.17E-04
Th-230	7.03E-07	6.16E-06	6.86E-06
Th-232	5.76E-06	5.89E-05	6.46E-05
Th-234	6.52E-06	4.49E-05	5.14E-05
U-234	3.01E-05	1.13E-05	4.15E-05
U-235	1.82E-05	1.74E-06	1.99E-05
U-238	1.94E-05	2.30E-05	4.24E-05

Summed	7.27E-02	6.02E-03	7.87E-02
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## Terrestrial Dose Report for Level 2 in rad/d

**Title:** ER\_R\_ter

<b>Terrestrial Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	1.21E-05	5.39E-03	5.40E-03
Co-60	3.50E-07	5.24E-06	5.59E-06
Cs-137	6.81E-07	2.36E-04	2.37E-04
K-40	2.84E-06	4.30E-03	4.30E-03
Ra-226	7.64E-06	1.36E-03	1.37E-03
Ra-228	1.21E-05	1.68E-03	1.69E-03
Th-228	2.28E-07	1.65E-04	1.65E-04
Th-230	2.16E-08	5.17E-06	5.19E-06
Th-232	1.80E-07	4.74E-05	4.76E-05
Th-234	5.74E-06	5.87E-05	6.45E-05
U-234	5.09E-08	9.68E-06	9.73E-06
U-235	3.19E-08	2.34E-06	2.37E-06
U-238	3.62E-08	3.26E-05	3.26E-05
Summed	4.20E-05	1.33E-02	1.33E-02

<b>Terrestrial Plant</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	3.46E-08	9.74E-03	9.74E-03
Co-60	2.80E-07	5.91E-06	6.19E-06
Cs-137	8.27E-08	2.22E-05	2.23E-05
K-40	9.44E-07	3.70E-03	3.70E-03
Ra-226	4.28E-08	2.39E-03	2.39E-03
Ra-228	2.82E-08	3.00E-03	3.00E-03
Th-228	8.98E-09	1.39E-04	1.39E-04
Th-230	3.56E-11	2.94E-06	2.94E-06
Th-232	2.96E-11	3.04E-05	3.04E-05
Th-234	5.73E-06	5.88E-05	6.45E-05
U-234	6.68E-11	9.62E-06	9.62E-06
U-235	1.28E-09	2.36E-06	2.36E-06
U-238	3.43E-09	3.27E-05	3.27E-05

Summed	7.16E-06	1.91E-02	1.91E-02
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## Aquatic Dose Report for Level 2 in rad/d

Title: TR\_A\_aq

<b>Aquatic Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Sediment</b>	<b>Summed</b>
Am-241	5.54E-02	6.40E-04	5.61E-02
Co-60	1.01E-03	8.31E-06	1.02E-03
Cs-137	4.08E-03	3.10E-05	4.11E-03
K-40	1.66E-02	3.88E-04	1.70E-02
Ra-226	5.97E-02	1.45E-04	5.98E-02
Ra-228	1.17E-01	7.44E-05	1.17E-01
Th-228	3.40E-04	1.56E-04	4.96E-04
Th-230	9.15E-05	6.63E-07	9.21E-05
Th-232	4.07E-04	5.60E-07	4.08E-04
Th-234	7.63E-04	7.82E-05	8.41E-04
U-234	9.86E-04	4.93E-07	9.86E-04
U-235	1.24E-03	1.97E-06	1.24E-03
U-238	9.75E-04	3.59E-05	1.01E-03
Summed	2.59E-01	1.56E-03	2.60E-01

<b>Riparian Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Sediment</b>	<b>Summed</b>
Am-241	1.66E-03	8.74E-03	1.04E-02
Co-60	7.92E-05	8.47E-06	8.77E-05
Cs-137	1.00E-02	4.89E-05	1.01E-02
K-40	1.93E-02	5.08E-04	1.98E-02
Ra-226	1.49E-02	2.08E-03	1.70E-02
Ra-228	2.93E-02	2.47E-03	3.18E-02
Th-228	6.22E-06	3.16E-04	3.22E-04
Th-230	1.69E-06	1.75E-05	1.91E-05
Th-232	7.39E-06	1.50E-04	1.58E-04
Th-234	5.34E-06	7.82E-05	8.35E-05
U-234	2.91E-05	2.88E-05	5.79E-05
U-235	3.65E-05	5.53E-06	4.20E-05
U-238	2.88E-05	6.18E-05	9.06E-05

Summed	7.54E-02	1.45E-02	8.99E-02
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## Terrestrial Dose Report for Level 2 in rad/d

**Title:** TR\_A\_ter

<b>Terrestrial Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	1.20E-05	1.16E-02	1.16E-02
Co-60	3.17E-07	1.08E-05	1.12E-05
Cs-137	7.13E-07	5.15E-03	5.15E-03
K-40	2.49E-06	1.82E-02	1.82E-02
Ra-226	7.50E-06	3.22E-03	3.23E-03
Ra-228	1.47E-05	4.61E-03	4.63E-03
Th-228	2.01E-07	4.73E-04	4.73E-04
Th-230	5.20E-08	1.61E-05	1.62E-05
Th-232	2.31E-07	1.21E-04	1.21E-04
Th-234	4.70E-06	1.56E-04	1.61E-04
U-234	4.92E-08	2.96E-05	2.96E-05
U-235	6.41E-08	7.43E-06	7.50E-06
U-238	5.37E-08	8.99E-05	9.00E-05
Summed	4.31E-05	4.37E-02	4.37E-02

<b>Terrestrial Plant</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	3.45E-08	2.09E-02	2.09E-02
Co-60	2.54E-07	1.22E-05	1.25E-05
Cs-137	8.66E-08	4.84E-04	4.84E-04
K-40	8.29E-07	1.57E-02	1.57E-02
Ra-226	4.20E-08	5.66E-03	5.66E-03
Ra-228	3.42E-08	8.26E-03	8.26E-03
Th-228	7.92E-09	3.99E-04	3.99E-04
Th-230	8.56E-11	9.18E-06	9.18E-06
Th-232	3.80E-11	7.77E-05	7.77E-05
Th-234	4.69E-06	1.56E-04	1.61E-04
U-234	6.46E-11	2.94E-05	2.94E-05
U-235	2.57E-09	7.50E-06	7.51E-06
U-238	5.08E-09	9.02E-05	9.02E-05

Summed	5.99E-06	5.18E-02	5.18E-02
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## Aquatic Dose Report for Level 2 in rad/d

Title: TR\_B\_aq

Aquatic Animal			
Nuclide	Water	Sediment	Summed
Am-241	5.54E-02	6.40E-04	5.61E-02
Co-60	1.01E-03	5.51E-06	1.01E-03
Cs-137	4.08E-03	2.17E-05	4.10E-03
K-40	1.66E-02	3.72E-04	1.70E-02
Ra-226	5.97E-02	1.62E-04	5.99E-02
Ra-228	1.17E-01	7.65E-05	1.17E-01
Th-228	3.40E-04	1.56E-04	4.96E-04
Th-230	9.15E-05	1.43E-06	9.29E-05
Th-232	4.07E-04	7.15E-07	4.08E-04
Th-234	7.63E-04	1.20E-04	8.83E-04
U-234	9.86E-04	8.17E-07	9.86E-04
U-235	1.24E-03	2.00E-06	1.24E-03
U-238	9.75E-04	5.71E-05	1.03E-03
Summed	2.59E-01	1.62E-03	2.60E-01

Riparian Animal			
Nuclide	Water	Sediment	Summed
Am-241	1.66E-03	8.74E-03	1.04E-02
Co-60	7.92E-05	5.62E-06	8.48E-05
Cs-137	1.00E-02	3.42E-05	1.00E-02
K-40	1.93E-02	4.88E-04	1.98E-02
Ra-226	1.49E-02	2.32E-03	1.72E-02
Ra-228	2.93E-02	2.53E-03	3.18E-02
Th-228	6.22E-06	3.16E-04	3.22E-04
Th-230	1.69E-06	3.77E-05	3.94E-05
Th-232	7.39E-06	1.92E-04	2.00E-04
Th-234	5.34E-06	1.20E-04	1.25E-04
U-234	2.91E-05	4.78E-05	7.69E-05
U-235	3.65E-05	5.63E-06	4.21E-05
U-238	2.88E-05	9.84E-05	1.27E-04

Summed	7.54E-02	1.49E-02	9.03E-02
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## Terrestrial Dose Report for Level 2 in rad/d

**Title:** TR\_B\_ter

<b>Terrestrial Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	1.20E-05	1.16E-02	1.16E-02
Co-60	3.17E-07	1.08E-05	1.12E-05
Cs-137	7.13E-07	5.15E-03	5.15E-03
K-40	2.49E-06	1.82E-02	1.82E-02
Ra-226	7.50E-06	3.22E-03	3.23E-03
Ra-228	1.47E-05	4.61E-03	4.63E-03
Th-228	2.01E-07	4.73E-04	4.73E-04
Th-230	5.20E-08	1.61E-05	1.62E-05
Th-232	2.31E-07	1.21E-04	1.21E-04
Th-234	4.70E-06	1.56E-04	1.61E-04
U-234	4.92E-08	2.96E-05	2.96E-05
U-235	6.41E-08	7.43E-06	7.50E-06
U-238	5.37E-08	8.99E-05	9.00E-05
Summed	4.31E-05	4.37E-02	4.37E-02

<b>Terrestrial Plant</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	3.45E-08	2.09E-02	2.09E-02
Co-60	2.54E-07	1.22E-05	1.25E-05
Cs-137	8.66E-08	4.84E-04	4.84E-04
K-40	8.29E-07	1.57E-02	1.57E-02
Ra-226	4.20E-08	5.66E-03	5.66E-03
Ra-228	3.42E-08	8.26E-03	8.26E-03
Th-228	7.92E-09	3.99E-04	3.99E-04
Th-230	8.56E-11	9.18E-06	9.18E-06
Th-232	3.80E-11	7.77E-05	7.77E-05
Th-234	4.69E-06	1.56E-04	1.61E-04
U-234	6.46E-11	2.94E-05	2.94E-05
U-235	2.57E-09	7.50E-06	7.51E-06
U-238	5.08E-09	9.02E-05	9.02E-05

Summed	5.99E-06	5.18E-02	5.18E-02
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## Aquatic Dose Report for Level 2 in rad/d

Title: TR\_R\_aq

Aquatic Animal			
Nuclide	Water	Sediment	Summed
Am-241	5.52E-02	3.55E-04	5.56E-02
Co-60	1.03E-03	3.07E-06	1.03E-03
Cs-137	3.90E-03	9.93E-07	3.90E-03
K-40	1.74E-02	2.77E-04	1.77E-02
Ra-226	5.64E-02	6.72E-05	5.64E-02
Ra-228	1.14E-01	5.00E-05	1.14E-01
Th-228	3.99E-04	8.60E-05	4.85E-04
Th-230	6.34E-05	2.47E-07	6.37E-05
Th-232	3.91E-04	4.14E-07	3.92E-04
Th-234	9.21E-04	2.94E-05	9.50E-04
U-234	1.47E-03	2.04E-07	1.47E-03
U-235	7.26E-04	6.18E-07	7.26E-04
U-238	9.13E-04	1.60E-05	9.29E-04
Summed	2.53E-01	8.86E-04	2.54E-01

Riparian Animal			
Nuclide	Water	Sediment	Summed
Am-241	1.65E-03	4.85E-03	6.50E-03
Co-60	8.06E-05	3.13E-06	8.38E-05
Cs-137	9.58E-03	1.57E-06	9.58E-03
K-40	2.02E-02	3.64E-04	2.06E-02
Ra-226	1.41E-02	9.62E-04	1.51E-02
Ra-228	2.85E-02	1.66E-03	3.02E-02
Th-228	7.30E-06	1.74E-04	1.81E-04
Th-230	1.17E-06	6.50E-06	7.68E-06
Th-232	7.10E-06	1.11E-04	1.18E-04
Th-234	6.44E-06	2.94E-05	3.58E-05
U-234	4.34E-05	1.19E-05	5.54E-05
U-235	2.14E-05	1.74E-06	2.32E-05
U-238	2.70E-05	2.75E-05	5.45E-05

Summed	7.43E-02	8.19E-03	8.25E-02
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## Terrestrial Dose Report for Level 2 in rad/d

**Title:** TR\_R\_ter

<b>Terrestrial Animal</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	1.20E-05	5.39E-03	5.40E-03
Co-60	3.23E-07	5.24E-06	5.56E-06
Cs-137	6.83E-07	2.36E-04	2.37E-04
K-40	2.61E-06	4.30E-03	4.30E-03
Ra-226	7.09E-06	1.36E-03	1.37E-03
Ra-228	1.43E-05	1.68E-03	1.69E-03
Th-228	2.35E-07	1.65E-04	1.65E-04
Th-230	3.60E-08	5.17E-06	5.21E-06
Th-232	2.22E-07	4.74E-05	4.76E-05
Th-234	5.67E-06	5.87E-05	6.44E-05
U-234	7.34E-08	9.68E-06	9.75E-06
U-235	3.77E-08	2.34E-06	2.38E-06
U-238	5.02E-08	3.26E-05	3.27E-05
Summed	4.33E-05	1.33E-02	1.33E-02

<b>Terrestrial Plant</b>			
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Summed</b>
Am-241	3.43E-08	9.74E-03	9.74E-03
Co-60	2.59E-07	5.91E-06	6.17E-06
Cs-137	8.29E-08	2.22E-05	2.23E-05
K-40	8.69E-07	3.70E-03	3.70E-03
Ra-226	3.97E-08	2.39E-03	2.39E-03
Ra-228	3.33E-08	3.00E-03	3.00E-03
Th-228	9.29E-09	1.39E-04	1.39E-04
Th-230	5.94E-11	2.94E-06	2.94E-06
Th-232	3.65E-11	3.04E-05	3.04E-05
Th-234	5.67E-06	5.88E-05	6.45E-05
U-234	9.63E-11	9.62E-06	9.62E-06
U-235	1.51E-09	2.36E-06	2.36E-06
U-238	4.76E-09	3.27E-05	3.27E-05

Summed	7.00E-06	1.91E-02	1.91E-02
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**ARCADIS**

**Attachment C**

Level 3 Input Parameter Reports  
for Riparian Animals

# RESRAD-BIOTA Input Parameter Report

## General Case Information

<b>Title:</b>	ER_A_aq_180 days
<b>Ecosystem:</b>	Aquatic
<b>Level:</b>	3
<b>Units:</b>	Traditional

## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	0	20.9	478
Co-60	0	5.72	0.0695
Cs-137	0	4.25	0.443
K-40	0	54.6	23.3
Ra-226	0	0.88	2.37
Ra-228	0	2.08	2.15
Th-228	0	0.124	2.09
Th-230	0	0.171	2.58
Th-232	0	0.0933	1.95
Th-234	0	194	9.28
U-234	0	0.265	2.96
U-235	0	0.153	0.267
U-238	0	0.172	2.95

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	180 days

## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Riparian Animal	0.1	1	Default	Default

Riparian Animal_180 days	0.1	1	GrizzlyBear	FishEggs
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BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Riparian Animal	Am-241	0.00E+00	1.20E+01	3.15E-03
Riparian Animal	Co-60	0.00E+00	1.57E+02	9.94E-03
Riparian Animal	Cs-137	0.00E+00	5.40E+04	2.70E-01
Riparian Animal	K-40	0.00E+00	1.16E+04	1.55E-01
Riparian Animal	Ra-226	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Ra-228	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Th-228	0.00E+00	1.46E+00	1.90E-03
Riparian Animal	Th-230	0.00E+00	1.48E+00	1.90E-03
Riparian Animal	Th-232	0.00E+00	1.45E+00	2.00E-03
Riparian Animal	Th-234	0.00E+00	6.78E-02	1.11E-04
Riparian Animal	U-234	0.00E+00	2.95E+01	3.76E-03
Riparian Animal	U-235	0.00E+00	2.95E+01	3.76E-03
Riparian Animal	U-238	0.00E+00	2.95E+01	3.76E-03
Riparian Animal_180 days	Am-241	0.00E+00	1.20E+01	3.15E-03
Riparian Animal_180 days	Co-60	0.00E+00	1.57E+02	9.94E-03
Riparian Animal_180 days	Cs-137	0.00E+00	5.40E+04	2.70E-01
Riparian Animal_180 days	K-40	0.00E+00	1.16E+04	1.55E-01
Riparian Animal_180 days	Ra-226	0.00E+00	8.00E+02	3.00E-02
Riparian Animal_180 days	Ra-228	0.00E+00	8.00E+02	3.00E-02
Riparian Animal_180 days	Th-228	0.00E+00	1.46E+00	1.90E-03
Riparian Animal_180 days	Th-230	0.00E+00	1.48E+00	1.90E-03
Riparian Animal_180 days	Th-232	0.00E+00	1.45E+00	2.00E-03
Riparian Animal_180 days	Th-234	0.00E+00	6.78E-02	1.11E-04
Riparian Animal_180 days	U-234	0.00E+00	2.95E+01	3.76E-03
Riparian Animal_180 days	U-235	0.00E+00	2.95E+01	3.76E-03
Riparian Animal_180 days	U-238	0.00E+00	2.95E+01	3.76E-03

No tissue concentration values were entered for this organism.

# RESRAD-BIOTA Input Parameter Report

## General Case Information

<b>Title:</b>	Default
<b>Ecosystem:</b>	Aquatic
<b>Level:</b>	3
<b>Units:</b>	Traditional

## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	0	26.6	389
Co-60	0	3.92	0.112
Cs-137	0	4.16	0.328
K-40	0	51.1	42.8
Ra-226	0	1.64	3.68
Ra-228	0	3.27	3.03
Th-228	0	0.127	3.02
Th-230	0	0.132	4.11
Th-232	0	0.0569	3.03
Th-234	0	266	6.99
U-234	0	0.173	3.81
U-235	0	0.152	0.261
U-238	0	0.3	4.05

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	180 days

## Organism Specific Data

Organism Data				
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size
Riparian Animal	0.1	1	Default	Default

Riparian Animal_180 days	0.1	1	GrizzlyBear	FishEggs
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BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Riparian Animal	Am-241	0.00E+00	1.20E+01	3.15E-03
Riparian Animal	Co-60	0.00E+00	1.57E+02	9.94E-03
Riparian Animal	Cs-137	0.00E+00	5.40E+04	2.70E-01
Riparian Animal	K-40	0.00E+00	1.16E+04	1.55E-01
Riparian Animal	Ra-226	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Ra-228	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Th-228	0.00E+00	1.46E+00	1.90E-03
Riparian Animal	Th-230	0.00E+00	1.48E+00	1.90E-03
Riparian Animal	Th-232	0.00E+00	1.45E+00	2.00E-03
Riparian Animal	Th-234	0.00E+00	6.78E-02	1.11E-04
Riparian Animal	U-234	0.00E+00	2.95E+01	3.76E-03
Riparian Animal	U-235	0.00E+00	2.95E+01	3.76E-03
Riparian Animal	U-238	0.00E+00	2.95E+01	3.76E-03
Riparian Animal_180 days	Am-241	0.00E+00	1.20E+01	3.15E-03
Riparian Animal_180 days	Co-60	0.00E+00	1.57E+02	9.94E-03
Riparian Animal_180 days	Cs-137	0.00E+00	5.40E+04	2.70E-01
Riparian Animal_180 days	K-40	0.00E+00	1.16E+04	1.55E-01
Riparian Animal_180 days	Ra-226	0.00E+00	8.00E+02	3.00E-02
Riparian Animal_180 days	Ra-228	0.00E+00	8.00E+02	3.00E-02
Riparian Animal_180 days	Th-228	0.00E+00	1.46E+00	1.90E-03
Riparian Animal_180 days	Th-230	0.00E+00	1.48E+00	1.90E-03
Riparian Animal_180 days	Th-232	0.00E+00	1.45E+00	2.00E-03
Riparian Animal_180 days	Th-234	0.00E+00	6.78E-02	1.11E-04
Riparian Animal_180 days	U-234	0.00E+00	2.95E+01	3.76E-03
Riparian Animal_180 days	U-235	0.00E+00	2.95E+01	3.76E-03
Riparian Animal_180 days	U-238	0.00E+00	2.95E+01	3.76E-03

No tissue concentration values were entered for this organism.

# RESRAD-BIOTA Input Parameter Report

## General Case Information

<b>Title:</b>	ER_C_aq
<b>Ecosystem:</b>	Aquatic
<b>Level:</b>	3
<b>Units:</b>	Traditional

## Radionuclide Specific Data

Concentrations			
Radionuclide	Soil (pCi/g)	Water (pCi/L)	Sediment (pCi/g)
Am-241	0	27.3	583
Co-60	0	3.59	0.0847
Cs-137	0	3.73	0.246
K-40	0	50	20.4
Ra-226	0	0.369	3.16
Ra-228	0	3.77	2.75
Th-228	0	0.109	2.39
Th-230	0	0.0743	5.21
Th-232	0	0.0463	2.49
Th-234	0	248	2.36
U-234	0	0.273	3.3
U-235	0	0.133	0.13
U-238	0	0.252	2.99

RBE Values			
Alpha	Beta	Gamma	Cut-off Half-life
20	1	1	180 days

## Organism Specific Data

Organism Data					
Name	Dose Limit (rad/d)	Area Factor	Internal Size	External Size	
Riparian Animal	0.1	1	Default	Default	

Riparian Animal_180 days	0.1	1	GrizzlyBear	FishEggs
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BIV Values				
Organism	Radionuclide	Soil	Water	Sediment
Riparian Animal	Am-241	0.00E+00	1.20E+01	3.15E-03
Riparian Animal	Co-60	0.00E+00	1.57E+02	9.94E-03
Riparian Animal	Cs-137	0.00E+00	5.40E+04	2.70E-01
Riparian Animal	K-40	0.00E+00	1.16E+04	1.55E-01
Riparian Animal	Ra-226	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Ra-228	0.00E+00	8.00E+02	3.00E-02
Riparian Animal	Th-228	0.00E+00	1.46E+00	1.90E-03
Riparian Animal	Th-230	0.00E+00	1.48E+00	1.90E-03
Riparian Animal	Th-232	0.00E+00	1.45E+00	2.00E-03
Riparian Animal	Th-234	0.00E+00	6.78E-02	1.11E-04
Riparian Animal	U-234	0.00E+00	2.95E+01	3.76E-03
Riparian Animal	U-235	0.00E+00	2.95E+01	3.76E-03
Riparian Animal	U-238	0.00E+00	2.95E+01	3.76E-03
Riparian Animal_180 days	Am-241	0.00E+00	1.20E+01	3.15E-03
Riparian Animal_180 days	Co-60	0.00E+00	1.57E+02	9.94E-03
Riparian Animal_180 days	Cs-137	0.00E+00	5.40E+04	2.70E-01
Riparian Animal_180 days	K-40	0.00E+00	1.16E+04	1.55E-01
Riparian Animal_180 days	Ra-226	0.00E+00	8.00E+02	3.00E-02
Riparian Animal_180 days	Ra-228	0.00E+00	8.00E+02	3.00E-02
Riparian Animal_180 days	Th-228	0.00E+00	1.46E+00	1.90E-03
Riparian Animal_180 days	Th-230	0.00E+00	1.48E+00	1.90E-03
Riparian Animal_180 days	Th-232	0.00E+00	1.45E+00	2.00E-03
Riparian Animal_180 days	Th-234	0.00E+00	6.78E-02	1.11E-04
Riparian Animal_180 days	U-234	0.00E+00	2.95E+01	3.76E-03
Riparian Animal_180 days	U-235	0.00E+00	2.95E+01	3.76E-03
Riparian Animal_180 days	U-238	0.00E+00	2.95E+01	3.76E-03

No tissue concentration values were entered for this organism.

**ARCADIS**

**Attachment D**

Level 3 Dose Reports for  
Riparian Animals

# Dose Report for Level 3 in rad/d

**Title:** ER\_A\_aq\_180 days

<b>Riparian Animal</b>					
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Sediment</b>	<b>Tissue</b>	<b>Summed</b>
Am-241	1.43E-03	0.00E+00	9.29E-03	0.00E+00	1.07E-02
Co-60	1.19E-04	0.00E+00	4.67E-06	0.00E+00	1.24E-04
Cs-137	9.96E-03	0.00E+00	1.42E-05	0.00E+00	9.97E-03
K-40	2.19E-02	0.00E+00	5.27E-04	0.00E+00	2.24E-02
Ra-226	2.16E-02	0.00E+00	2.35E-03	0.00E+00	2.39E-02
Ra-228	6.14E-02	0.00E+00	2.46E-03	0.00E+00	6.39E-02
Th-228	6.07E-06	0.00E+00	2.60E-04	0.00E+00	2.66E-04
Th-230	1.23E-06	0.00E+00	2.47E-05	0.00E+00	2.60E-05
Th-232	5.52E-06	0.00E+00	1.59E-04	0.00E+00	1.65E-04
Th-234	5.11E-06	0.00E+00	2.15E-04	0.00E+00	2.20E-04
U-234	3.88E-05	0.00E+00	5.62E-05	0.00E+00	9.49E-05
U-235	2.08E-05	0.00E+00	7.05E-06	0.00E+00	2.78E-05
U-238	2.27E-05	0.00E+00	1.18E-04	0.00E+00	1.41E-04
Summed	1.16E-01	0.00E+00	1.55E-02	0.00E+00	1.32E-01

<b>Riparian Animal_180 days</b>					
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Sediment</b>	<b>Tissue</b>	<b>Summed</b>
Am-241	1.42E-03	0.00E+00	8.88E-03	0.00E+00	1.03E-02
Co-60	8.39E-05	0.00E+00	4.51E-06	0.00E+00	8.84E-05
Cs-137	7.75E-03	0.00E+00	1.13E-05	0.00E+00	7.76E-03
K-40	1.96E-02	0.00E+00	4.04E-04	0.00E+00	2.00E-02
Ra-226	1.76E-02	0.00E+00	1.92E-03	0.00E+00	1.95E-02
Ra-228	8.72E-05	0.00E+00	6.04E-05	0.00E+00	1.48E-04
Th-228	6.05E-06	0.00E+00	2.40E-04	0.00E+00	2.46E-04
Th-230	1.23E-06	0.00E+00	2.38E-05	0.00E+00	2.51E-05
Th-232	5.63E-07	0.00E+00	1.63E-05	0.00E+00	1.68E-05
Th-234	4.07E-06	0.00E+00	1.66E-04	0.00E+00	1.70E-04
U-234	3.87E-05	0.00E+00	5.52E-05	0.00E+00	9.39E-05
U-235	2.05E-05	0.00E+00	5.90E-06	0.00E+00	2.64E-05
U-238	2.24E-05	0.00E+00	1.02E-04	0.00E+00	1.24E-04
Summed	4.67E-02	0.00E+00	1.19E-02	0.00E+00	5.86E-02

If the tissue concentration option is selected (i.e., a tissue

*concentration was entered rather than a BIV value or allometric parameters in the organism 'input source' and 'input' tabs), then the internal dose to the organism from the radionuclide is calculated based on this concentration. This dose is not attributed to any media, i.e. it is listed in the dose table under the heading 'Tissue'. The external dose from each medium, calculated based on the user input media concentrations, are listed in the dose table under the headings for each medium (Water, Soil, or Sediment). These external doses are added together along with the internal (tissue) dose to get the total dose which is reported under the heading 'Summed'. If the tissue concentration input option is not used, then the internal and external doses based on media concentrations are reported and the 'Tissue' dose is reported as 0.*

# Dose Report for Level 3 in rad/d

**Title:** Default

<b>Riparian Animal</b>					
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Sediment</b>	<b>Tissue</b>	<b>Summed</b>
Am-241	1.82E-03	0.00E+00	7.56E-03	0.00E+00	9.38E-03
Co-60	8.19E-05	0.00E+00	7.53E-06	0.00E+00	8.94E-05
Cs-137	9.75E-03	0.00E+00	1.05E-05	0.00E+00	9.76E-03
K-40	2.05E-02	0.00E+00	9.68E-04	0.00E+00	2.15E-02
Ra-226	4.02E-02	0.00E+00	3.64E-03	0.00E+00	4.38E-02
Ra-228	9.65E-02	0.00E+00	3.46E-03	0.00E+00	1.00E-01
Th-228	6.22E-06	0.00E+00	3.75E-04	0.00E+00	3.81E-04
Th-230	9.51E-07	0.00E+00	3.94E-05	0.00E+00	4.04E-05
Th-232	3.37E-06	0.00E+00	2.48E-04	0.00E+00	2.51E-04
Th-234	7.00E-06	0.00E+00	1.62E-04	0.00E+00	1.69E-04
U-234	2.53E-05	0.00E+00	7.23E-05	0.00E+00	9.76E-05
U-235	2.06E-05	0.00E+00	6.89E-06	0.00E+00	2.75E-05
U-238	3.96E-05	0.00E+00	1.63E-04	0.00E+00	2.02E-04
Summed	1.69E-01	0.00E+00	1.67E-02	0.00E+00	1.86E-01

<b>Riparian Animal_180 days</b>					
<b>Nuclide</b>	<b>Water</b>	<b>Soil</b>	<b>Sediment</b>	<b>Tissue</b>	<b>Summed</b>
Am-241	1.81E-03	0.00E+00	7.23E-03	0.00E+00	9.04E-03
Co-60	5.75E-05	0.00E+00	7.27E-06	0.00E+00	6.48E-05
Cs-137	7.59E-03	0.00E+00	8.37E-06	0.00E+00	7.60E-03
K-40	1.84E-02	0.00E+00	7.42E-04	0.00E+00	1.91E-02
Ra-226	3.28E-02	0.00E+00	2.98E-03	0.00E+00	3.58E-02
Ra-228	1.37E-04	0.00E+00	8.51E-05	0.00E+00	2.22E-04
Th-228	6.20E-06	0.00E+00	3.47E-04	0.00E+00	3.53E-04
Th-230	9.48E-07	0.00E+00	3.80E-05	0.00E+00	3.89E-05
Th-232	3.43E-07	0.00E+00	2.53E-05	0.00E+00	2.56E-05
Th-234	5.58E-06	0.00E+00	1.25E-04	0.00E+00	1.31E-04
U-234	2.53E-05	0.00E+00	7.11E-05	0.00E+00	9.64E-05
U-235	2.03E-05	0.00E+00	5.76E-06	0.00E+00	2.61E-05
U-238	3.90E-05	0.00E+00	1.40E-04	0.00E+00	1.79E-04
Summed	6.09E-02	0.00E+00	1.18E-02	0.00E+00	7.27E-02

If the tissue concentration option is selected (i.e., a tissue

*concentration was entered rather than a BIV value or allometric parameters in the organism 'input source' and 'input' tabs), then the internal dose to the organism from the radionuclide is calculated based on this concentration. This dose is not attributed to any media, i.e. it is listed in the dose table under the heading 'Tissue'. The external dose from each medium, calculated based on the user input media concentrations, are listed in the dose table under the headings for each medium (Water, Soil, or Sediment). These external doses are added together along with the internal (tissue) dose to get the total dose which is reported under the heading 'Summed'. If the tissue concentration input option is not used, then the internal and external doses based on media concentrations are reported and the 'Tissue' dose is reported as 0.*

# Dose Report for Level 3 in rad/d

Title: ER\_C\_aq

Riparian Animal					
Nuclide	Water	Soil	Sediment	Tissue	Summed
Am-241	1.86E-03	0.00E+00	1.13E-02	0.00E+00	1.32E-02
Co-60	7.50E-05	0.00E+00	5.69E-06	0.00E+00	8.07E-05
Cs-137	8.74E-03	0.00E+00	7.86E-06	0.00E+00	8.75E-03
K-40	2.01E-02	0.00E+00	4.61E-04	0.00E+00	2.05E-02
Ra-226	9.04E-03	0.00E+00	3.13E-03	0.00E+00	1.22E-02
Ra-228	1.11E-01	0.00E+00	3.14E-03	0.00E+00	1.14E-01
Th-228	5.34E-06	0.00E+00	2.97E-04	0.00E+00	3.02E-04
Th-230	5.35E-07	0.00E+00	5.00E-05	0.00E+00	5.05E-05
Th-232	2.74E-06	0.00E+00	2.04E-04	0.00E+00	2.06E-04
Th-234	6.53E-06	0.00E+00	5.46E-05	0.00E+00	6.12E-05
U-234	3.99E-05	0.00E+00	6.26E-05	0.00E+00	1.03E-04
U-235	1.80E-05	0.00E+00	3.43E-06	0.00E+00	2.15E-05
U-238	3.33E-05	0.00E+00	1.20E-04	0.00E+00	1.53E-04
Summed	1.51E-01	0.00E+00	1.89E-02	0.00E+00	1.70E-01

Riparian Animal_180 days					
Nuclide	Water	Soil	Sediment	Tissue	Summed
Am-241	1.86E-03	0.00E+00	1.08E-02	0.00E+00	1.27E-02
Co-60	5.27E-05	0.00E+00	5.50E-06	0.00E+00	5.82E-05
Cs-137	6.80E-03	0.00E+00	6.28E-06	0.00E+00	6.81E-03
K-40	1.80E-02	0.00E+00	3.54E-04	0.00E+00	1.83E-02
Ra-226	7.39E-03	0.00E+00	2.56E-03	0.00E+00	9.94E-03
Ra-228	1.58E-04	0.00E+00	7.73E-05	0.00E+00	2.35E-04
Th-228	5.32E-06	0.00E+00	2.75E-04	0.00E+00	2.80E-04
Th-230	5.33E-07	0.00E+00	4.81E-05	0.00E+00	4.86E-05
Th-232	2.79E-07	0.00E+00	2.08E-05	0.00E+00	2.10E-05
Th-234	5.20E-06	0.00E+00	4.22E-05	0.00E+00	4.74E-05
U-234	3.99E-05	0.00E+00	6.16E-05	0.00E+00	1.01E-04
U-235	1.78E-05	0.00E+00	2.87E-06	0.00E+00	2.07E-05
U-238	3.28E-05	0.00E+00	1.03E-04	0.00E+00	1.36E-04
Summed	3.43E-02	0.00E+00	1.44E-02	0.00E+00	4.87E-02

If the tissue concentration option is selected (i.e., a tissue

*concentration was entered rather than a BIV value or allometric parameters in the organism 'input source' and 'input' tabs), then the internal dose to the organism from the radionuclide is calculated based on this concentration. This dose is not attributed to any media, i.e. it is listed in the dose table under the heading 'Tissue'. The external dose from each medium, calculated based on the user input media concentrations, are listed in the dose table under the headings for each medium (Water, Soil, or Sediment). These external doses are added together along with the internal (tissue) dose to get the total dose which is reported under the heading 'Summed'. If the tissue concentration input option is not used, then the internal and external doses based on media concentrations are reported and the 'Tissue' dose is reported as 0.*