Attachment 4-3

Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs)

Eco-SSL Standard Operating Procedure (SOP) #4: Wildlife Toxicity Reference Value Literature Review, Data Extraction and Coding

OSWER Directive 92857-55

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Standard Operating Procedure (SOP) #4: Wildlife Toxicity Reference Value Literature Review, Data Extraction and Coding

for

Ecological Soil Screening Levels (Eco-SSLs)
OSWER Directive 92857-55

October 2005

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1.0 INTRODUCTION

1.1 Purpose

The United States Environmental Protection Agency (USEPA) Office of Emergency and Remedial Response (OERR) with a multi-stakeholder workgroup has developed risk-based soil screening levels (Eco-SSLs). Eco-SSLs are concentrations of contaminants in soils that are protective of ecological receptors that commonly come into contact with soil or ingest biota that live in or on soil. Eco-SSLs are derived separately for four groups of ecological receptors: mammals, birds, plants, and soil invertebrates. As such, these values are presumed to provide adequate protection of terrestrial ecosystems.

The Eco-SSLs should be used in the baseline ERA process to identify the contaminants that need to be evaluated further in the characterization of exposure, effects and risk characterization. The Eco-SSLs should be used during Step 2 of the Superfund ERA process, the screening-level risk calculation. This step normally is completed at a time when limited soil concentration data are available, and other site-specific data (e.g., contaminant bioavailability information, area use factors) are not available. It is expected that the Eco-SSLs will be used to screen the site soil data to identify those contaminants that are not of potential ecological concern and do not need to be considered in the subsequent baseline ERA.

Plant and soil biota Eco-SSLs are developed from available plant, soil invertebrate and microbial toxicity data. The mammal and bird Eco-SSLs are the result of back-calculations from a Hazard Quotient (HQ) of 1.0. The HQ is equal to the dose (associated with the contaminant concentration in soil) divided by a toxicity reference value (TRV). Generic food chain models are used to estimate the relationship between the concentration of the contaminant in soil and the dose for the receptor (mg per kg body weight per day). The TRV represents a numerical estimate of a no adverse effect level (dose) for the respective contaminant.

The methods for deriving the oral TRVs needed for calculation of Eco-SSLs for mammals and birds are contained within four standard operating procedures (SOPs):

Eco-SSL SOP #3	Literature Search and Retrieval (Attachment 4-2)
Eco-SSL SOP #4	Literature Review, Data Extraction and Coding (Attachment 4-3)
Eco-SSL SOP #5	Data Evaluation (Attachment 4-4)
Eco-SSL SOP #6	Derivation of the Oral TRV (Attachment 4-5)

This document serves as SOP #4 which is Attachment 4-4 of the Eco-SSL guidance document. It describes the procedures used for review and extraction of data from toxicological studies identified as a result of SOP #3 (Attachment 4-2) and also serves as a user's manual for the web-

based data entry system used to guide the data extraction process. The extracted data are evaluated (scored) for their usefulness in establishing an oral TRV according to procedures provided in SOP #5 (Attachment 4-4). The extracted and scored data are then used to derive TRVs for mammals and birds, according to the procedures outlined in SOP #6 (Attachment 4-5).

1.2 Wildlife TRV Database

The Wildlife TRV database is a tool designed to facilitate efficient and accurate data extraction from reviewed toxicological studies. Importing the data directly into an electronic database facilitates the necessary sorting, searching and presentation of the data for the purposes of TRV derivation. The original database was designed using Microsoft Access and included a series of data entry forms. It was envisioned that each of the parties responsible for data entry would receive a copy of the Access database on disk. After all toxicity studies had been entered and coded by individual parties, each remote database would then be transferred and merged into a master Access database., The use of the Access-based data entry system was reevaluated as a result of changes in the data entry process and the addition of USEPA regional users. Several issues were identified, including: 1) how to update future changes to the database after the initial distribution, 2) how to effectively merge and incorporate all remote databases into the master database, 3) how to distribute the completed master database to all interested parties after the data entry process has been completed, and 4) how to distribute the database for review by external parties.

A web-based data entry system was proposed to resolve these issues. The web-based data entry system allows for remote access from any computer with Internet capabilities. Entry to the site is password-protected and limited to only those individuals responsible for data entry. All information entered is sent directly to a master database, avoiding quality assurance problems associated with merging multiple sources into one database. This system provides immediate access to entered data. Any changes to the data entry process or scoring are immediately reflected on the website. The website also allows users to view summaries of entered information in a format designed for quality assurance (QA) review. Information in the system can be downloaded into Microsoft Access format.

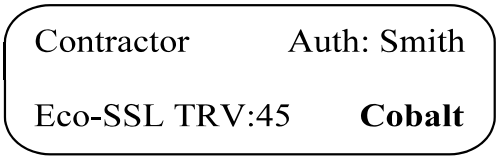
The results of the Eco-SSL coding effort are transferred to EPA, Mid-Continent Ecology Division, Duluth, MN for incorporation into the ECOTOX database. The coding guidelines used here for the Wildlife TRV effort follow the same basic structure as those used by EPA for TERRETOX. There are, however, some necessary additions and exclusions from the TERRETOX coding system. The TRV database is focused on identifying the no observed adverse effect level (NOAEL) and lowest observed adverse effect level (LOAEL) doses in relevant toxicological studies. Experimental data for toxicological endpoints are not entered into the TRV database.

2.0 REVIEW OF LITERATURE AND REJECTION CRITERIA

At this point in the Wildlife TRV derivation process, hard copies of literature identified as a result of SOP #5 are available to the User. A unique reference number is assigned to each article identified as a result of the literature search process. This reference number serves as a key to the full citation which is recorded in a commercially available bibliographic software program (ProCite or Reference Manager, ISI Researchsoft). The hard copies of the literature are housed at the EPA Region 8 offices in Denver, Colorado and at the EPA Mid-Continent Ecology Division in Duluth, MN.

The bibliographic reference file contains information on the article title, authors, journal or report title, date, volume, issue, page numbers, abstract, keywords, and article retrieval status. A unique Eco-SSL/TRV identification number provides the link between the data entered on the website and the article information identified in the literature search and recorded in the bibliographic reference file. This number is located in the upper-right corner of the article on a small white label. Additional information provided on this label includes the first author of the article and the identity of the contaminant of concern.

Example label:



A preliminary review is conducted on each article to determine whether the study contains data suitable for Wildlife TRV derivation. Table 1 provides a category listing of the types of publications and studies that are not included in the effort. These categories are referred to as rejection categories or criteria.

Table 1. Literature Rejection Categories

Rejection Criteria	Description	Basis
ABSTRACT (Abstract)	Abstracts of journal publications or conference presentations	Reference type
ACUTE STUDIES (Acu)	Single oral dose or exposure duration of three days or less.	Exposure
AIR POLLUTION (Air P)	Studies describing the results for air pollution studies.	Exposure
ALTERED RECEPTOR (Alt)	Studies that describe the effects of the contaminant on surgically-altered or chemically-modified receptors (e.g., right nephrectomy, left renal artery ligature, hormone implant, etc.).	Experimental design
AQUATIC STUDIES (Aquatic)	Studies that investigate toxicity in aquatic organisms	Experimental design
ANATOMICAL STUDIES (Anat)	Studies of anatomy. Instance where the contaminant is used in physical studies (e.g., silver nitrate staining for histology).	Experimental design

Table 1. Literature Rejection Categories		
Rejection Criteria	**Description**	**Basis**
BACTERIA (Bact)	Studies on bacteria or susceptibility to bacterial infection	Toxicant type
BIOACCUMULATION SURVEY (Bio Acc)	Studies reporting the measurement of the concentration of the contaminant in tissues.	Experimental design
BIOLOGICAL TOXICANT (BioX)	Studies of biological toxicants, including venoms, fungal toxins, *Bacillus thuringiensis*, other plant, animal, or microbial extracts or toxins.	Toxicant type
BIOMARKER (Biom)	Studies reporting results for a biomarker having no reported association with an adverse effect and an exposure dose (or concentration).	Endpoint
CARCINOGENICITY STUDIES (Carcin)	Studies that report data only for carcinogenic endpoints such as tumor induction. Papers that report systemic toxicity data are retained for coding of appropriate endpoints.	Endpoint
CHEMICAL METHODS (Chem Meth)	Studies reporting methods for determination of contaminants, purification of chemicals, etc. Studies describing the preparation and analysis of the contaminant in the tissues of the receptor.	Experimental design
CONFERENCE PROCEEDINGS (CP)	Studies reported in conference and symposium proceedings.	Data source
DEAD (Dead)	Studies reporting results for dead organisms. Studies. reporting field mortalities with necropsy data where it is not possible to establish the dose to the organism.	Exposure
DISSERTATIONS (Diss)	Dissertations are excluded. However, dissertations should be flagged for possible future use.	Data source
DRUG (Drug)	Studies reporting results for testing of drug and therapeutic effects and side-effects. Therapeutic drugs include vitamins and minerals. Studies of some minerals may be included if there is potential for adverse effects.	Endpoint
DUPLICATE DATA (Dup)	Studies reporting results that are duplicated in a separate publication. The publication with the earlier year is used.	
ECOLOGICAL INTERACTIONS (Ecol)	Studies of ecological processes that do not investigate effects of contaminant exposure (e.g., studies of "silver" fox natural history; studies on ferrets identified in iron search).	Experimental design
EFFLUENT (Effl)	Studies reporting effects of effluent, sewage, or polluted runoff.	Exposure
CHEMICAL FATE/METABOLISM (Fate)	Studies reporting what happens to the contaminant, rather than what happens to the organism. Studies describing the intermediary metabolism of the contaminant (e.g., radioactive tracer studies) without description of adverse effects.	Effect
FOREIGN LANGUAGE (FL)	Studies in languages other than English	Foreign Language
FOOD STUDIES (Food)	Food science studies conducted to improve production of food for human consumption.	Effect
FUNGUS (Fungus)	Studies on fungus	Receptor

Table 1. Literature Rejection Categories		
Rejection Criteria	**Description**	**Basis**
GENE (Gene)	Studies of genotoxicity (chromosomal aberrations and mutagenicity).	Endpoint
HUMAN HEALTH (HHE)	Studies with human subjects.	Receptor
IMMUNOLOGY (IMM)	Studies on the effects of contaminants on immunological endpoints.	Endpoint
INVERTEBRATE (Invert)	Studies that investigate the effects of contaminants on terrestrial invertebrates are excluded.	Receptor
IN VITRO (In Vit)	*In vitro* studies, including exposure of cell cultures, excised tissues and/or excised organs.	Effect
LEAD SHOT (Lead shot)	Studies administering lead shot as the exposure form. These studies are labeled separately for possible later retrieval and review.	Exposure
METHODS (Meth)	Studies reporting methods or methods development without usable toxicity test results for specific endpoints.	Experimental design
MINERAL REQUIREMENTS (Mineral)	Studies examining the minerals required for better production of animals for human consumption, unless there is potential for adverse effects.	Effect
MIXTURE (Mix)	Studies that report data for combinations of single toxicants (e.g. cadmium and copper) are excluded. Exposure in a field setting from contaminated natural soils or waste application to soil may be coded as Field Survey.	Exposure
MODELING (Model)	Studies reporting the use of existing data for modeling, i.e., no new organism toxicity data are reported. Studies which extrapolate effects based on known relationships between parameters and adverse effects.	Modeling/Existing data
NO CONTAMINANT OF CONCERN (No COC)	Studies that do not examine the toxicity of Eco-SSL contaminants of concern	Exposure
NO CONTROL (No Control)	Studies which lack a control or which have a control that is classified as invalid for derivation of TRVs.	Experimental design
NO DATA (No Data)	Studies for which results are stated in text but no data is provided. Also refers to studies with insufficient data where results are reported for only one organism per exposure concentration or dose. Also refers to studies where no data is provided but the text reports statistical comparison results and p values. Text statements for the presence/absence of genereal intoxication, general pathology, and mortality can be coded without reported data.	Experimental design
NO DOSE or CONC (No Dose)	Studies with no usable dose or concentration reported. These are usually identified after examination of full paper. This includes studies which examine effects after exposure to contaminant ceases. This also includes studies where offspring are exposed in utero and/or during lactation and then after weaning to similar concentrations (or doses) as their parents. Dose cannot be determined. In some cases, where exposure was during gestation and effects are measured after cessation of exposure (after birth), data are retained to record reproductive latent effects. This includes studies where the organisms are replaced or replenished during the study.	Exposure

Table 1. Literature Rejection Categories		
Rejection Criteria	**Description**	**Basis**
NO DURATION (No Dur)	Studies with no exposure duration. These are usually identified after examination of full paper.	Exposure
NO EFFECT (No Efct)	Studies with no relevant effect evaluated in a biological test species or data not reported for effect discussed.	Effect
NO ORAL (No Oral)	Studies using non-oral routes of contaminant administration including intraperitoneal injection, other injection, inhalation, and dermal exposures.	Exposure
NO ORGANISM (No Org)	Studies that do not examine or test a viable organism (also see in vitro rejection category).	Receptor
NOT AVAILABLE (Not Avail)	Papers that could not be located. Citation from electronic searches may be incorrect or the source is not readily available.	Data source
NOT PRIMARY (Not Prim)	Papers that are not the original compilation and/or publication of the experimental data.	Data source
NO TOXICANT (No Tox)	No toxicant used. Publications often report responses to changes in water or soil chemistry variables, e.g., pH or temperature. Such publications are not included.	Exposure
NUTRIENT DEFICIENCY (Nut def)	Studies of the effects of nutrient deficiencies. Nutritional deficient diet is identified by the author. If reviewer is uncertain then the administrator should be consulted. Effects associated with added nutrients are coded.	Exposure
NUTRITION (Nut)	Studies examining the best or minimum level of a chemical in the diet for improvement of health or maintenance of animals in captivity.	Exposure
OTHER AMBIENT CONDITIONS (OAC)	Studies which examine other ambient conditions: pH, salinity, DO, UV, radiation, etc.	Toxicant
OIL (Oil)	Studies which examine the effects of oil and petroleum products.	Toxicant
ORGANIC METAL (Org Met)	Studies which examine the effects of organic metals. This includes tetraethyl lead, triethyl lead, chromium picolinate, phenylarsonic acid, roxarsone, 3-nitro-4-phenylarsonic acid,, zinc phosphide, monomethylarsonic acid (MMA), dimethylarsinic acid (DMA), trimethylarsine oxide (TMAO), or arsenobetaine (AsBe) and other organo metallic fungicides. Metal acetates and methionines are not rejected and are evaluated.	Exposure
LEAD BEHAVIOR OR HIGH DOSE MODELS (Pb Behav)	There are a high number of studies in the literature that expose rats or mice to high concentrations of lead in drinking water (0.1, 1 to 2% solutions) and then observe behavior in offspring, and/or pathology changes in the brain of the exposed dam and/or the progeny. Only a representative subset of these studies were coded. Behavior studies examining complex behavior (learned tasks) were also not coded.	Exposure and endpoint
PHYSIOLOGY STUDIES (Phys)	Physiology studies where adverse effects are not associated with exposure to contaminants of concern.	Effects
PLANT (Plant)	Studies of terrestrial plants are excluded.	Receptor

Table 1. Literature Rejection Categories		
Rejection Criteria	**Description**	**Basis**
PRIMATE (Prim)	Primate studies are excluded.	Receptor
PUBL AS (Publ as)	The author states that the information in this report has been published in another source. Data are recorded from only one source. The secondary citation is noted as Publ As.	Data source
QSAR (QSAR)	Derivation of Quantitative Structure-Activity Relationships is a form of modeling. QSAR publications are rejected if raw toxicity data are not reported or if the toxicity data are published elsewhere as original data.	Model
REGULATIONS (Reg)	Regulations and related publications that are not a primary source of data.	Data source
REVIEW (Rev)	Studies in which the data reported in the article are not primary data from research conducted by the author. The publication is a compilation of data published elsewhere. These publications are reviewed manually to identify other relevant literature.	Data source
SEDIMENT CONC (Sed)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in sediment.	Exposure
SLUDGE	Studies on the effects of ingestion of soils amended with sewage sludge	Exposure
SOIL CONC (Soil)	Studies in which the only exposure concentration/dose reported is for the level of a toxicant in soil.	Exposure
STRESSOR (QAC)	Studies examining the interaction of a stressor (e.g., radiation, heat, etc.) and the contaminant, where the effect of the contaminant alone cannot be isolated.	Exposure
SURVEY (Surv)	Studies reporting the toxicity of a contaminant in the field over a period of time. Often neither a duration nor an exposure concentration is reported.	Exposure
REPTILE OR AMPHIBIAN (Herp)	Studies on reptiles and amphibians. These papers flagged for possible later review.	Receptor
UNRELATED (Unrel)	Studies that are unrelated to contaminant exposure and response and/or the receptor groups of interest.	Relevance
WATER QUALITY STUDY (Wqual)	Studies of water quality	Relevance
YEAST (Yeast)	Studies of yeast	Receptor

If a retrieved article is rejected after review, the user records the reason for rejection in the bibliographic reference file and the article is not considered further in the process. The results of the literature review and the application of rejection criteria are described for each contaminant of concern.. SOP #6 (Attachment 4-5) describes the process for deriving the Wildlife TRV.

3.0 WILDLIFE TRV DATABASE WEBSITE

3.1 Location and Log-On

The Wildlife TRV Database is located in Duluth, MN and maintained by the USEPA Mid-Continent Division. For quality assurance purposes, the Eco-SSL Wildlife TRV Database is accessible only to authorized users. It is important that users not give their log on information to others.

The Wildlife TRV Database website is accessed from the Explorer or Netscape browsers by typing http://trv.ecodev.com/ in the address bar. The TRV Homepage will appear and display a prompt to log on. The User clicks on "log" to access the Log On page. The User enters a username and password as directed and clicks "Log On" to access the database.

3.2 Navigation

The TRV Database contains a sidebar for navigation among the database functions. Navigation choices include Home, Log Out, Admin, Data Entry, and Password. Most features needed by TRV Database users are located under the Data Entry feature. A brief description of each function is provided below.

Home

Clicking on the Home option will return the User to the log on, which prompts the User for username and password.

Logout

The Logout option is used to exit the Wildlife TRV Database.

Admin

The Admin feature allows users with administrative authorization (Administrative Users) to permanently delete articles or alter database features such as data entry codes or programming code for calculations.

Data Entry

The Data Entry option displays the main menu for data entry navigation. Six options are available for this feature:

1. Add Article
2. Article List
3. A Targeted Article List
4. QA'd Article List

5. Reports
6. Download database

A brief description of each option is provided below.

Add Article: This option allows the User to add information from a new article. This function is discussed in more detail in Section 4.

Article List: This option displays all articles currently in the TRV system. The User may View/Edit Articles, Add Phases to an article, Delete Articles, access the Exposures/Endpoint edit screens, or access the QA report (a printable version of the information entered for the article), by clicking on the appropriate column. Listed articles may be changed by any user if they have not been locked by the QA approval process (see Section 6). When an article has been approved following a QA review, the Add Phase, Delete Article and Exposures edit options are disabled. Article Approval information is then displayed on the QA report, along with any QA comments.

A Targeted Article List: This option allows the User to create a list of articles for a specific SSL#, chemical, or author. The retrieved list displays the selected articles in the same manner, and offers the same QA functionality, as the full Article List.

QA'd Article List: This option displays a list of articles that have received QA approval. The display information includes Record #, Chemical, Author, Reviewer, Date reviewed, Approver, Date Approved, an Edit Article function, and QA report display. Articles that have passed QA are locked for editing by users without Administrative User status. Locking means that the Edit Article feature in this list does not allow reviewers to change the QA status of an article. However, a reviewer who disagrees with a QA revision may provide an explanation in the comment box.

If an approved article is unlocked by an Administrative User (i.e., the Article Approved field is changed to "No" or "Not Checked"), the article disappears from the QA'd Article List, and all editing functionality is restored.

Reports: Three types of reports are available under this function:

QA Modifications: This report displays a list of articles that have been quality assured, but not necessarily approved. The display includes contaminant of concern, SSL (Record) #, Ecoref # (i.e., the number used to identify the article in the ECOTOX database), Author, Reviewer, Review date, Approver, QA date, Last change date, and whether or not the article has been approved (Apr?). This report allows reviewers could keep track of quality assurance revisions and to maintain consistency of coding.

Article Counts: This report provides information on all contaminants of concern, the total articles reviewed for each chemical, which articles were reviewed by Duluth Offsite, how many articles were approved, and the number of articles with at least one score of greater than 65.

Article Information: Information on contaminant of concern, SSL#, Ecoref#, Author, Reviewer, Review date, High Score, and approval status (Apr?) is provided for each chemical. This report function provides a "sort by" window, which allows the User to sort by each parameter.

Password

The password option allows individual users to change their password.

4.0 CODING GUIDELINES AND DATA ENTRY

Entry of study-specific toxicological information into the TRV Database is facilitated by data entry screens which prompt the User for required information. This interface helps ensure that relevant data from each study is completely and consistently entered. Required information is divided into five categories with a corresponding data entry screen for each: Article Information, Study Information, Exposure Information, Endpoint Information, and Score Information. A navigation bar, which summarizes the specific article, phase, and endpoint which is currently being scored, is provided at the top of each data entry screen to identify the User's location throughout the data entry process.

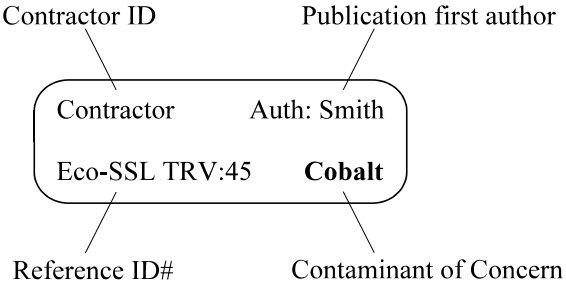
The data entry process is initiated by clicking on the Data Entry option located in the navigation bar. The User selects Complete Entry to begin entering information from a selected article or report. Once data entry has begun for a specific article or report, continue to enter information until *all endpoints* have been scored. This "start-to-finish" process ensures fewer errors resulting from incomplete entries. In addition, there is a time limit for data entry. The User is automatically logged out if no data entry activity is registered for a period of one hour.

4.1 Article Information

Record Number

The Record Number is a unique number assigned to an article identified in the literature search. The Record Number provides the link between the data entered on the website and the article information in the bibliographic reference file (e.g., ProCite or Reference Manager). This number is located on a small white label placed in the upper-right corner of the article. The User enters the number in the numeric field provided for the Record Number (eg.: 45 in the example below).

Example label:



Contaminant of Concern (COC)

The contaminant form tested in the reviewed study is entered at the "Exposure Information" screen. To ensure quality and consistency, a pull down list is provided for all contaminants which are to be reviewed for the Eco-SSL effort. This list is presented in Table 2. The User

selects the contaminant from the pull down list for entry into the database record. If results for several contaminants of concern (COCs) are available in a single article, separate results are entered for each COC.

Special cases for COC data entry are DDT and its metabolites and the polycyclic aromatic hydrocarbons (PAHs). Data for DDT metabolites (DDE, DDD, DDA, and DDMU) are entered as chemical forms of Total DDT. If an article contains experimental data for multiple forms, data for the parent compound and/or individual metabolites are entered as separate phases.

The PAHs of concern are listed individually in Table 2. The specific approach to evaluation of PAH toxicity and derivation of PAH TRVs is currently under review by EPA. The procedures for entering data on this class of contaminants will be added to this SOP in a future update.

Table 2. Contaminants of Concern

Contaminant Code	Contaminant Name	Contaminant Code	Contaminant Name
Chlorinated Organics		**Polycyclic Aromatic Hydrocarbons (PAHs)****	
Dld	Dieldrin	Dmg	3,3'-Dimethylbenzidine
PCB	Total PCBs	Dma	7,12-Dimethylbenz(a)-anthracene
DDT	Total DDT - DDT	Ace	Acenaphthene
DDD*	Total DDT - DDD	Acy	Acenaphthylene
DDE*	Total DDT - DDE	Ani	Aniline
DDA*	Total DDT - DDA	Ant	Anthracene
DDMU*	Total DDT - DDMU	Baa	Benz(a)anthracene
PCP	PCP (Pentachlorophenol)	Bap	Benzo(a)pyrene
Other Organics		Bkf	Benzo(k)fluoranthene
RDX	RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	Bghip	Benzo(g,h,I)perylene
TNT	TNT (Trinitrotoluene)	Bbf	Benzo(b)fluoranthene
Metals		Chr	Chrysene
Al	Aluminum	Dbaha	Dibenz(a,h)anthracene
Ba	Barium	Dbaep	Dibenzo(a,e)pyrene
Sb	Antimony	Dbf	Dibenzofuran
As	Arsenic	Fla	Fluoranthene
Be	Beryllium	Fl	Fluorene
Cd	Cadmium	Ind	Indeno(1,2,3-cd)pyrene
Cr	Chromium	Nap	Naphthalene
Co	Cobalt	Phe	Phenanthrene
Cu	Copper	Pyr	Pyrene
Fe	Iron		
Pb	Lead		
Mn	Manganese		
Ni	Nickel		
Se	Selenium		
Ag	Silver		
V	Vanadium		
Zn	Zinc		

* Considered a chemical form of DDT and is coded as a separate phase under the COC of Total DDT

** The specific approach to grouping of PAHs and derivation of TRVs is under consideration by USEPA and has not yet been finalized

Author Key

The Author Key is a text field designed to provide a citation for the article entered. This citation is used to verify the record number and is incorporated into the navigation bar at the top of each page. Author information is entered in the same way the article would be cited in a scientific document, with the author's last name(s) separated by a comma and the year. If there is one author, the citation appears as "Smith, 1997"; if there are two authors, the citation appears as "Smith and Jones, 1997"; if there are three or more authors, the citation appears as "Smith et al., 1997". The first or middle name initials are not used in the Author Key.

Primary Source

The toxicity data used for the Eco-SSL Wildlife TRVs are taken from primary sources only. A primary source is the original compilation and/or publication of the experimental data. Secondary sources are defined as studies where the data reported is not from research conducted by the author and/or the publication is a compilation of data published elsewhere. Secondary sources are coded as reviews ("Rev"; see Table 1) and are rejected for use (i.e., toxicological data from these sources are not entered into the TRV Database). However, secondary sources are examined to identify other relevant literature. This process is referred to as a manual review. The User selects "Yes" or "No" for primary source by checking the appropriate box. If "No" is selected, the information entered to this point is saved and the program exits to the "Data Entry" screen.

Results Reported for Exposure to a Single Contaminant

The Wildlife TRV database compiles data from experiments which examine exposure to a single contaminant. Studies that report results for concurrent exposure to multiple contaminants are rejected for use as a mixture ("mix"; see Table 1). In cases where exposures are for contaminants in sediment, soil or food, the exposure should be for a single contaminant in the environmental matrix. The sediment, soil or food cannot contain other contaminants in excess of nutritional requirements. The User selects "Yes" or "No" for exposure to a single contaminant by checking the appropriate box. If "No" is selected, the information entered to this point is saved and the program exits to the "Data Entry" screen.

When the "Article Information" screen is completed, the User verifies that all data entered are correct and then clicks on "Next" at the bottom of the screen to continue. The User **should not** use the browser back arrow to return to a previous data entry screen to correct errors, because use of this key results in a deletion of information.

4.2 Study Information

Study Phase determination

The study phase is the basic unit of experimental design for the Wildlife TRV Database. Multiple study phases are present if the study reports different results for any of the following parameters: test organism (different species /strain or lifestage), chemical form (e.g. DDE and p,p'DDT, Cadmium chloride and Cadmium sulfate, etc.), range of chemical doses or concentrations, test location, exposure type, control type, total number of doses, application frequency, or route of exposure. The User enters a description of each phase, including the basis for selection and differences in parameters, in the text box (remarks field) provided. The following is an example of data that would be coded as separate phases:

Example: Phase 1 - oral exposure to Cadmium chloride in food to rats for 10 weeks
Phase 2 - oral exposure to Cadmium chloride in food to mice for 10 weeks

The following cases would not be coded as multiple phases: 1) Experiments that perform interim measurements at intermediate time points in addition to terminal measurements; 2) Studies on metals where the dose is expressed as the metal (note: this is the only instance in which contaminant form does not trigger a new phase); 3) Results for male and female exposure groups within the same experiment. Results for males and females are not coded as separate phases because this could potentially create replicate NOAEL and LOAEL values. The User should select and enter the results for the most sensitive gender. Results for the opposite gender should be recorded in the NOAEL/LOAEL comment fields. In cases, where the male and female organisms have different exposure concentrations or doses, then they should be entered as separate phases.

In some cases it may be appropriate to code male and female results separately where more accurate exposure doses result. This is the case if authors report body weights specific to each of sexes or report respective doses for each of the sexes in mg/kg bw/day. It is more accurate to use the reported body weights for each sex or to use the reported doses. In these instances, the user should enter only the most conservative results across the sexes and not all endpoints for all sexes. A note should be made in the NOAEL/LOAEL comment field concerning the results for the sex not entered.

In some cases it may be appropriate to code data reported for different lifestages as one phase. If separation of results into separate phases by lifestage results in the study being rejected for a test population size of 1 then the data can be combined in one phase. The most conservative result should be recorded with the corresponding lifestage and the other lifestage and result noted in the comment field.

If multiple phases of a study report the same NOAEL and LOAEL concentrations (or doses) for the same endpoint and test species, the User enters results for only one of the Phases. The phase entered should be the one that will give the highest total score. Replicate tests are generally

considered one phase. Typically, the results for the shortest exposure duration that reports the most conservative results (lowest NOAEL or LOAEL) should be entered (see detailed comments on identification of the NOAEL and LOAEL below). If the author reports different doses for different exposure durations, the reviewer enters the data for each exposure duration as a separate phase. For gestational exposure studies that report separate results for different gestational days of exposure, the reviewer can enter the results as separate Phases. The rationale for data entry decisions is recorded in the comments field.

When the "Study Information" screen is completed, the User verifies that all data entered are correct and then clicks on "Next" at the bottom of the screen to continue. The newly entered data are recorded in the database at this time. The User **should not** use the browser back arrow to return to a previous data entry screen to correct errors, as use of this key results in deletion of information.

When data entry for an individual phase is completed, the database will ask the User if another phase is required. At the end of data entry, the database will automatically calculate the number of phases for each article. This value is included in the QA report.

4.3 Exposure Information

Phase Number

The phase number is automatically generated by the application and corresponds to the phases briefly described in the "Study Information" section. The User should verify that the phase number is correct. If there are any discrepancies, the User should record the specific information and contact a database administrator.

Contaminant Form

The form of contaminant used in the exposure is recorded by the User in the text box provided. The form can be entered as a name or as a contaminant formula (eg.: Cadmium Chloride or $CdCl_2$). If a specific contaminant form is not provided in the article, the User enters the general name for the contaminant (e.g., cadmium). Organic forms of metals are not used for derivation of Wildlife TRVs and should not be coded (with the exception of acetate forms which readily dissociate in solution).

Administered Amount of a Contaminant (% Molecular Weight)

Toxicological studies administer metals using compounds which contain various amounts of the metal by weight. Some studies report concentrations (or doses) as units of metal per amount of exposure medium (water or diet) (e.g., mg of Co per kg of diet), while others report concentrations (or doses) based on the compound used (e.g., mg of cobalt chloride per kg of diet). For example, if the administered compound is cadmium chloride, then only 61.32 percent by weight was delivered as cadmium (based on the molecular weight (MW) for cadmium

chloride ($CdCl_2$) of 183.32 g/mol and the MW for cadmium of 112.41 g/mol). A dose of cadmium chloride of 5 mg/kg is therefore equal to 3.1 mg of cadmium/kg (i.e., 5 mg/kg * 61.32% = 3.1 mg/kg). Table 3 provides a list of contaminant forms and the respective percentages of metal by weight. The User enters the listed percent in the numeric field provided. If the exposure is reported as pure contaminant, the User enters the number 100.

It is important to examine and enter data for metals accurately, as failure to do so may introduce errors into the calculation of the NOAEL and LOAEL. If, for example, the authors give the chemical form as lead acetate, but report the chemical concentration as 50 mg Pb/kg, then it should be assumed that the concentration is based on lead, not lead acetate, and the percentage of MW would be 100. However, if the chemical concentration had been 50 mg/kg, the percentage of MW would be 54.61. In another case, if the paper using a chemical form reports the concentration or dose based on a portion of the form, e.g., reports the concentration based on selenite for sodium selenite, the chemical should be reported as the portion of the form (selenite), and the percentage of MW would be the amount of selenium in selenite.

For organic chemicals, the study should be reviewed for information on the purity of the tested material. The purity of an organic chemical (including DDT and metabolites) is assumed to be 100%, unless the paper specifically reports material of lesser purity was used (e. g. 80% technical grade DDT). If a lesser purity is reported the user should enter the appropriate amount. If the author reports the purity as > x% then then x value should be entered as the purity.

Table 3. Percentages of Metal and Occurrence in Soil

Contaminant	Compound	CAS #	% of MW as Metal	Could be Found in Soil Environment	Reference
Aluminum	Aluminum chloride ($AlCl_3$)	7446-70-0	20.23	No	2
Aluminum	Aluminum fluoride (AlF_3)	7784-18-1	32.13	Yes	3
Aluminum	Aluminum nitrate (AlN_30_9)	13473-90-0	12.67	Yes	
Aluminum	Aluminum potassium sulfate ($AlKO_8S_2$)	10043-67-1	10.45	No	
Aluminum	Aluminum sulfate ($Al(SO_4)_3$)	10043-01-3	15.77	Yes	2, 3
Aluminum	Aluminum sulfate hydrate ($Al(SO_4)_3H_20$	57292-32-7	14.98	Yes	2, 3
Aluminum	**Aluminum nitrate nonahydrate** ($AlH_{18}N_3O_{18}$)	7784-27-2	7.19	Yes	
Aluminum	Aluminum chloride hexahydrate ($AlCl_3H_{12}O_6$)	7784-13-6	11.18	No	2
Aluminum	Aluminum trihydrate (AlH_3O_3)	21645-51-2	34.59	Yes	
Aluminum	Aluminum sulfate octahydrate ($Al_2H_{36}O_{30}S_3$)	7784-31-8	8.10	Yes	3
Aluminum	Aluminum fluoride dihydrate ($AlF_3H_6O_3$)	15098-87-0	19.55	Yes	3
Aluminum	Aluminum sulfate hexadecahydrate ($Al_2H_{28}O_{26}S_{3)}$	16828-11-8	9.08	Yes	3
Antimony	Potassium antimonate (pyro) ($K_4O_7Sb_2$)	29638-69-5	47.05	No	
Antimony	Potassium antimonate (pyro) tetrathydrate ($K_2H_2Sb_2O_7$).	10090-54-7	46.31	No	
Antimony	Potassium antimonate hydrate ($KSbO_3$)	10090-54-7	46.31	No	
Antimony	Antimony potassium tartrate ($Sb_2H_4K_2O_{12}$)	11071-15-1	39.67	No	
Antimony	Antimony trichloride ($SbCl_3$)	10025-91-9	53.38	Yes	2
Antimony	Antimony trifluoride (SbF_3)	7783-56-4	68.11	No	

Table 3. Percentages of Metal and Occurrence in Soil					
Contaminant	**Compound**	**CAS #**	**% of MW as Metal**	**Could be Found in Soil Environment**	**Reference**
Antimony	Antimony trioxide (Sb_2O_3)	1309-64-4	83.53	Yes	2
Antimony	Antimony trisulfide (Sb_2S_3)	1345-04-6	71.69	Yes	2
Antimony	Potassium hexahydroxoantimonate (H_6KO_6Sb)	12208-13-8	46.32	No	
Arsenic	Sodium arsenate ($NaAsO_4$)	13464-38-5	36.04	Yes	1
Arsenic	Sodium arsenite ($NaAsO_2$)	7784-46-5	56.5	Yes	
Arsenic	Sodium arsenate (generic form) (AsH_2NaO_4)	7631-89-2	45.71	Yes	1
Barium	Barium carbonate (Ba CO_3)	513-77-9	69.59	Yes	2
Barium	Barium acetate (Ba $(C_2H_8O_2)_2$	543-80-6	53.77	No	
Barium	Barium chloride dihydrate ($BaCl_2H_40_2$)	10326-27-9	56.22	Yes	3
Barium	Barium sulfate (BaO_4S)	7727-43-7	58.84	Yes	2
Barium	Barium nitrate (BaN_2O_6)	10022-31-8	52.55	Yes	3
Barium	Barium chloride ($BaCl_2$)	10361-37-2	65.95	Yes	3
Barium	Barite (barium sulfate) (BaO_4S)	13462-86-7	58.84	Yes	2
Barium	Barium sulfide (BaS)	21109-95-5	81.07	No	2
Beryllium	Beryllium chloride ($BeCl_2$)	7787-47-5	11.27	Yes	3
Beryllium	Beryllium fluoride (BeF_2)	7787-49-7	19.17	No	
Beryllium	Beryllium hydroxide (BeH_2O_2)	13327-32-7	20.94	Yes	3
Beryllium	Beryllium nitrate trihydrate ($Be(NO_3)_2$⁄3H_2O)	7787-55-5	4.82	Yes	
Beryllium	Beryllium nitrate ($Be(NO_3)_2$)	13597-99-4	6.77	Yes	
Beryllium	Beryllium silicate (Be_2O_4Si)	15191-85-2	16.37	Yes	3
Beryllium	Beryllium sulfate (BeO_4S)	13510-49-1	8.58	Yes	3
Beryllium	Beryllium sulfate tetrahydrate (BeH_8O_8S)	7787-56-6	5.09	Yes	3
Cadmium	Cadmium acetate ($C_4H_6CdO_4$)	543-90-8	48.77	No	
Cadmium	Cadmium bromide ($CdBr_2$)	7789-42-6	41.29	No	
Cadmium	Cadmium chloride ($CdCl_2$)	10108-64-2	61.32	Yes	1
Cadmium	Cadmium iodide (CdI_2)	7790-80-9	30.69	No	
Cadmium	Cadmium nitrate (CdN_2O_6)	10325-94-7	47.55	Yes	
Cadmium	Cadmium sulfate ($CdSO_4$)	10124-36-4	53.92	Yes	1
Cadmium	Cadmium chloride hydrate ($Cd_2Cl_4H_{10}O_5$)	7790-78-5	49.23	Yes	1
Cadmium	Cadmium sulfate hydrate ($CdH_{16}O_{12}S$)	7790-84-3	31.88	Yes	1
Chromium	Chromium (Cr)	7440-47-3	100	Yes	1
Chromium	Chromic acid (VI) (CrH_2O_4)	7738-94-5	44.06	No	
Chromium	Sodium chromate (VI) ($CrNa_2O_4$)	7775-11-3	32.10	Yes	1
Chromium	Chromium fluoride (III) (CrF_3)	7788-97-8	47.71	No	
Chromium	Chromium chloride ($CrCl_3$)	10025-73-7	32.83	Yes	
Chromium	Chromium potassium sulfate (III) ($CrKO_8S_2$)	10141-00-1	18.36	Yes	3
Chromium	Sodium dichromate (VI) ($Cr_2Na_2O_7$)	10588-01-9	39.70	Yes	1
Chromium	Chromium (III) nitrate (CrN_3O_9)	13548-38-4	21.85		
Chromium	Chromate (CrO_4)	11104-59-9	44.83	Yes	1
Chromium	Chromium sulfate pentahydrate (III) ($Cr_2O_{12}S_3$)	15244-38-9	26.52	Yes	3
Chromium	Hexavalent chromium ion (Cr^{+6}+6)	18540-29-9	100	Yes	3
Chromium	Chromium nitrate nonahydrate ($CrH_{18}N_3O_{18}$)	7789-02-8	13.00	Yes	

Table 3. Percentages of Metal and Occurrence in Soil					
Contaminant	**Compound**	**CAS #**	**% of MW as Metal**	**Could be Found in Soil Environment**	**Reference**
Chromium	Potassium chromate (CrK_2O_4)	7789-00-6	26.78	Yes	3
Chromium	Potassium dichromate ($Cr_2K_2O_7$)	7778-50-9	35.35	Yes	3
Cobalt	Cobalt acetate ($CoO_4C_4H_6$)	71-48-7	33.29	No	
Cobalt	Cobalt chloride ($CoCl_2$)	7646-79-9	45.39	Yes	
Cobalt	Cobalt chloride hexahydrate ($CoCl_2$+$6H_20$)	7791-13-1	24.9	Yes	
Cobalt	Cobalt nitrate $Co(NO_3)_2$	10141-05-6	32.22	Yes	
Cobalt	Cobalt sulfate ($CoSO_4$)	10124-43-3	38.02	Yes	2
Cobalt	Cobalt sulfate heptahydrate ($CoSO_4x7H^20$)	10026-24-1	21.91	Yes	2
Cobalt	Cobalt (II) formate ($CoO_4C_2H_2$)	544-18-3	39.55	No	
Copper	Copper acetate ($CuO_4C_4H_6$)	4180-12-5	51.84	No	
Copper	Copper (I) acetate ($C_2H_3CuO_2$)	598-54-9	51.84	No	
Copper	Copper carbonate (CCuO3)	1184-64-1	51.43	Yes	
Copper	Copper chloride ($CuCl_2$)	1344-67-8	47.27	Yes	1
Copper	Copper chloride dihydrate ($Cl_2CuH_4O_2$)	10125-13-0	37.28	Yes	1
Copper	Copper oxychloride ($Cu_2Cl(OH)_3$)	1332-65-6	59.51	No	
Copper	Copper (II) sulfate ($CuSO_4$)	7758-98-7	39.81	Yes	1
Copper	Copper sulfate pentahydrate	7758-99-8	25.45		
Copper	Cupric acetate ($CuO_4C_4H_6$)	142-71-2	34.99	No	
Copper	Cupric nitrate $Cu(NO_3)_2$	3251-23-8	33.88	Yes	
Copper	Cupric chloride ($CuCl_2$)	7447-39-4	47.27	Yes	1
Copper	Cuprous chloride (CuCl)	7758-89-6	64.19	Yes	1
Copper	Cupric oxide	1317-38-0	79.55		
Copper	Cuprous oxide	1317-39-1	44.41		
Copper	Cupric perchlorate hexahydrate ($Cl_2CuH_{12}O_{14}$)	13770-18-8	17.15	No	
Copper	Cupric nitrate hemipentahydrate ($Cu_2H_{10}N_4O_{19}$)	19004-19-4	27.32	Yes	
Iron	Ferric chloride (Cl_3Fe)	7705-08-0	34.43	Yes	2
Iron	Ferrous chloride (Cl_2Fe)	7758-94-3	44.06	Yes	2
Iron	Sulfonic acid, iron salt ($Fe_2O_{12}S_3$)	10124-49-9	27.93	No	
Iron	Ferric hydroxide (H_3FeO_3)	1309-33-7	52.26		
Iron	Ferrous sulfide (FeS)	1317-37-9	63.53	Yes	2
Iron	Ferrous sulfate (FeO_4S)	7720-78-7	36.77		
Iron	Ferric sulfate ($Fe_2O_{12}S_3$)	10028-22-5	27.93		
Iron	Ferrous hydroxide ($Fe_2H_3O_3$)	18624-44-7	52.26	Yes	
Iron	Ferric sulfate hydrate ($Fe_2O_{12}S_3$)	10028-22-5	27.93		
Iron	Iron trichloride ($FeCl_3$)	7705-08-0	34.43		
Iron	Iron (II) dichloride tetrahydrate ($FeCl_2H_8O_4$)	13478-10-9	28.09		
Lead	Lead acetate ($C_4H_6O_4Pb$)	301-04-2	54.61	No	
Lead	Lead carbonate ($PbCO_3$)	598-63-0	77.55	Yes	1
Lead	Lead chloride ($PbCl_2$)	7758-95-4	74.50	Yes	2
Lead	Lead nitrate $Pb(NO_3)_2$	10099-74-8	62.56	Yes	
Lead	Lead oxide (Pb0)	1317-36-8	92.83	Yes	
Lead	Lead powder (Pb)	7439-92-1	100	Yes	

Table 3. Percentages of Metal and Occurrence in Soil					
Contaminant	**Compound**	**CAS #**	**% of MW as Metal**	**Could be Found in Soil Environment**	**Reference**
Lead	Lead sulfate ($PbSO_4$)	7446-14-2	68.32	Yes	2
Manganese	Manganese (II) chloride (Cl_2Mn)	7773-01-5	43.66	Yes	
Manganese	Manganese (II) nitrate (MnN_2O_6)	10377-66-9	30.70	Yes	
Manganese	Manganese (II) nitrate hydrate ($H_2MnN_2O_7$)	15710-66-4	27.89	Yes	
Nickel	Nickel chloride hexahydrate ($Cl_2H_{12}NiO_6$)	7791-20-0	24.69	Yes	
Nickel	Nickelous chloride (Cl_2Ni)	7718-54-9	45.29	Yes	
Nickel	Nickelous nitrate (N_2NiO_6)	13138-45-9	32.12	Yes	
Nickel	Nickel sulfate hexahydrate ($H_{12}NiO_{10}S$)	10101-97-0	22.33	Yes	1
Nickel	Nickelous acetate tetrahydrate ($C_4H_6NiO_4$)	373-02-4	33.20	No	
Nickel	Nickel (II) chloride hydrate ($H_{12}N_2NiO_{12}$)	13478-00-7	20.18	Yes	
Selenium	Selenium dioxide (O_2Se)	7446-08-4	71.16	No	4
Selenium	Potassium selenate (K_2O_4Se)	7790-59-2	35.71	Yes	4
Selenium	Potassium selenite (K_2O_3Se)	10431-47-7	38.49	Yes	4
Selenium	Hydrogen selenide (H_2Se)	7783-07-5	97.51	Yes	4
Selenium	Selenious acid (H_2O_3Se)	7783-00-8	61.22	Yes	4
Selenium	Sodium selenate (Na_2O_4Se)	13410-01-0	41.79	Yes	4
Selenium	Sodium selenite (Na_2O_3Se)	10102-18-8	45.66	Yes	4
Selenium	Sodium selenide (Na_2Se)	1313-85-5	63.20	Yes	4
Selenium	Selenium sulfide (S_2Se)	7488-56-4	55.19	No	
Selenium	Selenocystine ($C_6H_{12}N_2O_4Se_2$)	1464-43-3	47.27	Yes	2
Selenium	Selenomethionine (environmental form) ($C_5H_{11}NO_2Se$)	1464-42-2	40.26	Yes	4
Silver	Silver acetate	563-63-3	64.63	No	
Silver	Silver nitrate	7761-88-8	63.50	Yes	
Silver	Silver chloride	7783-90-6	75.26	Yes	
Silver	Silver sulfate	10294-26-5	69.19	Yes	
Vanadium	Sodium Orthovanadate	13721-39-6	21.27	Yes	
Vanadium	Vanadium (III) chloride (Cl_3V)	7718-98-1	32.38	Yes	1
Vanadium	Vanadyl trichloride (Cl_3OV)	7727-18-6	29.39	Yes	1
Vanadium	Vanadic acid, Ammonium salt (H_4NO_3V)	7803-55-6	43.55	Yes	1
Vanadium	Sodium vanadate ($NaVO_3$)	13718-26-8	41.78	Yes	1
Vanadium	Vanadic acid, Trisodium salt (Na_3O_4V)	13721-39-6	26.70	Yes	1
Zinc	Zinc chloride (Cl_2Zn)	7646-85-7	47.98	Yes	1
Zinc	Zinc nitrate (N_2O_6Zn)	7779-88-6	34.52	Yes	
Zinc	Zinc sulfate ($Zn\ SO_4$)	7733-02-0	40.50	Yes	1
Zinc	Zinc acetate ($C_4H_6O_4Zn$)	557-34-6	35.64	No	
Zinc	Zinc peroxide (O_2Zn)	1314-22-3	67.14	No	
Zinc	Zinc phosphide (Zn_3P_2)	1314-84-7	76.00	No	
Zinc	Zinc sulfate heptahydrate ($H_{14}O_{11}SZn$)	7446-20-0	22.74	Yes	1
Zinc	Zinc bromide ($Zn\ Br_2$)	7699-45-8	29.04	No	
Zinc	Zinc iodide ($Zn\ I_2$)	10139-47-6	20.49	No	
Zinc	Zinc nitrate hexahydrate ($H_{12}N_2O_{12}Zn$)	10196-18-6	21.98	Yes	

Table 3. Percentages of Metal and Occurrence in Soil					
Contaminant	**Compound**	**CAS #**	**% of MW as Metal**	**Could be Found in Soil Environment**	**Reference**
Zinc	Zinc acetate dihydrate ($C_4H_{10}O_6Zn$)	5970-45-6	29.79	No	
[1]Alloway (1990) [2]Merck Index [3]Bodek et al. (1988) [4]Shamberger (1983)					

Species Common Name/Laboratory Strain

The common name or laboratory strain of the test organism is entered in the text box provided. Common name examples include: mouse, rat, dog, chicken, etc. Experiments testing different strains if the same species should be coded as different phases.

Genus and Species

The scientific name (genus and species) of the test organism is entered in the text box provided. If the genus and species are not reported in the article, use the Species Lookup Table next to the Species text box to find the correct scientific name.

Table 4a. Order, Family, and Common Name for Avian Test Species				
Common Name	**Order**	**Family**	**Genus**	**Species**
Bobwhite, northern	Galliformes	Odontophoridae	*Colinus*	*virginianus*
Chicken	Galliformes	Phasianidae	*Gallus*	*gallus*
Chicken	Galliformes	Phasianidae	*Gallus*	*domesticus*
Chicken	Galliformes	Phasianidae	*Gallus*	*sp.*
Cormorant, double-	Ciconiiformes	Phalacrocoracidae	*Phalacrocorax*	*auritus*
Cowbird, brown-headed	Passeriformes	Fringillidae	*Molothrus*	*ater*
Dove, Ringed turtle-	Columbiformes	Columbidae	*Streptopelia*	*risoria*
Dove, rock	Columbiformes	Columbidae	*Columba*	*livia*
Duck, dabbling	Anseriformes	Anatidae	*Anas*	*sp.*
Duck, American black	Anseriformes	Anatidae	*Anas*	*rubripes*
Duck, mallard	Anseriformes	Anatidae	*Anas*	*platyrhynchos*
Duck, wood	Anseriformes	Anatidae	*Aix*	*sponsa*
Eagle, bald	Ciconiiformes	Accipitridae	*Haliaeetus*	*leucocephalus*
Finch, striated	Passeriformes	Passeridae	*Lonchura*	*striata*
Finch, zebra	Passeriformes	Estrildidae	*Poephila*	*guttata*
Goose, swan	Anseriformes	Anatidae	*Anser*	*cygnoides*
Guineafowl, helmeted	Galliformes	Numididae	*Numida*	*meleagris*
Hawk, red-tailed	Ciconiiformes	Accipitridae	*Buteo*	*jamaicensis*

Table 4a. Order, Family, and Common Name for Avian Test Species				
Common Name	**Order**	**Family**	**Genus**	**Species**
Heron, black-crowned	Ciconiiformes	Ardeidae	*Nycticorax*	*nycticorax*
House sparrow	Passeriformes	Passeridae	*Passer*	*domesticus*
Kestrel, American	Ciconiiformes	Falconidae	*Falco*	*sparverius*
Owl, common barn	Strigiformes	Tytonidae	*Tyto*	*alba*
Owl eastern screech	Strigiformes	Strigidae	*Otus*	*asio*
Pheasant, ring-necked	Galliformes	Phasianidae	*Phasianus*	*colchicus*
Pigeon	Columbiformes	Columbidae	*Columba*	*sp.*
Quail	Galliformes	Phasianidae	*Coturnix*	*coturnix*
Quail, Japanese	Galliformes	Phasianidae	*Coturnix*	*japonica*
Robin, American	Passeriformes	Muscicapidae	*Turdus*	*migratorius*
Shrike, loggerhead	Passeriformes	Laniidae	*Lanius*	*ludovicianus*
Starling, European	Passeriformes	Sturnidae	*Sturnus*	*vulgaris*
Titmouse, tufted	Passeriformes	Paridae	*Parus*	*bicolor*
Turkey	Galliformes	Phasianidae	*Meleagris*	*gallopavo*

Table 4b. Order, Family, and Common Name for Mammalian Test Species				
Common Name	**Order**	**Family**	**Genus**	**Species**
Bank vole	Rodentia	Muridae	*Clethrionomys*	*glareolus*
Bat, little brown	Chiroptera	Vespertilionidae	*Myotis*	*lucifugus*
Blesbok	Artiodactyla	Bovidae	*Damaliscus*	*pygargus*
Cattle	Artiodactyla	Bovidae	*Bos*	*taurus*
Dog	Carnivora	Canidae	*Canis*	*familiaris*
Goat	Artiodactyla	Bovidae	*Capra*	*hircus*
Guinea pig	Rodentia	Caviidae	*Cavia*	*porcellus*
Hamster, golden	Rodentia	Muridae	*Mesocricetus*	*auratus*
Mink	Carnivora	Mustelidae	*Mustela*	*vison*
Mouse	Rodentia	Muridae	*Mus*	*sp.*
Mouse, white-footed	Rodentia	Muridae	*Peromyscus*	*leucopus*
Mouse, house	Rodentia	Muridae	*Mus*	*musculus*
Mouse, oldfield	Rodentia	Muridae	*Peromyscus*	*polionotus*
Pig	Artiodactyla	Suidae	*Sus*	*sp.*
Pig, domestic/feral	Artiodactyla	Suidae	*Sus*	*scrofa*
Pronghorn	Artiodactyla	Antilocapridae	*Antilocapra*	*americana*
Rabbit, European	Lagomorpha	Leporidae	*Oryctolagus*	*cuniculus*
Rat, black	Rodentia	Muridae	*Rattus*	*rattus*
Rat	Rodentia	Muridae	*Rattus*	*sp.*
Rat, cotton	Rodentia	Muridae	*Sigmodon*	*hispidus*

Table 4b. Order, Family, and Common Name for Mammalian Test Species				
Common Name	**Order**	**Family**	**Genus**	**Species**
Rat, Norway	Rodentia	Muridae	*Rattus*	*norvegicus*
Sheep, Dall	Artiodactyla	Bovidae	*Ovis*	*dalli*
Sheep	Artiodactyla	Bovidae	*Ovis*	*aries*
Shrew, short-tailed	Insectivora	Soricidae	*Blarina*	*brevicauda*
Shrew, common	Insectivora	Soricidae	*Sorex*	*araneus*
Vole, short-tailed	Rodentia	Muridae	*Microtus*	*agrestis*
Vole, meadow	Rodentia	Muridae	*Microtus*	*pennsylvanicus*
Wapiti	Artiodactyla	Cervidae	*Cervus*	*elaphus*
Whitetail deer	Artiodactyla	Cervidae	*Odocoileus*	*virginianus*

Organism Source

The source of the test organism is selected from the pull down list. A detailed description of each organism source is available under the description link to the right of the pull down list. The list of available organism sources is provided in Table 5. The User should use the code for COM to denote if laboratory species was obtained from an outside source. Confusion occurs when a laboratory rat strain is from a commercial source. In this case the code COM should be used. If there is no mention of source for laboratory strains the User should assign the LAB code.

Table 5. Organism Source Code	
Code	**Organism Source Description**
CBC	Captive Breeding Colony
COM	Commercial Source
DOM	Domestic Strain
GAM	Game Farm Strain
GOV	Government Agency Source
LAB	Laboratory Strain
NR	Not Reported
WLD	Wild Strain

Control Type

The effects of contaminant exposure are evaluated by comparing groups of exposed organisms to one or more groups of untreated organisms. These untreated organisms are designated as the controls. The User selects the type of test control(s) used in the study from the Control Type pull down list. Detailed descriptions of each available control type are available under the description link to the right of the pull down list. The list of available control types is provided in Table 6. If the study reports multiple controls, select "M" for Multiple and briefly describe the control types in the comments text box provided. If the authors report that the control had a background level of the contaminant, this should be entered in the control comment field. Studies which use control types coded as historical B, H, K, P, Z and NR lack an acceptable control group and are not used for the derivation of Wildlife TRVs. Studies with gavage exposures must have a vehicle or sham

control group to have a valid control. Gavage studies without a valid control should be rejected as "no control".

Table 6. Control Type Code Descriptions		
Code	**Validity of Control**	**Description**
B	Invalid	**Baseline or Background Control**: parameters of actual or representative test species measured either before or after administration of test contaminant, though not as part of the same test scenario.
C	Valid	**Concurrent Control:** controls are run simultaneously with the contaminant exposure, e.g. in the laboratory where a contaminant free test chamber is used or in field studies where the control data are obtained upstream from the exposure data; also includes field tests where the controls are run in a separate system, i.e., pond A and pond B or field A and field B.
H	Invalid	**Historical Control:** applicable to natural field system testing, data collected prior to exposure often during an independent long-term survey of the area; see also B - Baseline Control. In laboratory studies, the term historical control refers to compilation of data for a specific endpoint in multiple experiments over time.
K	Invalid	**Insufficient Information:** Data for control are presented, but without accompanying methodology to identify procedures used
M	Valid, if one control type is valid.	**Multiple:** multiple controls were reported, e.g. historic and concurrent
P	Invalid	**Positive control**: employs a test substance known to give a positive response for a specific endpoint in the test organism.
V	Valid	**Carrier, vehicle, or solvent control**: test organisms are concurrently exposed to the carrier or solvent (the "vehicle") used to administer the contaminant
Z	Invalid	**No Control:** no controls were used in the study
NR	Invalid	**Not Reported:** there is no information about presence or absence of controls provided in the publication

For some elements it may be necessary to establish if a control diet is provided or potentially toxic exposures are administered. Table 7 provides a list of the elements that are considered to be essential elements and nutrient requirements for domestic species. These ranges of essential nutrient requirements should be used to establish if exposures are nutritionally deficient, sufficient or potentially toxic (higher than nutrient requirements).

Table 7. Nutritional Requirements

Organism	Specific Organism Type	Sex	Age	Copper Requirement mg/kg diet	Copper Requirement Reported for	Copper Reference	Copper Requirement mg/kg bw/d[1]	Manganese Requirement mg/kg diet	Manganese Requirement Reported for	Manganese Reference	Manganese Requirement mg/kg bw/d[1]
cat	unspecified	M	weaning to 90 days	5	Kitten	NRC (1986)	0.3119	4 to 5	Kitten	NRC (1986)	0.2495 to 0.3119
cat	unspecified	M	90 days to 1 year								
cat	unspecified	M	1 year or older								
cat	unspecified	F	weaning to 90 days	5	Kitten	NRC (1986)	0.3200	4 to 5	Kitten	NRC (1986)	0.2560 to 0.3200
cat	unspecified	F	90 days to 1 year								
cat	unspecified	F	1 year or older								
cattle	unspecified	BH	3 to 7 days	3.6 to 16.8	Juvenile	Underwood and Suttle, 1999	0.1170 to 0.5460	10 to 25	Cattle	U & S 1999	0.3250 to 0.8126
cattle	unspecified	BH	6 to 8 weeks	3.6 to 16.8	Juvenile	Underwood and Suttle, 1999	0.1056 to 0.4930	10 to 25	Cattle	U & S 1999	0.2934 to 0.7336
cattle	unspecified	BH	8 to 10 weeks	3.6 to 16.8	Juvenile	Underwood and Suttle, 1999	0.1030 to 0.4808	10 to 25	Cattle	U & S 1999	0.2862 to 0.7154
cattle	unspecified	BH	13 to 16 weeks	3.6 to 16.8	Juvenile	Underwood and Suttle, 1999	0.0965 to 0.4503	10 to 25	Cattle	U & S 1999	0.2680 to 0.6700
cattle	unspecified	BH	22 to 51 weeks	3.6 to 16.8	Juvenile	Underwood and Suttle, 1999	0.0919 to 0.4289	10 to 25	Cattle	U & S 1999	0.2553 to 0.6383
cattle	Beef	BH	Weaning	3.6 to 16.8	Juvenile	Underwood and Suttle, 1999	0.0947 to 0.4419	10 to 25	Cattle	U & S 1999	0.2630 to 0.6576
cattle	Beef	F	Pregnant	4.4 to 20.8	Pregnant or lactating	Underwood and Suttle, 1999	0.1036 to 0.4899	10 to 25	Cattle	U & S 1999	0.2355 to 0.5889
cattle	Beef	F	Lactating	4.4 to 20.8	Pregnant or lactating	Underwood and Suttle, 1999	0.1017 to 0.4809	10 to 25	Cattle	U & S 1999	0.2312 to 0.5780
cattle	Beef	BH	1 year or older	4.4 to 20.8	Pregnant or lactating	Underwood and Suttle, 1999	0.1017 to 0.4809	10 to 25	Cattle	U & S 1999	0.2312 to 0.5780
cattle	Fresian	F	10 months	3.6 to 16.8	Juvenile	Underwood and Suttle, 1999	0.1092 to 0.5094	10 to 25	Cattle	U & S 1999	0.3032 to 0.7580
cattle	Dairy, Holstein	F	Lactating	13 to 16	Holstein, adult	NRC (2001)	0.2797 to 0.3443	17 to 21	Holstein, adult	NRC (2001)	0.3658 to 0.4518
cattle	Dairy, Jersey	F	Lactating	12 to 15	Jersey, adult	NRC (2001)	0.2774 to 0.3468	15 to 19	Jersey, adult	NRC (2001)	0.3468 to 0.4393
chicken	unspecified	M	Older than 30 days	4	Growing, (8 to 18 w)	Underwood and Suttle, 1999	0.2623	33	Breeding	U & S 1999	2.1637
								30	Growing	U & S 1999	3.6601
								55	Chicken	NAS (1980)	3.6061
chicken	unspecified	F	Older than 30 days	4 to 5	Immature, egg-laying	NRC (1994)	0.2527 to 0.3159	28 to 60	Immature, egg laying	NRC (1994)	1.7692 to 3.7912
				4	Growing, (8 to 18 w)	Underwood and Suttle, 1999	0.2527	17 to 25	Mature, egg laying	NRC (1994)	1.0742 to 1.5797
								33	Breeding	U & S 1999	2.0852
								30	Growing	U & S 1999	3.4617
								55	Chicken	NAS (1980)	3.4753
chicken	domestic	BH	1 day	8	Juvenile (0 to 8 w)	NRC (1994)	0.9760	60	Juvenile (0 to 8 w)	NRC (1994)	7.3202
								30	Growing	U & S 1999	3.2030
								55	Chicken	NAS (1980)	6.7102
chicken	domestic	BH	3 days	8	Juvenile (0 to 8 w)	NRC (1994)	0.9231	60	Juvenile (0 to 8 w)	NRC (1994)	6.9233
								30	Growing	U & S 1999	2.5133
								55	Chicken	NAS (1980)	6.3464
chicken	domestic	BH	7 days	8	Juvenile (0 to 8 w)	NRC (1994)	0.8541	60	Juvenile (0 to 8 w)	NRC (1994)	6.4060
								30	Growing	U & S 1999	2.2822
								55	Chicken	NAS (1980)	5.8722
chicken	domestic	BH	14 days	8	Juvenile (0 to 8 w)	NRC (1994)	0.6702	60	Juvenile (0 to 8 w)	NRC (1994)	5.0267
								30	Growing	U & S 1999	2.0460
								55	Chicken	NAS (1980)	4.6078
chicken	domestic	BH	20 days	8	Juvenile (0 to 8 w)	NRC (1994)	0.6086	60	Juvenile (0 to 8 w)	NRC (1994)	4.5644
								30	Growing	U & S 1999	1.9670
								55	Chicken	NAS (1980)	4.1840
chicken	domestic	BH	28 days	8	Juvenile (0 to 8 w)	NRC (1994)	0.5456	60	Juvenile (0 to 8 w)	NRC (1994)	4.0919
								30	Growing	U & S 1999	1.8956
								55	Chicken	NAS (1980)	3.7509
dog	unspecified	M	weaning to 90 days					4.5	Dog	NAS (1980)	0.2645
dog	unspecified	M	90 days to 1 year					4.5	Dog	NAS (1980)	0.2024
dog	unspecified	M	1 year or older					4.5	Dog	NAS (1980)	0.1933
dog	unspecified	F	weaning to 90 days					4.5	Dog	NAS (1980)	0.2740
dog	unspecified	F	90 days to 1 year					4.5	Dog	NAS (1980)	0.2048
dog	unspecified	F	1 year or older					4.5	Dog	NAS (1980)	0.1933
dove	ringed turtle	B	0 days								
dove	ringed turtle	B	7 days								
dove	ringed turtle	B	14 days								
dove	ringed turtle	B	21 days								
dove	ringed turtle	B	28 days								
dove	ringed turtle	B	Adult								

[1] mg/kg bw/d calculated based on default body weights in Table 20 and algorithms for estimating food intake in Attachment A.

Table 7. Nutritional Requirements

Organism	Specific Organism Type	Sex	Age	Copper Requirement mg/kg diet	Copper Requirement Reported for	Copper Reference	Copper Requirement mg/kg bw/d[1]	Manganese Requirement mg/kg diet	Manganese Requirement Reported for	Manganese Reference	Manganese Requirement mg/kg bw/d[1]
duck	mallard	F	Adult					50	Juvenile, 0 to 2 w	NRC (1994)	3.3772
duck	mallard	M	Adult					50	Juvenile, 0 to 2 w	NRC (1994)	3.3253
duck	mallard	JV	10 days					50	Juvenile, 0 to 2 w	NRC (1994)	5.2526
duck	mallard	JV	30 days					50	Juvenile, 0 to 2 w	NRC (1994)	3.9442
duck	white pekin	B	0 days					50	Juvenile, 0 to 2 w	NRC (1994)	5.6678
duck	white pekin	B	7 days					50	Juvenile, 0 to 2 w	NRC (1994)	4.3365
duck	white pekin	M	14 days					50	Juvenile, 0 to 2 w	NRC (1994)	3.5903
duck	white pekin	F	14 days					50	Juvenile, 0 to 2 w	NRC (1994)	3.6241
duck	white pekin	M	21 days					50	Juvenile, 0 to 2 w	NRC (1994)	3.2436
duck	white pekin	F	21 days					50	Juvenile, 0 to 2 w	NRC (1994)	3.2873
duck	white pekin	M	28 days					50	Juvenile, 0 to 2 w	NRC (1994)	3.0472
duck	white pekin	F	28 days					50	Juvenile, 0 to 2 w	NRC (1994)	3.0877
duck	white pekin	M	35 days					50	Juvenile, 0 to 2 w	NRC (1994)	2.9201
duck	white pekin	F	35 days					50	Juvenile, 0 to 2 w	NRC (1994)	2.9617
duck	white pekin	M	42 days					50	Juvenile, 0 to 2 w	NRC (1994)	2.8316
duck	white pekin	F	42 days					50	Juvenile, 0 to 2 w	NRC (1994)	2.8727
duck	white pekin	M	49 days					50	Juvenile, 0 to 2 w	NRC (1994)	2.7714
duck	white pekin	F	49 days					50	Juvenile, 0 to 2 w	NRC (1994)	2.8149
duck	white pekin	M	56 days					50	Juvenile, 0 to 2 w	NRC (1994)	2.7333
duck	white pekin	F	56 days					50	Juvenile, 0 to 2 w	NRC (1994)	2.7789
eagle	bald eagle	M	Adult								
eagle	bald eagle	F	Adult								
gerbil	unspecified	M	weaning to 90 days	5	Growing	NRC (1995)	0.5897	10	Growing and breeding	NRC (1995)	1.1795
				8	Breeding	NRC (1995)	0.9436				
gerbil	unspecified	M	90 days to 1 year	8	Breeding	NRC (1995)	0.8541	10	Growing and breeding	NRC (1995)	1.0677
				5	Growing	NRC (1995)	0.5338				
gerbil	unspecified	M	1 year or older	5	Growing	NRC (1995)	0.5175	10	Growing and breeding	NRC (1995)	1.0350
				8	Breeding	NRC (1995)	0.8280				
gerbil	unspecified	F	weaning to 90 days	5	Growing	NRC (1995)	0.6092	10	Growing and breeding	NRC (1995)	1.2184
				8	Breeding	NRC (1995)	0.9747				
gerbil	unspecified	F	90 days to 1 year	8	Breeding	NRC (1995)	0.8757	10	Growing and breeding	NRC (1995)	1.0947
				5	Growing	NRC (1995)	0.5473				
gerbil	unspecified	F	1 year or older	5	Growing	NRC (1995)	0.5273	10	Growing and breeding	NRC (1995)	1.0546
				8	Breeding	NRC (1995)	0.8437				
guinea pig	unspecified	M	weaning to 90 days	6	Guinea pig	NRC (1995)	0.4697	40	Guinea pig	NRC (1995)	3.1315
guinea pig	unspecified	M	90 days to 1 year	6	Guinea pig	NRC (1995)	0.4208	40	Guinea pig	NRC (1995)	2.8056
guinea pig	unspecified	M	1 year or older	6	Guinea pig	NRC (1995)	0.4122	40	Guinea pig	NRC (1995)	2.7480
guinea pig	unspecified	F	weaning to 90 days	6	Guinea pig	NRC (1995)	0.4874	40	Guinea pig	NRC (1995)	3.2494
guinea pig	unspecified	F	90 days to 1 year	6	Guinea pig	NRC (1995)	0.4234	40	Guinea pig	NRC (1995)	2.8228
guinea pig	unspecified	F	1 year or older	6	Guinea pig	NRC (1995)	0.4200	40	Guinea pig	NRC (1995)	2.8000
hamster	golden Syrian	M	weaning to 90 days								
hamster	golden Syrian	M	90 days to 1 year								
hamster	golden Syrian	M	1 year or older								
hamster	golden Syrian	F	weaning to 90 days								
hamster	golden Syrian	F	90 days to 1 year								
hamster	golden Syrian	F	1 year or older								
hamster	Chinese & Djungarai	M	weaning to 90 days								
hamster	Chinese & Djungarai	M	90 days to 1 year								
hamster	Chinese & Djungarai	M	1 year or older								
hamster	Chinese & Djungarai	F	weaning to 90 days								
hamster	Chinese & Djungarai	F	90 days to 1 year								
hamster	Chinese & Djungarai	F	1 year or older								
hamster	unspecified	M	weaning to 90 days								
hamster	unspecified	M	90 days to 1 year								
hamster	unspecified	M	1 year or older								
hamster	unspecified	F	weaning to 90 days								
hamster	unspecified	F	90 days to 1 year								
hamster	unspecified	F	1 year or older								
horse	unspecified	B	> 2 year								

[1] mg/kg bw/d calculated based on default body weights in Table 20 and algorithms for estimating food intake in Attachment A.

Table 7. Nutritional Requirements

Organism	Specific Organism Type	Sex	Age	Copper Requirement mg/kg diet	Copper Requirement Reported for	Copper Reference	Copper Requirement mg/kg bw/d[1]	Manganese Requirement mg/kg diet	Manganese Requirement Reported for	Manganese Reference	Manganese Requirement mg/kg bw/d[1]
horse	unspecified	M	2 to 5 months	8 to 25	Foal	U & S 1999	0.2178 to 0.6805				
horse	unspecified	M	5 to 12 months								
horse	unspecified	M	12 to 24 months								
mink	unspecified	M	weaning to 49 days					40	Growing	NRC (1982)	2.7383
mink	unspecified	F	weaning to 49 days					40	Growing	NRC (1982)	3.0250
mink	unspecified	M	> 1 year	4.5 to 6.0	Mink	NRC (1982)	0.3002 to 0.4002	44	Breeding	NRC (1982)	2.9350
mink	unspecified	F	> 1 year	4.5 to 6.0	Mink	NRC (1982)	0.3390 to 0.4520	44	Breeding	NRC (1982)	3.3145
mouse	BAF1	M	weaning to 90 days	6	Mouse	NRC (1995)	0.8112	10	Mouse	NRC (1995)	1.3519
mouse	BAF1	M	90 days to 1 year	6	Mouse	NRC (1995)	0.7888	10	Mouse	NRC (1995)	1.3146
mouse	BAF1	M	1 year or older	6	Mouse	NRC (1995)	0.7486	10	Mouse	NRC (1995)	1.2477
mouse	BAF1	F	weaning to 90 days	6	Mouse	NRC (1995)	0.8241	10	Mouse	NRC (1995)	1.3735
mouse	BAF1	F	90 days to 1 year	6	Mouse	NRC (1995)	0.8118	10	Mouse	NRC (1995)	1.3530
mouse	BAF1	F	1 year or older	6	Mouse	NRC (1995)	0.7695	10	Mouse	NRC (1995)	1.2824
mouse	B6C3F1	M	weaning to 90 days	6	Mouse	NRC (1995)	0.7624	10	Mouse	NRC (1995)	1.2706
mouse	B6C3F1	M	90 days to 1 year	6	Mouse	NRC (1995)	0.7402	10	Mouse	NRC (1995)	1.2337
mouse	B6C3F1	M	1 year or older	6	Mouse	NRC (1995)	0.7310	10	Mouse	NRC (1995)	1.2184
mouse	B6C3F1	F	weaning to 90 days	6	Mouse	NRC (1995)	0.7971	10	Mouse	NRC (1995)	1.3285
mouse	B6C3F1	F	90 days to 1 year	6	Mouse	NRC (1995)	0.7475	10	Mouse	NRC (1995)	1.2458
mouse	B6C3F1	F	1 year or older	6	Mouse	NRC (1995)	0.7486	10	Mouse	NRC (1995)	1.2477
mouse	deer mouse	M	Adult	6	Mouse	NRC (1995)	0.8270	10	Mouse	NRC (1995)	1.3784
mouse	deer mouse	F	Adult	6	Mouse	NRC (1995)	0.8346	10	Mouse	NRC (1995)	1.3910
mouse	unspecified	M	weaning to 90 days	6	Mouse	NRC (1995)	0.7843	10	Mouse	NRC (1995)	1.3071
mouse	unspecified	M	90 days to 1 year	6	Mouse	NRC (1995)	0.7619	10	Mouse	NRC (1995)	1.2699
mouse	unspecified	M	1 year or older	6	Mouse	NRC (1995)	0.7395	10	Mouse	NRC (1995)	1.2325
mouse	unspecified	F	weaning to 90 days	6	Mouse	NRC (1995)	0.8099	10	Mouse	NRC (1995)	1.3498
mouse	unspecified	F	90 days to 1 year	6	Mouse	NRC (1995)	0.7753	10	Mouse	NRC (1995)	1.2922
mouse	unspecified	F	1 year or older	6	Mouse	NRC (1995)	0.7586	10	Mouse	NRC (1995)	1.2643
pheasant	ring-necked	F	Adult					60	Ring-necked (9 to 17 wk an	NRC (1994)	4.1598
pheasant	ring-necked	M	Adult					60	Ring-necked (9 to 17 wk an	NRC (1994)	3.9339
owl	barn owl	M	Adult								
owl	barn owl	F	Adult								
pigeon	pigeon	F	Adult								
pigeon	pigeon	M	Adult								
pig	miniature	BH	Adult					4 to 10	Growing, adult	U & S 1999	0.1282 to 0.3205
pig	unspecified	BH	1 day	4	Growing	U & S 1999	0.1612	4 to 10	Growing, adult	U & S 1999	0.2660 to 0.6651
pig	unspecified	BH	21 to 25 days	4	Growing	U & S 1999	0.1612	4 to 10	Growing, adult	U & S 1999	0.1964 tp 0.4910
pig	unspecified	BH	26 to 29 days	4	Growing	U & S 1999	0.1578	4 to 10	Growing, adult	U & S 1999	0.1902 to 0.4755
pig	unspecified	BH	30 to 35 days	4	Growing	U & S 1999	0.1718	4 to 10	Growing, adult	U & S 1999	0.1848 to 0.4619
pig	unspecified	BH	36 to 66 days	4	Growing	U & S 1999	0.1906	4 to 10	Growing, adult	U & S 1999	0.1487 to 0.3718
pig	unspecified	BH	67 to 150 days	4	Growing	U & S 1999	0.1457	4 to 10	Growing, adult	U & S 1999	0.1322 to 0.3305
pig	unspecified	BH	151 to 299 days	4	Growing	U & S 1999	0.1211	4 to 10	Growing, adult	U & S 1999	0.1322 to 0.3305
pig	unspecified	BH	> 299 days	4	Growing	U & S 1999	0.1211	4 to 10	Growing, adult	U & S 1999	0.1202 to 0.3006
pig	unspecified	F	Adult					4 to 10	Growing, adult	U & S 1999	0.1124 to 0.2809
quail	Japanese	F	Adult	5	Starting, growing and	NRC (1994)	0.5175	60	Growing and breeding	NRC (1994)	6.2102
quail	Japanese	M	Adult	5	Starting, growing and	NRC (1994)	0.5273	60	Growing and breeding	NRC (1994)	6.3278
quail	Japanese	BH	0 to 1 day	5	Starting, growing and	NRC (1994)	0.5508				
quail	Japanese	BH	7 to 8 days	5	Starting, growing and	NRC (1994)	0.5148				
quail	Japanese	BH	14 to 28 days	5	Starting, growing and	NRC (1994)	0.5010	60	Growing and breeding	NRC (1994)	6.0119
quail	Japanese	BH	29 to 59 days	5	Starting, growing and	NRC (1994)	0.4926	60	Growing and breeding	NRC (1994)	5.9108
quail	Japanese	BH	60 to 154 days	5	Starting, growing and	NRC (1994)	0.4906	60	Growing and breeding	NRC (1994)	5.8872
quail	bobwhite	F	Adult								
quail	bobwhite	M	Adult								
quail	bobwhite	JV	10 days								
quail	bobwhite	JV	30 days								

[1] mg/kg bw/d calculated based on default body weights in Table 20 and algorithms for estimating food intake in Attachment A.

Table 7. Nutritional Requirements

Organism	Specific Organism Type	Sex	Age	Copper Requirement mg/kg diet	Copper Requirement Reported for	Copper Reference	Copper Requirement mg/kg bw/d[1]	Manganese Requirement mg/kg diet	Manganese Requirement Reported for	Manganese Reference	Manganese Requirement mg/kg bw/d[1]
quail	bobwhite	BH	13 days								
rabbit	unspecified	M	weaning to 90 days					8.5	Rabbit	NAS (1980)	0.4843
rabbit	unspecified	M	90 days to 1 year					8.5	Rabbit	NAS (1980)	0.4613
rabbit	unspecified	M	1 year or older					8.5	Rabbit	NAS (1980)	0.4563
rabbit	unspecified	F	weaning to 90 days					8.5	Rabbit	NAS (1980)	0.4774
rabbit	unspecified	F	90 days to 1 year					8.5	Rabbit	NAS (1980)	0.4577
rabbit	unspecified	F	1 year or older					8.5	Rabbit	NAS (1980)	0.4543
rat	Fischer 344	M	weaning to 90 days	5 to 8	Rat	NRC (1995)	0.4661 to 0.7458	10	Rat	NRC (1995)	0.9322
								50	Rat	NAS (1980)	4.6611
rat	Fischer 344	M	90 days to 1 year	5 to 8	Rat	NRC (1995)	0.4081 to 0.6529	10	Rat	NRC (1995)	0.8161
								50	Rat	NAS (1980)	4.0806
rat	Fischer 344	M	1 year or older	5 to 8	Rat	NRC (1995)	0.4044 to 0.6470	10	Rat	NRC (1995)	0.8087
								50	Rat	NAS (1980)	4.0435
rat	Fischer 344	F	weaning to 90 days	5 to 8	Rat	NRC (1995)	0.4981 to 0.7969	10	Rat	NRC (1995)	0.9962
								50	Rat	NAS (1980)	4.9808
rat	Fischer 344	F	90 days to 1 year	5 to 8	Rat	NRC (1995)	0.4466 to 0.7145	10	Rat	NRC (1995)	0.8931
								50	Rat	NAS (1980)	4.4656
rat	Fischer 344	F	1 year or older	5 to 8	Rat	NRC (1995)	0.4396 to 0.7034	10	Rat	NRC (1995)	0.8793
								50	Rat	NAS (1980)	4.3964
rat	Long-Evans	M	weaning to 90 days	5 to 8	Rat	NRC (1995)	0.4403 to 0.7044	10	Rat	NRC (1995)	0.8805
								50	Rat	NAS (1980)	4.4027
rat	Long-Evans	M	90 days to 1 year	5 to 8	Rat	NRC (1995)	0.3926 to 0.6282	10	Rat	NRC (1995)	0.7852
								50	Rat	NAS (1980)	3.9261
rat	Long-Evans	M	1 year or older	5 to 8	Rat	NRC (1995)	0.3886 to 0.6218	10	Rat	NRC (1995)	0.7772
								50	Rat	NAS (1980)	3.8861
rat	Long-Evans	F	weaning to 90 days	5 to 8	Rat	NRC (1995)	0.4666 to 0.7465	10	Rat	NRC (1995)	0.9331
								50	Rat	NAS (1980)	4.6657
rat	Long-Evans	F	90 days to 1 year	5 to 8	Rat	NRC (1995)	0.4154 to 0.6646	10	Rat	NRC (1995)	0.8307
								50	Rat	NAS (1980)	4.1535
rat	Long-Evans	F	1 year or older	5 to 8	Rat	NRC (1995)	0.4141 to 0.6625	10	Rat	NRC (1995)	0.8282
								50	Rat	NAS (1980)	4.1408
rat	Osborne-Mendel	M	weaning to 90 days	5 to 8	Rat	NRC (1995)	0.4357 to 0.6971	10	Rat	NRC (1995)	0.8714
								50	Rat	NAS (1980)	4.3569
rat	Osborne-Mendel	M	90 days to 1 year	5 to 8	Rat	NRC (1995)	0.3867 to 0.6187	10	Rat	NRC (1995)	0.7734
								50	Rat	NAS (1980)	3.8670
rat	Osborne-Mendel	M	1 year or older	5 to 8	Rat	NRC (1995)	0.3821 to 0.6113	10	Rat	NRC (1995)	0.7641
								50	Rat	NAS (1980)	3.8207
rat	Osborne-Mendel	F	weaning to 90 days	5 to 8	Rat	NRC (1995)	0.4570 to 0.7313	10	Rat	NRC (1995)	0.9141
								50	Rat	NAS (1980)	4.5704
rat	Osborne-Mendel	F	90 days to 1 year	5 to 8	Rat	NRC (1995)	0.4064 to 0.6502	10	Rat	NRC (1995)	0.8127
								50	Rat	NAS (1980)	4.0636
rat	Osborne-Mendel	F	1 year or older	5 to 8	Rat	NRC (1995)	0.4044 to 0.6470	10	Rat	NRC (1995)	0.8087
								50	Rat	NAS (1980)	4.0435
rat	Sprague-Dawley	M	weaning to 90 days	5 to 8	Rat	NRC (1995)	0.4345 to 0.6952	10	Rat	NRC (1995)	0.8690
								50	Rat	NAS (1980)	4.3452
rat	Sprague-Dawley	M	90 days to 1 year	5 to 8	Rat	NRC (1995)	0.3855 to 0.6168	10	Rat	NRC (1995)	0.7710
								50	Rat	NAS (1980)	3.8551
rat	Sprague-Dawley	M	1 year or older	5 to 8	Rat	NRC (1995)	0.3762 to 0.6019	10	Rat	NRC (1995)	0.7524
								50	Rat	NAS (1980)	3.7620
rat	Sprague-Dawley	F	weaning to 90 days	5 to 8	Rat	NRC (1995)	0.4558 to 0.7293	10	Rat	NRC (1995)	0.9117
								50	Rat	NAS (1980)	4.5584
rat	Sprague-Dawley	F	90 days to 1 year	5 to 8	Rat	NRC (1995)	0.4167 to 0.6667	10	Rat	NRC (1995)	0.8333
								50	Rat	NAS (1980)	4.1666
rat	Sprague-Dawley	F	1 year or older	5 to 8	Rat	NRC (1995)	0.4141 to 0.6625	10	Rat	NRC (1995)	0.8282
								50	Rat	NAS (1980)	4.1408
rat	Wistar	M	weaning to 90 days	5 to 8	Rat	NRC (1995)	0.4509 to 0.7214	10	Rat	NRC (1995)	0.9017
								50	Rat	NAS (1980)	4.5086
rat	Wistar	M	90 days to 1 year	5 to 8	Rat	NRC (1995)	0.3941 to 0.6306	10	Rat	NRC (1995)	0.7882
								50	Rat	NAS (1980)	3.9411

[1] mg/kg bw/d calculated based on default body weights in Table 20 and algorithms for estimating food intake in Attachment A.

Table 7. Nutritional Requirements

Organism	Specific Organism Type	Sex	Age	Copper Requirement mg/kg diet	Copper Requirement Reported for	Copper Reference	Copper Requirement mg/kg bw/d[1]	Manganese Requirement mg/kg diet	Manganese Requirement Reported for	Manganese Reference	Manganese Requirement mg/kg bw/d[1]
rat	Wistar	M	1 year or older	5 to 8	Rat	NRC (1995)	0.3886 to 0.6218	10	Rat	NRC (1995)	0.7772
								50	Rat	NAS (1980)	3.8861
rat	Wistar	F	weaning to 90 days	5 to 8	Rat	NRC (1995)	0.4781 to 0.7650	10	Rat	NRC (1995)	0.9563
								50	Rat	NAS (1980)	4.7814
rat	Wistar	F	90 days to 1 year	5 to 8	Rat	NRC (1995)	0.4264 to 0.6822	10	Rat	NRC (1995)	0.8527
								50	Rat	NAS (1980)	4.2636
rat	Wistar	F	1 year or older	5 to 8	Rat	NRC (1995)	0.4207 to 0.6732	10	Rat	NRC (1995)	0.8415
								50	Rat	NAS (1980)	4.2074
rat	unspecified	M	weaning to 90 days	5 to 8	Rat	NRC (1995)	0.4445 to 0.7112	10	Rat	NRC (1995)	0.8890
								50	Rat	NAS (1980)	4.4451
rat	unspecified	M	90 days to 1 year	5 to 8	Rat	NRC (1995)	0.3929 to 0.6286	10	Rat	NRC (1995)	0.7858
								50	Rat	NAS (1980)	3.9288
rat	unspecified	M	1 year or older	5 to 8	Rat	NRC (1995)	0.3872 to 0.6196	10	Rat	NRC (1995)	0.7745
								50	Rat	NAS (1980)	3.8724
rat	unspecified	F	weaning to 90 days	5 to 8	Rat	NRC (1995)	0.4565 to 0.7304	10	Rat	NRC (1995)	0.9130
								50	Rat	NAS (1980)	4.5648
rat	unspecified	F	90 days to 1 year	5 to 8	Rat	NRC (1995)	0.4072 to 0.6515	10	Rat	NRC (1995)	0.8144
								50	Rat	NAS (1980)	4.0719
rat	unspecified	F	1 year or older	5 to 8	Rat	NRC (1995)	0.4044 to 0.6470	10	Rat	NRC (1995)	0.8087
								50	Rat	NAS (1980)	4.0435
sheep	Old Norse	M	Adult					30	Sheep	NAS (1980)	1.0552
sheep	Old Norse	F	Adult	5.8 to 28.4	Lactating Ewe	U & S 1999	0.2150 to 1.0528	30	Sheep	NAS (1980)	1.1121
sheep	Dala	M	Adult					30	Sheep	NAS (1980)	0.8857
sheep	Dala	F	Adult	5.8 to 28.4	Lactating Ewe	U & S 1999	0.1827 to 0.8944	30	Sheep	NAS (1980)	0.9448
sheep	Chun forest	BH	Juvenile	4.3 to 17.2	Juvenile	U & S 1999	0.1678 to 0.6711	30	Sheep	NAS (1980)	1.1706
sheep	Chun forest	M	Adult					30	Sheep	NAS (1980)	0.9225
sheep	Chun forest	F	Adult	5.8 to 28.4	Lactating Ewe	U & S 1999	0.1857 to 0.9091	30	Sheep	NAS (1980)	0.9603
sheep	domestic	B	1 week	4.3 to 17.2	Juvenile	U & S 1999	0.1490 to 0.5959	30	Sheep	NAS (1980)	1.0393
sheep	unspecified	BH	112 to 189 days	4.3 to 17.2	Juvenile	U & S 1999	0.1577 to 0.6308	30	Sheep	NAS (1980)	1.1002
sheep	unspecified	BH	189 to 224 days	4.3 to 17.2	Juvenile	U & S 1999	0.1528 to 0.6112	30	Sheep	NAS (1980)	1.0660
sheep	unspecified	BH	225 to 252 days	4.3 to 17.2	Juvenile	U & S 1999	0.1429 to 0.5717	30	Sheep	NAS (1980)	0.9971
sheep	unspecified	BH	> 252 days	4.3 to 17.2	Juvenile	U & S 1999	0.1405 to 0.5619	30	Sheep	NAS (1980)	0.9801
sheep	unspecified	F	Gestation	7.0 to 21	Pregnant Ewe	U & S 1999	0.2257 to 0.6772	30	Sheep	NAS (1980)	0.9675
				5.8 to 28.4	Lactating Ewe	U & S 1999	0.1870 to 0.9159				
shrew	short-tailed	M	Adult								
shrew	short-tailed	F	Adult								
sparrow	white-throated	B	Adult								
starling	starling	M	Adult								
starling	starling	F	Adult								
turkey	domestic	M	1 w	6	0 to 8 wk, egg laying	NRC (1994)	0.6012	55	Turkey	NAS 1980	5.5109
turkey	domestic	F	1 w	6	0 to 8 wk, egg laying	NRC (1994)	0.6012	55	Turkey	NAS 1980	5.5109
turkey	domestic	M	2 w	6	0 to 8 wk, egg laying	NRC (1994)	0.5276	55	Turkey	NAS 1980	4.8360
turkey	domestic	F	2 w	6	0 to 8 wk, egg laying	NRC (1994)	0.5314	55	Turkey	NAS 1980	4.8713
turkey	domestic	M	3 w	6	0 to 8 wk, egg laying	NRC (1994)	0.4663	55	Turkey	NAS 1980	4.2747
turkey	domestic	F	3 w	6	0 to 8 wk, egg laying	NRC (1994)	0.4733	55	Turkey	NAS 1980	4.3386
turkey	domestic	M	4 w	6	0 to 8 wk, egg laying	NRC (1994)	0.4122	55	Turkey	NAS 1980	3.7785
turkey	domestic	F	4 w	6	0 to 8 wk, egg laying	NRC (1994)	0.4200	55	Turkey	NAS 1980	3.8500
turkey	domestic	M	5 w	6	0 to 8 wk, egg laying	NRC (1994)	0.3791	55	Turkey	NAS 1980	3.4753
turkey	domestic	F	5 w	6	0 to 8 wk, egg laying	NRC (1994)	0.3882	55	Turkey	NAS 1980	3.5588
turkey	domestic	M	6 w	6	0 to 8 wk, egg laying	NRC (1994)	0.3582	55	Turkey	NAS 1980	3.2837
turkey	domestic	F	6 w	6	0 to 8 wk, egg laying	NRC (1994)	0.3713	55	Turkey	NAS 1980	3.4031
turkey	domestic	M	7 w	6	0 to 8 wk, egg laying	NRC (1994)	0.3370	55	Turkey	NAS 1980	3.0893
turkey	domestic	F	7 w	6	0 to 8 wk, egg laying	NRC (1994)	0.3554	55	Turkey	NAS 1980	3.2579
turkey	domestic	M	8 w	8	8 to 24 wk, breeding	NRC (1994)	0.4294	55	Turkey	NAS 1980	2.9522

[1] mg/kg bw/d calculated based on default body weights in Table 20 and algorithms for estimating food intake in Attachment A.

Table 7. Nutritional Requirements

Organism	Specific Organism Type	Sex	Age	Copper Requirement mg/kg diet	Copper Requirement Reported for	Copper Reference	Copper Requirement mg/kg bw/d[1]	Manganese Requirement mg/kg diet	Manganese Requirement Reported for	Manganese Reference	Manganese Requirement mg/kg bw/d[1]
turkey	domestic	F	8 w	8	8 to 24 wk, breeding	NRC (1994)	0.4520	55	Turkey	NAS 1980	3.1074
turkey	domestic	M	9 w	8	8 to 24 wk, breeding	NRC (1994)	0.4127	55	Turkey	NAS 1980	2.8373
turkey	domestic	F	9 w	8	8 to 24 wk, breeding	NRC (1994)	0.4354	55	Turkey	NAS 1980	2.9935
turkey	domestic	M	10 w	8	8 to 24 wk, breeding	NRC (1994)	0.3995	55	Turkey	NAS 1980	2.7467
turkey	domestic	F	10 w	8	8 to 24 wk, breeding	NRC (1994)	0.4222	55	Turkey	NAS 1980	2.9026
turkey	domestic	M	11 w	8	8 to 24 wk, breeding	NRC (1994)	0.3877	55	Turkey	NAS 1980	2.6656
turkey	domestic	F	11 w	8	8 to 24 wk, breeding	NRC (1994)	0.4098	55	Turkey	NAS 1980	2.8175
turkey	domestic	M	12 w	8	8 to 24 wk, breeding	NRC (1994)	0.3779	55	Turkey	NAS 1980	2.5981
turkey	domestic	F	12 w	8	8 to 24 wk, breeding	NRC (1994)	0.3995	55	Turkey	NAS 1980	2.7467
turkey	domestic	M	13 w	8	8 to 24 wk, breeding	NRC (1994)	0.3695	55	Turkey	NAS 1980	2.5406
turkey	domestic	F	13 w	8	8 to 24 wk, breeding	NRC (1994)	0.3907	55	Turkey	NAS 1980	2.6862
turkey	domestic	M	14 w	8	8 to 24 wk, breeding	NRC (1994)	0.3616	55	Turkey	NAS 1980	2.4863
turkey	domestic	F	14 w	8	8 to 24 wk, breeding	NRC (1994)	0.3840	55	Turkey	NAS 1980	2.6397
turkey	domestic	M	15 w	8	8 to 24 wk, breeding	NRC (1994)	0.3558	55	Turkey	NAS 1980	2.4463
turkey	domestic	F	15 w	8	8 to 24 wk, breeding	NRC (1994)	0.3771	55	Turkey	NAS 1980	2.5925
turkey	domestic	M	16 w	8	8 to 24 wk, breeding	NRC (1994)	0.3501	55	Turkey	NAS 1980	2.4069
turkey	domestic	F	16 w	8	8 to 24 wk, breeding	NRC (1994)	0.3724	55	Turkey	NAS 1980	2.5605
turkey	domestic	M	17 w	8	8 to 24 wk, breeding	NRC (1994)	0.3458	55	Turkey	NAS 1980	2.3775
turkey	domestic	F	17 w	8	8 to 24 wk, breeding	NRC (1994)	0.3675	55	Turkey	NAS 1980	2.5262
turkey	domestic	M	18 w	8	8 to 24 wk, breeding	NRC (1994)	0.3419	55	Turkey	NAS 1980	2.3503
turkey	domestic	F	18 w	8	8 to 24 wk, breeding	NRC (1994)	0.3635	55	Turkey	NAS 1980	2.4991
turkey	domestic	M	19 w	8	8 to 24 wk, breeding	NRC (1994)	0.3386	55	Turkey	NAS 1980	2.3278
turkey	domestic	F	19 w	8	8 to 24 wk, breeding	NRC (1994)	0.3592	55	Turkey	NAS 1980	2.4698
turkey	domestic	M	20 w	8	8 to 24 wk, breeding	NRC (1994)	0.3351	55	Turkey	NAS 1980	2.3041
turkey	domestic	F	20 w	8	8 to 24 wk, breeding	NRC (1994)	0.3558	55	Turkey	NAS 1980	2.4463
turkey	domestic	M	21 w	8	8 to 24 wk, breeding	NRC (1994)	0.3319	55	Turkey	NAS 1980	2.2819
turkey	domestic	M	22 w	8	8 to 24 wk, breeding	NRC (1994)	0.3289	55	Turkey	NAS 1980	2.2611
turkey	domestic	M	23 w	8	8 to 24 wk, breeding	NRC (1994)	0.3266	55	Turkey	NAS 1980	2.2457
turkey	domestic	M	24 w	8	8 to 24 wk, breeding	NRC (1994)	0.3242	55	Turkey	NAS 1980	2.2289
turkey	domestic	M	20 w	8	8 to 24 wk, breeding	NRC (1994)	0.3423	60	Breeding and Laying	NRC (1994)	2.5672
turkey	domestic	F	20 w	8	8 to 24 wk, breeding	NRC (1994)	0.3763	60	Breeding and Laying	NRC (1994)	2.8222
turkey	domestic	M	25 w					60	Breeding and Laying	NRC (1994)	2.5053
turkey	domestic	F	25 w					60	Breeding and Laying	NRC (1994)	2.7458
turkey	domestic	M	30 w					60	Breeding and Laying	NRC (1994)	2.4383
turkey	domestic	F	30 w					60	Breeding and Laying	NRC (1994)	2.6856
turkey	domestic	M	35 w					60	Breeding and Laying	NRC (1994)	2.4036
turkey	domestic	F	35 w					60	Breeding and Laying	NRC (1994)	2.6856
turkey	domestic	M	40 w					60	Breeding and Laying	NRC (1994)	2.3816
turkey	domestic	F	40 w					60	Breeding and Laying	NRC (1994)	2.6987
turkey	domestic	M	45 w					60	Breeding and Laying	NRC (1994)	2.3682
turkey	domestic	F	45 w					60	Breeding and Laying	NRC (1994)	2.7123
turkey	domestic	M	50 w					60	Breeding and Laying	NRC (1994)	2.3553
turkey	domestic	F	50 w					60	Breeding and Laying	NRC (1994)	2.7123
turkey	domestic	M	55 w					60	Breeding and Laying	NRC (1994)	2.3429
turkey	domestic	F	55 w					60	Breeding and Laying	NRC (1994)	2.7123
turkey	domestic	M	60 w					60	Breeding and Laying	NRC (1994)	2.3326
turkey	domestic	F	60 w					60	Breeding and Laying	NRC (1994)	2.7077
vole	prairie vole	BH	Adult								
vole	meadow vole	M	Adult								
vole	meadow vole	F	Adult								
finch	zebra finch	B	Adult								

[1] mg/kg bw/d calculated based on default body weights in Table 20 and algorithms for estimating food intake in Attachment A.

Table 7. Nutritional Requirements

Organism	Specific Organism Type	Sex	Age	Selenium Requirement mg/kg diet	Selenium Requirement Reported for	Selenium Reference	Selenium Requirement mg/kg bw/d[1]	Zinc Requirement mg/kg diet	Zinc Requirement Reported for	Zinc Reference	Zinc Requirement mg/kg bw/d[1]
cat	unspecified	M	weaning to 90 days					15	Kitten (minimum)	NRC (1986)	0.9357
cat	unspecified	M	90 days to 1 year								
cat	unspecified	M	1 year or older	0.1	Cat (minimum)	NRC (1986)	0.0054				
cat	unspecified	F	weaning to 90 days					15	Kitten (minimum)	NRC (1986)	0.9599
cat	unspecified	F	90 days to 1 year								
cat	unspecified	F	1 year or older	0.1	Cat (minimum)	NRC (1986)	0.0056				
cattle	unspecified	BH	3 to 7 days	0.036 to 0.062	Cattle (beef)	U & S 1999	0.00077 to 0.00202	9 to 14	Cattle (calf)	McDowell 1985	0.2925 to 0.4550
cattle	unspecified	BH	6 to 8 weeks	0.036 to 0.062	Cattle (beef)	U & S 1999	0.00083 to 0.00182	9 to 14	Cattle (calf)	McDowell 1985	0.2641 to 0.4108
cattle	unspecified	BH	8 to 10 weeks	0.036 to 0.062	Cattle (beef)	U & S 1999	0.00117 to 0.00177	9 to 14	Cattle (calf)	McDowell 1985	0.2576 to 0.4006
cattle	unspecified	BH	13 to 16 weeks	0.036 to 0.062	Cattle (beef)	U & S 1999	0.00106 to 0.00166	9 to 14	Cattle (calf)	McDowell 1985	0.2412 to 0.3752
cattle	unspecified	BH	22 to 51 weeks	0.036 to 0.062	Cattle (beef)	U & S 1999	0.00103 to 0.00158	9 to 14	Cattle (calf)	McDowell 1985	0.2298 to 0.3575
cattle	Beef	BH	Weaning	0.036 to 0.062	Cattle (beef)	U & S 1999	0.00095 to 0.0016	9 to 14	Cattle (calf)	McDowell 1985	0.2367 to 0.3682
cattle	Beef	F	Pregnant	0.036 to 0.062	Cattle (beef)	U & S 1999	0.00085 to 0.0015	20 to 50	Cattle	McDowell 1985	0.4711 to 1.1777
cattle	Beef	F	Lactating	0.036 to 0.062	Cattle (beef)	U & S 1999	0.00083 to 0.0014	20 to 50	Cattle	McDowell 1985	0.4624 to 1.1560
cattle	Beef	BH	1 year or older	0.036 to 0.062	Cattle (beef)	U & S 1999	0.00083 to 0.0014				
cattle	Fresian	F	10 months	0.036 to 0.062	Cattle (beef)	U & S 1999	0.00096 to 0.00188	9 to 14	Cattle (calf)	McDowell 1985	0.2729 to 0.4245
cattle	Dairy, Holstein	F	Lactating	0.3	Holstein, adult	NRC (2001)	0.0065	54 to 73	Holstein, adult	NRC (2001)	
				0.044 to 0.070	Cattle (dairy)	U & S 1999	0.00095 to 0.0015				
cattle	Dairy, Jersey	F	Lactating	0.3	Jersey, adult	NRC (2001)	0.0069	56 to 67	Jersey, adult	NRC (2001)	
				0.044 to 0.070	Cattle (dairy)	U & S 1999	0.00102 to 0.00162				
chicken	unspecified	M	Older than 30 days					65	Breeding	U & S 1999	4.2618
								40	Juvenile (0 to 8 wk)	NRC (1994)	2.6226
chicken	unspecified	F	Older than 30 days	0.10 to 0.15	Immature (egg laying)	NRC (1994)	0.00656 to 0.00983	29 to 44	Mature (egg laying)	NRC 1994	1.9014 to 2.8849
				0.05 to 0.08	Mature (egg laying)	NRC (1994)	0.00316 to 0.00505	33 to 40	Immature (egg laying)	NRC 1994	2.0852 to 2.5275
								65	Breeding	U & S 1999	4.1071
								40	Juvenile (0 to 8 wk)	NRC (1994)	2.5275
chicken	domestic	BH	1 day	0.15	Juvenile (0 to 8 w)	NRC (1994)	0.0183	35	Juvenile, growing	U & S 1999	4.2701
								40	Juvenile (0 to 8 wk)	NRC (1994)	4.8801
chicken	domestic	BH	3 days	0.15	Juvenile (0 to 8 w)	NRC (1994)	0.0173	35	Juvenile, growing	U & S 1999	4.0386
								40	Juvenile (0 to 8 wk)	NRC (1994)	4.6155
chicken	domestic	BH	7 days	0.15	Juvenile (0 to 8 w)	NRC (1994)	0.0160	35	Juvenile, growing	U & S 1999	3.7368
								40	Juvenile (0 to 8 wk)	NRC (1994)	4.2707
chicken	domestic	BH	14 days	0.15	Juvenile (0 to 8 w)	NRC (1994)	0.0126	35	Juvenile, growing	U & S 1999	2.9322
								40	Juvenile (0 to 8 wk)	NRC (1994)	3.3511
chicken	domestic	BH	20 days	0.15	Juvenile (0 to 8 w)	NRC (1994)	0.0114	35	Juvenile, growing	U & S 1999	2.6625
								40	Juvenile (0 to 8 wk)	NRC (1994)	3.0429
chicken	domestic	BH	28 days	0.15	Juvenile (0 to 8 w)	NRC (1994)	0.0102	35	Juvenile, growing	U & S 1999	2.3870
								40	Juvenile (0 to 8 wk)	NRC (1994)	2.7279
dog	unspecified	M	weaning to 90 days								
dog	unspecified	M	90 days to 1 year								
dog	unspecified	M	1 year or older								
dog	unspecified	F	weaning to 90 days								
dog	unspecified	F	90 days to 1 year								
dog	unspecified	F	1 year or older								
dove	ringed turtle	B	0 days								
dove	ringed turtle	B	7 days								
dove	ringed turtle	B	14 days								
dove	ringed turtle	B	21 days								
dove	ringed turtle	B	28 days								
dove	ringed turtle	B	Adult								

[1] mg/kg bw/d calculated based on default body weights in Table 20 and algorithms for estimating food intake in Attachment A.

Table 7. Nutritional Requirements

Organism	Specific Organism Type	Sex	Age	Selenium Requirement mg/kg diet	Selenium Requirement Reported for	Selenium Reference	Selenium Requirement mg/kg bw/d[1]	Zinc Requirement mg/kg diet	Zinc Requirement Reported for	Zinc Reference	Zinc Requirement mg/kg bw/d[1]
duck	mallard	F	Adult	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0135				
duck	mallard	M	Adult	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0133				
duck	mallard	JV	10 days	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0210	60	Juvenile (0 to 2 w)	NRC (1994)	6.3031
duck	mallard	JV	30 days	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0158				
duck	white pekin	B	0 days	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0227	60	Juvenile (0 to 2 w)	NRC (1994)	6.8014
duck	white pekin	B	7 days	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0173	60	Juvenile (0 to 2 w)	NRC (1994)	5.2039
duck	white pekin	M	14 days	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0144	60	Juvenile (0 to 2 w)	NRC (1994)	4.3084
duck	white pekin	F	14 days	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0145	60	Juvenile (0 to 2 w)	NRC (1994)	4.3490
duck	white pekin	M	21 days	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0130				
duck	white pekin	F	21 days	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0131				
duck	white pekin	M	28 days	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0122				
duck	white pekin	F	28 days	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0124				
duck	white pekin	M	35 days	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0117				
duck	white pekin	F	35 days	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0118				
duck	white pekin	M	42 days	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0113				
duck	white pekin	F	42 days	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0115				
duck	white pekin	M	49 days	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0111				
duck	white pekin	F	49 days	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0113				
duck	white pekin	M	56 days	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0109				
duck	white pekin	F	56 days	0.2	Juvenile (0 to 2 wk)	NRC (1994)	0.0111				
eagle	bald eagle	M	Adult								
eagle	bald eagle	F	Adult								
gerbil	unspecified	M	weaning to 90 days	0.15	Growing	NRC (1995)	0.0177	25	Gerbil	NRC (1995)	2.9487
				0.4	Breeding	NRC (1995)	0.0472				
gerbil	unspecified	M	90 days to 1 year	0.4	Breeding	NRC (1995)	0.0427	25	Gerbil	NRC (1995)	2.6692
				0.15	Growing	NRC (1995)	0.0160				
gerbil	unspecified	M	1 year or older	0.15	Growing	NRC (1995)	0.0155	25	Gerbil	NRC (1995)	2.5876
				0.4	Breeding	NRC (1995)	0.0414				
gerbil	unspecified	F	weaning to 90 days	0.15	Growing	NRC (1995)	0.0183	25	Gerbil	NRC (1995)	3.0460
				0.4	Breeding	NRC (1995)	0.0487				
gerbil	unspecified	F	90 days to 1 year	0.4	Breeding	NRC (1995)	0.0438	25	Gerbil	NRC (1995)	2.7367
				0.15	Growing	NRC (1995)	0.0164				
gerbil	unspecified	F	1 year or older	0.15	Growing	NRC (1995)	0.0158	25	Gerbil	NRC (1995)	2.6366
				0.4	Breeding	NRC (1995)	0.0422				
guinea pig	unspecified	M	weaning to 90 days	0.15	Guinea pig	NRC (1995)	0.0117	20	Guinea pig	NRC (1995)	1.5658
guinea pig	unspecified	M	90 days to 1 year	0.15	Guinea pig	NRC (1995)	0.0105	20	Guinea pig	NRC (1995)	1.4028
guinea pig	unspecified	M	1 year or older	0.15	Guinea pig	NRC (1995)	0.0103	20	Guinea pig	NRC (1995)	1.3740
guinea pig	unspecified	F	weaning to 90 days	0.15	Guinea pig	NRC (1995)	0.0122	20	Guinea pig	NRC (1995)	1.6247
guinea pig	unspecified	F	90 days to 1 year	0.15	Guinea pig	NRC (1995)	0.0106	20	Guinea pig	NRC (1995)	1.4114
guinea pig	unspecified	F	1 year or older	0.15	Guinea pig	NRC (1995)	0.0105	20	Guinea pig	NRC (1995)	1.4000
hamster	golden Syrian	M	weaning to 90 days	0.2	Growing	NRC (1995)	0.0208				
hamster	golden Syrian	M	90 days to 1 year	0.2	Growing	NRC (1995)	0.0196				
hamster	golden Syrian	M	1 year or older	0.15	Golden Hamster	NRC (1995)	0.0144				
hamster	golden Syrian	F	weaning to 90 days	0.2	Growing	NRC (1995)	0.0209				
hamster	golden Syrian	F	90 days to 1 year	0.2	Growing	NRC (1995)	0.0194				
hamster	golden Syrian	F	1 year or older	0.4	Pregnancy and Lactation	NRC (1995)	0.0381				
hamster	Chinese & Djungarai	M	weaning to 90 days								
hamster	Chinese & Djungarai	M	90 days to 1 year								
hamster	Chinese & Djungarai	M	1 year or older								
hamster	Chinese & Djungarai	F	weaning to 90 days								
hamster	Chinese & Djungarai	F	90 days to 1 year								
hamster	Chinese & Djungarai	F	1 year or older								
hamster	unspecified	M	weaning to 90 days								
hamster	unspecified	M	90 days to 1 year								
hamster	unspecified	M	1 year or older								
hamster	unspecified	F	weaning to 90 days								
hamster	unspecified	F	90 days to 1 year								
hamster	unspecified	F	1 year or older								
horse	unspecified	B	> 2 year	0.1	Horse	U & S 1999	0.0023				

[1] mg/kg bw/d calculated based on default body weights in Table 20 and algorithms for estimating food intake in Attachment A.

Table 7. Nutritional Requirements

Organism	Specific Organism Type	Sex	Age	Selenium Requirement mg/kg diet	Selenium Requirement Reported for	Selenium Reference	Selenium Requirement mg/kg bw/d[1]	Zinc Requirement mg/kg diet	Zinc Requirement Reported for	Zinc Reference	Zinc Requirement mg/kg bw/d[1]
horse	unspecified	M	2 to 5 months	0.1	Horse	U & S 1999	0.0027				
horse	unspecified	M	5 to 12 months	0.1	Horse	U & S 1999	0.0025				
horse	unspecified	M	12 to 24 months	0.1	Horse	U & S 1999	0.0024				
mink	unspecified	M	weaning to 49 days					59	Growing	NRC (1982)	4.0390
mink	unspecified	F	weaning to 49 days					59	Growing	NRC (1982)	4.4619
mink	unspecified	M	> 1 year					66	Breeding	NRC (1982)	4.4026
mink	unspecified	F	> 1 year					66	Breeding	NRC (1982)	4.9717
mouse	BAF1	M	weaning to 90 days	0.15	Mouse	NRC (1995)	0.0203	10	Mouse	NRC (1995)	1.3519
mouse	BAF1	M	90 days to 1 year	0.15	Mouse	NRC (1995)	0.0197	10	Mouse	NRC (1995)	1.3146
mouse	BAF1	M	1 year or older	0.15	Mouse	NRC (1995)	0.0187	10	Mouse	NRC (1995)	1.2477
mouse	BAF1	F	weaning to 90 days	0.15	Mouse	NRC (1995)	0.0206	10	Mouse	NRC (1995)	1.3735
mouse	BAF1	F	90 days to 1 year	0.15	Mouse	NRC (1995)	0.0203	10	Mouse	NRC (1995)	1.3530
mouse	BAF1	F	1 year or older	0.15	Mouse	NRC (1995)	0.0192	10	Mouse	NRC (1995)	1.2824
mouse	B6C3F1	M	weaning to 90 days	0.15	Mouse	NRC (1995)	0.0191	10	Mouse	NRC (1995)	1.2706
mouse	B6C3F1	M	90 days to 1 year	0.15	Mouse	NRC (1995)	0.0185	10	Mouse	NRC (1995)	1.2337
mouse	B6C3F1	M	1 year or older	0.15	Mouse	NRC (1995)	0.0183	10	Mouse	NRC (1995)	1.2184
mouse	B6C3F1	F	weaning to 90 days	0.15	Mouse	NRC (1995)	0.0199	10	Mouse	NRC (1995)	1.3285
mouse	B6C3F1	F	90 days to 1 year	0.15	Mouse	NRC (1995)	0.0187	10	Mouse	NRC (1995)	1.2458
mouse	B6C3F1	F	1 year or older	0.15	Mouse	NRC (1995)	0.0187	10	Mouse	NRC (1995)	1.2477
mouse	deer mouse	M	Adult	0.15	Mouse	NRC (1995)	0.0207	10	Mouse	NRC (1995)	1.3784
mouse	deer mouse	F	Adult	0.15	Mouse	NRC (1995)	0.0209	10	Mouse	NRC (1995)	1.3910
mouse	unspecified	M	weaning to 90 days	0.15	Mouse	NRC (1995)	0.0196	10	Mouse	NRC (1995)	1.3071
mouse	unspecified	M	90 days to 1 year	0.15	Mouse	NRC (1995)	0.0190	10	Mouse	NRC (1995)	1.2699
mouse	unspecified	M	1 year or older	0.15	Mouse	NRC (1995)	0.0185	10	Mouse	NRC (1995)	1.2325
mouse	unspecified	F	weaning to 90 days	0.15	Mouse	NRC (1995)	0.0202	10	Mouse	NRC (1995)	1.3498
mouse	unspecified	F	90 days to 1 year	0.15	Mouse	NRC (1995)	0.0194	10	Mouse	NRC (1995)	1.2922
mouse	unspecified	F	1 year or older	0.15	Mouse	NRC (1995)	0.0190	10	Mouse	NRC (1995)	1.2643
pheasant	ring-necked	F	Adult					60	Ring-necked, Breeding (9	NRC (1994)	4.1598
pheasant	ring-necked	M	Adult					60	Ring-necked, Breeding (9	NRC (1994)	3.9339
owl	barn owl	M	Adult								
owl	barn owl	F	Adult								
pigeon	pigeon	F	Adult								
pigeon	pigeon	M	Adult								
pig	miniature	BH	Adult	0.05	Pig (lactating)	U & S 1999	0.0016				
pig	unspecified	BH	1 day								
pig	unspecified	BH	21 to 25 days								
pig	unspecified	BH	26 to 29 days								
pig	unspecified	BH	30 to 35 days								
pig	unspecified	BH	36 to 66 days								
pig	unspecified	BH	67 to 150 days								
pig	unspecified	BH	151 to 299 days								
pig	unspecified	BH	> 299 days								
pig	unspecified	F	Adult	0.05	Pig (lactating)	U & S 1999	0.0014				
quail	Japanese	F	Adult	0.2	Growing and breeding	NRC (1994)	0.0207	50	Breeding	NRC (1994)	5.1752
								25	Starting and growing	NRC (1994)	2.5876
quail	Japanese	M	Adult	0.2	Growing and breeding	NRC (1994)	0.0211	50	Breeding	NRC (1994)	5.2732
								25	Starting and growing	NRC (1994)	2.6366
quail	Japanese	BH	0 to 1 day								
quail	Japanese	BH	7 to 8 days					50	Breeding	NRC (1994)	5.1480
								25	Starting and growing	NRC (1994)	2.5740
quail	Japanese	BH	14 to 28 days	0.2	Growing and breeding	NRC (1994)	0.0200	50	Breeding	NRC (1994)	5.0099
								25	Starting and growing	NRC (1994)	2.5050
quail	Japanese	BH	29 to 59 days	0.2	Growing and breeding	NRC (1994)	0.0197	50	Breeding	NRC (1994)	4.9257
								25	Starting and growing	NRC (1994)	2.4628
quail	Japanese	BH	60 to 154 days	0.2	Growing and breeding	NRC (1994)	0.0196				
quail	bobwhite	F	Adult								
quail	bobwhite	M	Adult								
quail	bobwhite	JV	10 days								
quail	bobwhite	JV	30 days								

[1] mg/kg bw/d calculated based on default body weights in Table 20 and algorithms for estimating food intake in Attachment A.

Table 7. Nutritional Requirements

Organism	Specific Organism Type	Sex	Age	Selenium Requirement mg/kg diet	Selenium Requirement Reported for	Selenium Reference	Selenium Requirement mg/kg bw/d[1]	Zinc Requirement mg/kg diet	Zinc Requirement Reported for	Zinc Reference	Zinc Requirement mg/kg bw/d[1]
quail	bobwhite	BH	13 days								
rabbit	unspecified	M	weaning to 90 days								
rabbit	unspecified	M	90 days to 1 year								
rabbit	unspecified	M	1 year or older								
rabbit	unspecified	F	weaning to 90 days								
rabbit	unspecified	F	90 days to 1 year								
rabbit	unspecified	F	1 year or older								
rat	Fischer 344	M	weaning to 90 days	0.150 to 0.400	Rat	NRC (1995)	0.0140 to 0.0373	12 to 25	Rat	NRC (1995)	1.1187 to 2.3305
rat	Fischer 344	M	90 days to 1 year	0.150 to 0.400	Rat	NRC (1995)	0.0122 to 0.0326	12 to 25	Rat	NRC (1995)	0.9793 to 2.0403
rat	Fischer 344	M	1 year or older	0.150 to 0.400	Rat	NRC (1995)	0.0121 to 0.0323	12 to 25	Rat	NRC (1995)	0.9704 to 2.0218
rat	Fischer 344	F	weaning to 90 days	0.150 to 0.400	Rat	NRC (1995)	0.0149 to 0.0398	12 to 25	Rat	NRC (1995)	1.1954 to 2.4904
rat	Fischer 344	F	90 days to 1 year	0.150 to 0.400	Rat	NRC (1995)	0.0134 to 0.0357	12 to 25	Rat	NRC (1995)	1.0717 to 2.2328
rat	Fischer 344	F	1 year or older	0.150 to 0.400	Rat	NRC (1995)	0.0132 to 0.0352	12 to 25	Rat	NRC (1995)	1.0551 to 2.1982
rat	Long-Evans	M	weaning to 90 days	0.150 to 0.400	Rat	NRC (1995)	0.0132 to 0.0352	12 to 25	Rat	NRC (1995)	1.0566 to 2.2013
rat	Long-Evans	M	90 days to 1 year	0.150 to 0.400	Rat	NRC (1995)	0.0118 to 0.0314	12 to 25	Rat	NRC (1995)	0.9423 to 1.9631
rat	Long-Evans	M	1 year or older	0.150 to 0.400	Rat	NRC (1995)	0.0117 to 0.0311	12 to 25	Rat	NRC (1995)	0.9327 to 1.9430
rat	Long-Evans	F	weaning to 90 days	0.150 to 0.400	Rat	NRC (1995)	0.014 to 0.0373	12 to 25	Rat	NRC (1995)	1.1198 to 2.3329
rat	Long-Evans	F	90 days to 1 year	0.150 to 0.400	Rat	NRC (1995)	0.0125 to 0.0332	12 to 25	Rat	NRC (1995)	0.9969 to 2.0768
rat	Long-Evans	F	1 year or older	0.150 to 0.400	Rat	NRC (1995)	0.0124 to 0.0331	12 to 25	Rat	NRC (1995)	0.9938 to 2.0704
rat	Osborne-Mendel	M	weaning to 90 days	0.150 to 0.400	Rat	NRC (1995)	0.0131 to 0.0349	12 to 25	Rat	NRC (1995)	1.0456 to 2.1784
rat	Osborne-Mendel	M	90 days to 1 year	0.150 to 0.400	Rat	NRC (1995)	0.0116 to 0.0309	12 to 25	Rat	NRC (1995)	0.9281 to 1.9335
rat	Osborne-Mendel	M	1 year or older	0.150 to 0.400	Rat	NRC (1995)	0.0115 to 0.0306	12 to 25	Rat	NRC (1995)	0.9170 to 1.9103
rat	Osborne-Mendel	F	weaning to 90 days	0.150 to 0.400	Rat	NRC (1995)	0.0137 to 0.0366	12 to 25	Rat	NRC (1995)	1.0969 to 2.2852
rat	Osborne-Mendel	F	90 days to 1 year	0.150 to 0.400	Rat	NRC (1995)	0.0122 to 0.0325	12 to 25	Rat	NRC (1995)	0.9753 to 2.0318
rat	Osborne-Mendel	F	1 year or older	0.150 to 0.400	Rat	NRC (1995)	0.0121 to 0.0323	12 to 25	Rat	NRC (1995)	0.9704 to 2.0218
rat	Sprague-Dawley	M	weaning to 90 days	0.150 to 0.400	Rat	NRC (1995)	0.0130 to 0.0348	12 to 25	Rat	NRC (1995)	1.0428 to 2.1726
rat	Sprague-Dawley	M	90 days to 1 year	0.150 to 0.400	Rat	NRC (1995)	0.0116 to 0.0308	12 to 25	Rat	NRC (1995)	0.9252 to 1.9275
rat	Sprague-Dawley	M	1 year or older	0.150 to 0.400	Rat	NRC (1995)	0.0113 to 0.0301	12 to 25	Rat	NRC (1995)	0.9029 to 1.8810
rat	Sprague-Dawley	F	weaning to 90 days	0.150 to 0.400	Rat	NRC (1995)	0.0137 to 0.0365	12 to 25	Rat	NRC (1995)	1.0940 to 2.2792
rat	Sprague-Dawley	F	90 days to 1 year	0.150 to 0.400	Rat	NRC (1995)	0.0125 to 0.0333	12 to 25	Rat	NRC (1995)	1.000 to 2.0833
rat	Sprague-Dawley	F	1 year or older	0.150 to 0.400	Rat	NRC (1995)	0.0124 to 0.0331	12 to 25	Rat	NRC (1995)	0.9938 to 2.0704
rat	Wistar	M	weaning to 90 days	0.150 to 0.400	Rat	NRC (1995)	0.0135 to 0.0361	12 to 25	Rat	NRC (1995)	1.0821 to 2.2543
rat	Wistar	M	90 days to 1 year	0.150 to 0.400	Rat	NRC (1995)	0.0118 to 0.0315	12 to 25	Rat	NRC (1995)	0.9459 to 1.9706

[1] mg/kg bw/d calculated based on default body weights in Table 20 and algorithms for estimating food intake in Attachment A.

Table 7. Nutritional Requirements

Organism	Specific Organism Type	Sex	Age	Selenium Requirement mg/kg diet	Selenium Requirement Reported for	Selenium Reference	Selenium Requirement mg/kg bw/d[1]	Zinc Requirement mg/kg diet	Zinc Requirement Reported for	Zinc Reference	Zinc Requirement mg/kg bw/d[1]
~~rat~~	~~Wistar~~	~~M~~	~~1 year or older~~	0.150 to 0.400	Rat	NRC (1995)	0.0117 to 0.0311	12 to 25	Rat	NRC (1995)	0.9327 to 1.9430
rat	Wistar	F	weaning to 90 days	0.150 to 0.400	Rat	NRC (1995)	0.0143 to 0.0383	12 to 25	Rat	NRC (1995)	1.1475 to 2.3907
rat	Wistar	F	90 days to 1 year	0.150 to 0.400	Rat	NRC (1995)	0.0128 to 0.0341	12 to 25	Rat	NRC (1995)	1.0233 to 2.1318
rat	Wistar	F	1 year or older	0.150 to 0.400	Rat	NRC (1995)	0.0126 to 0.0337	12 to 25	Rat	NRC (1995)	1.0098 to 2.1037
rat	unspecified	M	weaning to 90 days	0.150 to 0.400	Rat	NRC (1995)	0.0133 to 0.0356	12 to 25	Rat	NRC (1995)	1.0668 to 2.2225
rat	unspecified	M	90 days to 1 year	0.150 to 0.400	Rat	NRC (1995)	0.0118 to 0.0314	12 to 25	Rat	NRC (1995)	0.9429 to 1.9644
rat	unspecified	M	1 year or older	0.150 to 0.400	Rat	NRC (1995)	0.0116 to 0.0310	12 to 25	Rat	NRC (1995)	0.9294 to 1.9362
rat	unspecified	F	weaning to 90 days	0.150 to 0.400	Rat	NRC (1995)	0.0137 to 0.0365	12 to 25	Rat	NRC (1995)	1.0956 to 2.2824
rat	unspecified	F	90 days to 1 year	0.150 to 0.400	Rat	NRC (1995)	0.0122 to 0.0326	12 to 25	Rat	NRC (1995)	0.9773 to 2.0359
rat	unspecified	F	1 year or older	0.150 to 0.400	Rat	NRC (1995)	0.0121 to 0.0323	12 to 25	Rat	NRC (1995)	0.9704 to 2.0218
sheep	Old Norse	M	Adult								
sheep	Old Norse	F	Adult	0.028 to 0.043	Female	U & S 1999	0.0010 to 0.0016				
sheep	Dala	M	Adult								
sheep	Dala	F	Adult	0.028 to 0.043	Female	U & S 1999	0.0009 to 0.0014				
sheep	Chun forest	BH	Juvenile	0.031 to 0.055	Juvenile	U & S 1999	0.0012 to 0.0021	17	Juvenile	NRC (1995)	0.6633
								18 to 33	Juvenile	NRC (1995)	0.7023 to 1.2876
sheep	Chun forest	M	Adult								
sheep	Chun forest	F	Adult	0.028 to 0.043	Female	U & S 1999	0.0009 to 0.0014				
sheep	domestic	B	1 week	0.031 to 0.055	Juvenile	U & S 1999	0.0011 to 0.0019	17	Juvenile	NRC (1995)	0.5890
				0.028 to 0.043	Female	U & S 1999	0.00097 to 0.00149	18 to 33	Juvenile	NRC (1995)	0.6236 to 1.1433
sheep	unspecified	BH	112 to 189 days	0.031 to 0.055	Juvenile	U & S 1999	0.00114 to 0.00202	17	Juvenile	NRC (1995)	0.6235
				0.028 to 0.043	Female	U & S 1999	0.00103 to 0.00158	18 to 33	Juvenile	NRC (1995)	0.6601 to 1.2102
sheep	unspecified	BH	189 to 224 days	0.031 to 0.055	Juvenile	U & S 1999	0.00110 to 0.00195	17	Juvenile	NRC (1995)	0.6041
				0.028 to 0.043	Female	U & S 1999	0.00099 to 0.00153	18 to 33	Juvenile	NRC (1995)	0.6396 to 1.1726
sheep	unspecified	BH	225 to 252 days	0.031 to 0.055	Juvenile	U & S 1999	0.00103 to 0.00183	17	Juvenile	NRC (1995)	0.5650
				0.028 to 0.043	Female	U & S 1999	0.00093 to 0.00143	18 to 33	Juvenile	NRC (1995)	0.5983 to 1.0968
sheep	unspecified	BH	> 252 days	0.028 to 0.043	Female	U & S 1999	0.00091 to 0.0014				
sheep	unspecified	F	Gestation	0.028 to 0.043	Female	U & S 1999	0.00090 to 0.00139				
shrew	short-tailed	M	Adult								
shrew	short-tailed	F	Adult								
sparrow	white-throated	B	Adult								
starling	starling	M	Adult								
starling	starling	F	Adult								
turkey	domestic	M	1 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0200	70	Juvenile (0 to 4 w)	NRC (1994)	7.0139
turkey	domestic	F	1 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0200	70	Juvenile (0 to 4 w)	NRC (1994)	7.0139
turkey	domestic	M	2 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0176	70	Juvenile (0 to 4 w)	NRC (1994)	6.1549
turkey	domestic	F	2 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0177	70	Juvenile (0 to 4 w)	NRC (1994)	6.1998
turkey	domestic	M	3 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0155	70	Juvenile (0 to 4 w)	NRC (1994)	5.4405
turkey	domestic	F	3 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0158	70	Juvenile (0 to 4 w)	NRC (1994)	5.5218
turkey	domestic	M	4 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0137	70	Juvenile (0 to 4 w)	NRC (1994)	4.8090
turkey	domestic	F	4 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0140	70	Juvenile (0 to 4 w)	NRC (1994)	4.9000
turkey	domestic	M	5 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0126				
turkey	domestic	F	5 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0129	65	Juvenile, Egg-laying (4 to	NRC (1994)	4.2059
turkey	domestic	M	6 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0119				
turkey	domestic	F	6 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0124	65	Juvenile, Egg-laying (4 to	NRC (1994)	4.0219
turkey	domestic	M	7 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0112				
turkey	domestic	F	7 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0118	65	Juvenile, Egg-laying (4 to	NRC (1994)	3.8502
turkey	domestic	M	8 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0107				

[1] mg/kg bw/d calculated based on default body weights in Table 20 and algorithms for estimating food intake in Attachment A.

Table 7. Nutritional Requirements

Organism	Specific Organism Type	Sex	Age	Selenium Requirement mg/kg diet	Selenium Requirement Reported for	Selenium Reference	Selenium Requirement mg/kg bw/d[1]	Zinc Requirement mg/kg diet	Zinc Requirement Reported for	Zinc Reference	Zinc Requirement mg/kg bw/d[1]
turkey	domestic	F	8 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0113	65	Juvenile, Egg-laying (4 to	NRC (1994)	3.6723
turkey	domestic	M	9 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0103	50	Juvenile (8 to 12 w)	NRC (1994)	2.5793
turkey	domestic	F	9 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0109	50	Juvenile (8 to 12 w)	NRC (1994)	2.7214
turkey	domestic	M	10 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0100	50	Juvenile (8 to 12 w)	NRC (1994)	2.4970
turkey	domestic	F	10 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0106	50	Juvenile (8 to 12 w)	NRC (1994)	2.6387
turkey	domestic	M	11 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0097	50	Juvenile (8 to 12 w)	NRC (1994)	2.4233
turkey	domestic	F	11 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0102	50	Juvenile (8 to 12 w)	NRC (1994)	2.5614
turkey	domestic	M	12 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0094	50	Juvenile (8 to 12 w)	NRC (1994)	2.3619
turkey	domestic	F	12 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0100	50	Juvenile (8 to 12 w)	NRC (1994)	2.4970
turkey	domestic	M	13 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0092	40	Juvenile (12 to 24 w)	NRC (1994)	1.8477
turkey	domestic	F	13 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0098	40	Juvenile (12 to 24 w)	NRC (1994)	1.9536
turkey	domestic	M	14 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0090	40	Juvenile (12 to 24 w)	NRC (1994)	1.8082
turkey	domestic	F	14 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0096	40	Juvenile (12 to 24 w)	NRC (1994)	1.9198
turkey	domestic	M	15 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0089	40	Juvenile (12 to 24 w)	NRC (1994)	1.7791
turkey	domestic	F	15 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0094	40	Juvenile (12 to 24 w)	NRC (1994)	1.8855
turkey	domestic	M	16 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0088	40	Juvenile (12 to 24 w)	NRC (1994)	1.7505
turkey	domestic	F	16 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0093	40	Juvenile (12 to 24 w)	NRC (1994)	1.8622
turkey	domestic	M	17 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0086	40	Juvenile (12 to 24 w)	NRC (1994)	1.7291
turkey	domestic	F	17 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0092	40	Juvenile (12 to 24 w)	NRC (1994)	1.8373
turkey	domestic	M	18 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0085	40	Juvenile (12 to 24 w)	NRC (1994)	1.7093
turkey	domestic	F	18 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0091	40	Juvenile (12 to 24 w)	NRC (1994)	1.8175
turkey	domestic	M	19 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0085	40	Juvenile (12 to 24 w)	NRC (1994)	1.6930
turkey	domestic	F	19 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0090	40	Juvenile (12 to 24 w)	NRC (1994)	1.7962
turkey	domestic	M	20 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0084	40	Juvenile (12 to 24 w)	NRC (1994)	1.6757
turkey	domestic	F	20 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0089	40	Juvenile (12 to 24 w)	NRC (1994)	1.7791
turkey	domestic	M	21 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0083	40	Juvenile (12 to 24 w)	NRC (1994)	1.6596
turkey	domestic	M	22 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0082	40	Juvenile (12 to 24 w)	NRC (1994)	1.6444
turkey	domestic	M	23 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0082	40	Juvenile (12 to 24 w)	NRC (1994)	1.6332
turkey	domestic	M	24 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0081	40	Juvenile (12 to 24 w)	NRC (1994)	1.6210
turkey	domestic	M	20 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0086	40	Juvenile (12 to 24 w)	NRC (1994)	1.7115
turkey	domestic	F	20 w	0.2	Breeding and laying (0 to 24 w)	NRC (1994)	0.0094	40	Juvenile (12 to 24 w)	NRC (1994)	1.8815
turkey	domestic	M	25 w								
turkey	domestic	F	25 w								
turkey	domestic	M	30 w								
turkey	domestic	F	30 w								
turkey	domestic	M	35 w								
turkey	domestic	F	35 w								
turkey	domestic	M	40 w								
turkey	domestic	F	40 w								
turkey	domestic	M	45 w								
turkey	domestic	F	45 w								
turkey	domestic	M	50 w								
turkey	domestic	F	50 w								
turkey	domestic	M	55 w								
turkey	domestic	F	55 w								
turkey	domestic	M	60 w								
turkey	domestic	F	60 w								
vole	prairie vole	BH	Adult								
vole	meadow vole	M	Adult								
vole	meadow vole	F	Adult								
finch	zebra finch	B	Adult								

[1] mg/kg bw/d calculated based on default body weights in Table 20 and algorithms for estimating food intake in Attachment A.

Number of Concentrations or Doses Tested

The total number of different concentrations or doses administered to the test organism is entered for the specific phase in the numeric field provided. The total number of concentrations (or doses) includes the control(s). For example, for a study which has four exposure groups of 5, 10, 20, 50 mg/kg and a valid control, the number 5 would be entered. A study must have at least two concentrations or doses (i.e., a valid control and one exposure group) to be used for derivation of Wildlife TRVs.

If a diet deficiency dose is reported for the chemical of concern (e.g. 0/0.2/1/2 mg/kg Selenium and 0.2 level is identified as the normal diet level), then code the normal diet (e.g., 0.2 mg/kg) as the control value (e.g., 0/1/2 mg/kg Se) and note the normal diet level (e.g., 0.2 mg/kg Se) in the control comments as the background level. The User should not include the diet deficient level in the number of total doses.

Test Concentrations or Test Doses with Units

The test ***concentration*** is the amount of contaminant to which the test organism is exposed per unit of exposure medium (water, diet or other medium). The test ***dose*** is the amount of contaminant administered to the test organism per unit of body weight in a specified period of time. Doses are preferred over concentrations for the purpose of establishing a wildlife TRV, but they are not reported in many toxicological studies.

If both dry and wet weight concentrations or doses are provided in the study, use the dry weight values, as this is the more conservative measurement. Tests in which doses varied over the exposure period after the initial dose level are coded only if the result is reported before a change in dose.

Information from gavage and capsule studies needs to be carefully examined to determine whether the contaminant was administered on a mg/kg body weight or mg/organism basis. In either case, the administered amount is a dose, and **should not** be entered as a concentration.

In cases where nursing offspring are exposed via the mother's milk, the concentration of contaminant in milk must be reported in order for the results to be coded as a juvenile lifestage effect. In most developmental and reproductive studies, exposure concentrations or doses are reported only for the mother and are not specifically estimated or reported for the offspring.

If only exposure concentrations are reported in the study, the User **should not** calculate the respective dose. The application is designed to calculate the dose automatically based on the reported concentrations and User-supplied body weight and ingestion rate parameters. The User should enter either the reported exposure concentrations **OR** doses, but not both, in the field. The concentrations or doses are separated by a forward-slash in the text box provided. The control(s) should be included as the first in the series (eg.: 0 / 5 / 10 / 20 / 50), and should always be zero. If a background level of contaminant is reported for the control, that information should be entered in the control comment field.

There is an exception to the rule to allow the system to calculate the dose. For studies that report different ingestion and body weights for each of the exposure levels, it is more accurate to calculate the doses for each exposure level and enter these in the system.

A separate data entry field allows the User to select the appropriate units for concentration (or dose) from the pull down list. The list of available concentration units and conversions to dose is shown in Table 7. The list of available dose units and conversion to standard units of mg/kg/day is shown in Table 8. A detailed description of the available units is provided under the description link to the right of the pull down list. The application assumes that doses which do not specify a unit of time (e.g., g/org or g/kg BW) are in or have been converted to units of **per day** prior to entry.

Table 8. Concentration Units and Conversions to Dose

Concentration Fields		Conversion to Concentration (C) as mg/kg or mg/L	Conversion to Dose as mg/kg BW/day
% in diet	percent in diet	multiply by 10000	Multiply C by the IR (kg/day) and divide by BW in kg
g/g	grams per g	multiply by 1,000,000	Multiply C by IR (kg/day) and divide by BW in kg
g/kg	grams per kilogram	multiply by 1,000	Multiply C by IR (kg/day) and divide by BW in kg
g/kg/d	grams per kilogram per day	multiply by 1,000	Multiply C by IR (kg/day) and divide by BW in kg
g/L	grams per liter	multiply by 1,000	Multiply C by IR (L/day) and divide by BW in kg
mg/g	milligrams per gram	multiply by 1,000	Multiply C by IR (kg/day) and divide by BW in kg
mg/kg	milligrams per kilogram	multiply by 1	Multiply C IR (kg/day) and divide by BW in kg
mg/kg/d	milligrams per kilogram per day	multiply by 1	Multiply C by IR (kg/day) and divide by BW in kg
mg/l	milligrams per liter	multiply by 1	Multiply C by IR (L/day) and divide by BW in kg
mg/ml	milligrams per milliliter	multiply by 1000	Multiply C by IR (L/day) and divide by BW in kg
ng/g	nanograms per gram	multiply by 0.001	Multiply C by IR (kg/day) and divide by BW in kg
ng/kg	nanograms per kilogram	multiply by 0.000001	Multiply C by IR (kg/day) and divide by BW in kg
ng/l	nanograms per liter	multiply by 0.000001	Multiply C by IR (L/day) and divide by BW in kg
ng/mg	nanograms per milligram	multiply by 1	Multiply C by IR (kg/day) and divide by BW in kg
ppb	parts per billion	multiply by 0.001	Multiply C by IR (kg/day) and divide by BW in kg
ppm	parts per million	multiply by 1	Multiply C IR (kg/day) and divide by BW in kg
ug/g	micrograms per gram	multiply by 1	Multiply C by IR (kg/day) and divide by BW in kg
ug/kg	micrograms per kilogram	multiply by 0.001	Multiply C by IR (kg/day) and divide by BW in kg
ug/l	micrograms per liter	multiply by 0.001	Multiply C by IR (L/day) and divide by BW in kg
ug/mg	micrograms per milligram	multiply by 1000	Multiply C by IR (kg/day) and divide by BW in kg
mg%	milligram percent by weight in diet or drinking water (i.e., mg/100 g diet or mg/100 mL drinking water)	multiply by 10	Multiply C by IR (L or kg/day) and divide by BW in kg
g%	gram percent by weight in diet or drinking water (i.e., g/100g diet or g/100mL drinking water)	multiply by 10,000	Multiply C by IR (L or kg/day) and divide by BW in kg

Table 9. Dose Units and Conversion to mg/kg BW/day		
Dose Fields*		**Conversion to mg/kg BW/day**
g/d	grams per day	multiply by 1,000 then divide by BW in kg
g/g BW	grams per gram body weight	multiply by 1,000,000
g/kg BW	grams per kilogram body weight	multiply by 1,000
g/kg BW /d	grams per kilogram body weight per day	multiply by 1,000
g/org	grams per organism	multiply by 1,000, divide by BW in kg
g/org/d	grams per organism per day	multiply by 1,000 then divide by BW in kg
kg/d	kilograms per day	multiply by 1,000,000 and divide by BW in kg
kg/org	kilograms per organism	multiply by 1,000,000, divide by BW in kg
kg/org/d	kilograms per organism per day	multiply by 1,000,000 and divide by BW in kg
mg/d	milligrams per day	divide by BW in kg
mg/g BW	milligrams per gram body weight	multiply by 1000
mg/g BW/d	milligrams per gram body weight per day	multiply by 1000
mg/kg BW	milligrams per kilogram body weight	multiply by 1
mg/kg BW/d	milligrams per kilogram body weight per day	multiply by 1
mg/org	milligrams per organism	divide by BW in kg
mg/org/d	milligrams per organism per day	divide by BW in kg
ng/g bw	nanograms per gram body weight	multiply by 0.001
ng/g bw/d	nanograms per gram body weight per day	multiply by 0.001
ng/kg BW	nanograms per kilogram body weight	multiply by 0.000001
ng/kg BW/d	nanograms per kilogram body weight per day	multiply by 0.000001
ng/org	nanograms per organism	multiply by 0.000001, divide by BW in kg
ug/org	micrograms per organism	multiply by 0.001, divide by BW in kg
ug/org/d	micrograms per organism per day	multiply by 0.001, divide by BW in kg
ug/kg BW	micrograms per kilogram body weight	multiply by 0.001
ug/kg BW/d	micrograms per kilogram body weight per day	multiply by 0.001

*The application assumes that doses which do not specify a unit of time (e.g., g/org or g/kg BW) are in or have been converted to units of **per day** prior to entry

In cases where the dose is not reported on a per day basis, the User must manually adjust the NOAEL and/or LOAEL for the duration between administered doses. For example, this conversion would be required in a study that administered the test material every other day or only on five out of seven days per week. An example of adjustment for duration is provided in the text box to the right. In cases where the reported concentration or dose units are not provided in the pull down list, the User must convert the reported results to one of the units available for selection.

Example for Conversion to Duration-Adjusted Concentration or Dose Units

A study reports a NOAEL dose administered as 10 ug per animal every two days. The User needs to convert this dose to any set of units that can be entered into the application. The User chooses to convert the dose to mg per day by multiplying the dose by a conversion factor for ug to mg of 0.001 and dividing by 2 to achieve an administered concentration of 0.005 mg **per day**. The User can now enter this result and select the mg per day units from the dose fields. The User should enter the conversions in detail in the comment field provided.

Are Absorbed Doses Reported?

An absorbed dose is defined as the amount of the exposure dose which is absorbed into the bloodstream. For example, if 80 percent of an exposure dose of 10 mg/kg BW/day is absorbed, the absorbed dose is 8 mg/kg BW/day. Absorbed doses are most often reported in toxicokinetic studies. They are not typically reported in the type of toxicity studies reviewed for inclusion in the TRV database.

The User selects "Yes" or "No" by checking the appropriate box. If "Yes" is selected, the User enters a brief description of how the absorbed doses were measured and reported in the text box provided. For example, the absorbed dose is estimated in some studies as the difference between administered dose or intake of the contaminant and the amount of contaminant or metabolite(s) excreted in feces and/or urine. When blood residue levels are reported, the User should select "No" for the Absorbed Doses check box, but enter the code "BL-RSDE" in the Absorbed Doses comments field.

Method of Contaminant Analysis

This field enables the User to indicate whether the tested concentrations (or doses) were quantified or if nominal (target) values are reported. The User selects the method of contaminant analysis from the pull down list provided. A detailed description of each method of analysis is available under the "Description" link to the right of the pull down list. The list of available contaminant analysis methods is shown in Table 10. The User selects "M" if the test concentrations (or doses) are quantified and the results are reported. The User selects "U" if nominal (target) values are reported or the method of contaminant analysis is not clear from the information provided in the study. To complete data entry for this field, the User needs to read the text of the paper carefully to determine whether exposure concentrations in the diet or drinking water are verified by contaminant analysis. Some studies that verify or measure the concentration or doses administered indicate in the text of the paper that analysis was performed, but do not report data for the measured dose levels. The method of contaminant analysis in this case is coded as unmeasured but verified (UX).

Table 10. Method of Contaminant Analysis Code Descriptions

Code	Method of Contaminant Analysis Description
Measured (M)	Exposure and/or observation concentrations or doses are verified by analytical methods and are reported as quantitative measured values.
Unmeasured (U)	Exposure and/or observation concentrations or doses are clearly identified as nominal values; or when the author does not report any information about whether the concentrations were measured or nominal, i.e. unmeasured is used as a default value when there is no information provided about the contaminant concentrations.
Unmeasured but Verified (UX)	Unmeasured exposure concentrations or doses are clearly identified as nominal values. The author reports that contaminant analysis was done to verify the nominal values, but analytical results are not reported in the article.

Measured Concentrations/Measured Doses with Units

The measured *concentration* is the amount of the contaminant in the exposure medium as determined by analysis. The measured *dose* is the amount of contaminant in the exposure vehicle as determined by analysis, expressed per unit of organism (amount of contaminant per unit body weight or per organism), and administered in a specified period of time. Doses are preferred over concentrations for derivation of Wildlife TRVs. If only concentrations are reported in the study, the User **does not** calculate the respective dose. The application is designed to calculate the dose automatically. The User enters either the measured concentrations **OR** doses (not both) for each of the treatment groups separated by a forward-slash in the text box provided. The control(s) are included first in the series. (eg.: 0 / 4.8 / 10.2 / 18.9 / 51.1). The User next selects the appropriate units associated with the measured concentrations or doses reported in the study from the pull down list. A detailed description of available units is provided under the description link to the right of the pull down list. The list of available units is shown in Table 8.

If both measured and nominal doses or concentrations are reported, the User enters the measured data only. If two different measured doses or concentrations are reported, the User enters the most conservative (lower value).

Application Frequency

The frequency of the exposure application is selected from the pull down list. For exposures in which there are "X" applications per a given time period, the User enters the number of applications in the numerical field provided. A detailed description of the selections available for application frequency is available under the description link to the right of the pull down list. The list of available application frequency selections is shown in Table 11a.

The User should note that this feature is NOT used to automatically calculate duration-adjusted doses (e.g. for doses administered every other day or five days per week). Duration-adjusted dose conversion must be performed manually by the User as described above.

Table 11a. Application Frequency Code Descriptions

ADL	Ad libitum; without limit or restraint
CON	Continual; non-pulsed
DLY	Daily; dosing regime not specified
EOD	Every other day
X	Dosed x time(s) per study period; e.g. 1 time = 1X
X per h	X times per hour
X per d	X times per day
X per w	X times per week
X per mo	X times per month
NR	Not Reported

Exposure Type

The exposure type represents the method by which the contaminant is administered to the test organism. Studies reporting results for oral exposures (diet, gavage, capsule and drinking water) are used exclusively for the purpose of establishing the Wildlife TRVs. Studies reporting an exposure type other than oral should have been excluded earlier in the process by application of the Literature Rejection Criteria described in Section 2. If the User discovers a study reporting results for non-oral exposures at this point of the data entry process, the information entered to this point is saved and the program exits to the "Data Entry" screen.

The following are special cases that might be encountered in coding exposure type and route. If the publication only indicates "diet" as an exposure, the User should choose "FD" (contaminant incorporated into the food) for the exposure route. If the exposure route changes within a test, the data are entered as a separate phase. Dosing of progeny via the mother's milk in reproductive and/or developmental studies is considered a food (FD) route, not a drinking water route. The User should note that the concentration of the contaminant of concern in mother's milk must be reported in order to code data for juvenile animals exposed via lactation.

Table 11b. Exposure Type Code Descriptions

Code	Description
FD	contaminant incorporated into the food
DR	contaminant incorporated into the drinking water
CH	choice of treated or untreated food or drinking water
GV	gavage
OR	other oral (e.g. capsule)

Route of Exposure

The route of exposure is directly related to the "Exposure Type" as described in Table 11b. Because the Wildlife TRVs are based on data from oral exposure studies, only codes specific to oral exposures are available in the pull down list.

Test Location

The User selects the appropriate location or setting in which the experiment is reported to be conducted from the pull down list. The list of test locations and definitions is provided in Table 12. The listed options are based on Rand (1995). If the test location is not specified, the User is instructed to select "NR" for Not Reported.

Table 12. Test Location Code Descriptions	
FieldA*	**Field, Artificial** - a simulated or artificial field study is conducted in "an artificially bounded system that is a simplification of a specific ecosystem", e.g., aviaries, pens, enclosures
FieldN*	**Field, Natural** - a natural field study is one "in which both the test system [...] and exposure to the stressor are "naturally" derived"; e.g., sprayed agricultural field or orchard plots, field surveys
FieldU*	**Field - Unable** to determine whether natural or artificial setting
Lab*	**Laboratory** indoor setting
NR*	**Not Reported** - unable to determine if laboratory or field

* Rand (1995)

Experimental Design

The purpose of the experimental design field is to capture information on the overall purpose and design of the study and to record important information that is not entered elsewhere. The User enters a statement on the objective of the experiment and a brief description of the experimental design in the text box provided. Care should also be taken to enter information on reproductive stages in this section. The experimental design should include, but is not limited to, information specific to the number of experiments conducted, dosing design, types of endpoints recorded, exposure durations (including the full duration of the experiment and interim time points), and statistical methods used to analyze the results. In studies with multiple phases this information may overlap information entered in the remarks field. In this case, enter "see remarks" for information that would be otherwise duplicated. An example of an experimental design entry is provided in the text box . Six main points to capture in this section: (1) Purpose of study; (2) Brief description of exposure (species, initial age, chemical, and duration of exposure); (3) time intervals when food consumption was monitored and dosing design; (4) time intervals when effect measurements were taken; (5) brief summary of effect groups that were measured during the study; (6) statistical analysis

Experimental Design - Example Text

Purpose of study was to assess the effect of cadmium on energy metabolism and tissue metal concentrations. Juvenile mallard drakes were exposed to cadmium in feed for 41 to 43 days. Food consumption was monitored for 3 day periods at biweekly intervals. Body weights were determined on days 0, 21, and 42. Terminal endpoints included selected organ weights; concentration of cadmium, copper, and zinc in liver and kidney; biochemical measurements in liver, blodd, kidney, blood, and urine. One-way ANOVA was used to test for significant effects. Duncan's multiple range test was used to test for significant effects in pair-wise comparisons among variables significantly affected by treatment.

If test methods are not reported in the current paper, but are reported in another paper being used for TRV, the User should enter the SSL-ID number for the paper containing the full description of test methods.

Test Conditions

A checklist of representative USEPA (2002) and ASTM (2001a-d) standard guidelines and reporting parameters for toxicological studies is provided as Table 13. Comparable toxicology study guidelines are also published by the U.S. Food and Drug Administration (USFDA, 2002) and the Organisation for Economic Development and Cooperation (OECD, 2002). These guidelines provide detailed descriptions of acceptable methodology for specific types of toxicity tests and are designed to generate consistently acceptable data for regulatory purposes. Studies conducted by the National Toxicology Program follow procedures comparable to those described in the USEPA guidelines, and should be considered guideline studies for purposes of deriving Wildlife TRVs..

For derivation of Wildlife TRVs, the objective in reviewing studies for guideline compliance is to determine whether the study authors used acceptable general methodology and animal husbandry procedures. A comparison of reporting parameters for 16 standard toxicological test protocols in Table 13 indicates that descriptions of procurement, animal care, characterization of the material tested are common to many standard guidelines. Therefore, reporting of information on these parameters in a study under evaluation for derivation of a TRV is considered a good indication that an acceptable approach to testing was used. The User evaluates the test conditions reported in the study by comparison to the parameters in Table 13. The User then chooses the appropriate description from the pull down list based on the test conditions and parameters reported in the study. If the test conditions are not reported in the current paper, but are reported in a separate paper being used for TRV, the User records the SSL-ID number for the source of the test methods in the Experimental Design comment field.

Experiment Sample Size

The experiment sample size should be summarized within this field. The user should denote the number of experimental animals per exposure dose or concentration as well as the controls. Any reduction in animal numbers during the experiment for reasons other than contaminant exposure should be denoted (losses from disease, handling, etc.,).

Table 13. Standard Study Guidelines and Reporting Parameters

Test Conditions	Test Protocols							
	Avian Dietary	**Avian Reproduction**	**90 day Oral Study in Rats**	**Chronic Oral Study in Rats**	**Subacute Dietary with Avian Species**	**Reproductive Studies with Avian Species**	**Developmental Toxicity in Rats and Rabbits**	**Reproduction and Fertility Study in Rats**
	OPPTS 850.2200	**OPPTS 850.2300***	**ASTM E 1372-95**	**ASTM E 1619-95**	**ASTM E 857-87**	**ASTM E 1062-86**	**ASTM E 1483-92**	**ASTM E 1062-86***
Source of Test Animals	X	X	X	X	X	X	X	X
Health of Test Animals	X	X	X	X	X	X	X	X
Age of Test Animals	X	X	X	X	X	X	X	X
Acclimation procedures	X	X	X	X	X	X	X	X
Assignment of animals to housing	X	X	X	X	X	X	X	X
Description of basal diet	X	X	X	X	X	X	X	X

Table 13. Standard Study Guidelines and Reporting Parameters								
Test Conditions	**Test Protocols**							
	Avian Dietary	**Avian Reproduction**	**90 day Oral Study in Rats**	**Chronic Oral Study in Rats**	**Subacute Dietary with Avian Species**	**Reproductive Studies with Avian Species**	**Developmental Toxicity in Rats and Rabbits**	**Reproduction and Fertility Study in Rats**
	OPPTS 850.2200	**OPPTS 850.2300***	**ASTM E 1372-95**	**ASTM E 1619-95**	**ASTM E 857-87**	**ASTM E 1062-86**	**ASTM E 1483-92**	**ASTM E 1062-86***
(including source, diluents and supplements)								
Nutrient content of diet	X	X	X	X	X	X	X	X
Water	X	X	X	X	X	X	X	X
Description of housing conditions (including size, type, material)	X	X	X	X	X	X	X	X
Temperature	X	X	X	X	X	X	X	X
Photoperiod	X	X	X	X	X	X	X	X
Lighting intensity	X	X	X	X	X	X	X	X
Humidity	X	X	X	X	X	X	X	X
Frequency, duration and methods of observation	X	X	X	X	X	X	X	X
General description of facilities	X	X	X	X	X	X	X	X
Description of test substance (including CAS number, purity, source, solvent or carrier, if used.)	X	X	X	X	X	X	X	X

* These test guidelines have recently been withdrawn without designation of replacement guidelines. Information on replacement guidelines will be included in future updates of this SOP as it becomes available.

The "Exposure Information" screen is now complete. The User now verifies that all data entered are correct and click on "Next" at the bottom of the screen to continue. The User **should not** use the browser back arrow to return to a previous data entry screen to correct errors. Using the back arrow results in deletion of information.

4.4 Endpoint Information

Exposure Duration and Units

The exposure duration for a specific endpoint is entered in the numeric field provided. For example, if contaminant exposure lasts for ten weeks, the User enters the number 10. For studies that report dosages (or concentrations) that are varied during the period of exposure, the User evaluates each unique dosage duration as a separate endpoint. The units associated with the exposure duration are selected from the pull down list provided. The list of available units is shown in Table 14. Studies of three days or less are considered acute and are not coded. Results reported for recovery periods (i.e., after exposure to the contaminant ceases) longer than one day

post-exposure are not coded. The exception to this rule are exposures during gestation. If exposures are for three or more days during gestation and the exposure ceases prior to birth, the data is recorded. In these cases, measurements of effects may be made from after birth to weaning in the offspring as long as the offspring are not dosed themselves. In some cases other more latent effects (>5 days post birth) may also be recorded. In the comment field the User should also record the exposure durations at which measurements of the endpoint was made (e.g. 1, 14 and 28 days).

Coding Gestational and Lactation Exposure Studies

Gestational Exposures

- Enter results for gestational exposures as Phases for the mother not the progeny
- Effects to the progeny are coded as reproductive endpoints (REP)
- Enter the exposure duration as the time chemical was administered during gestation. If exact time is not reported estimate based on gestation of test animal.

Lactation Exposures

- Enter results for lactation exposures as Phases separate for the mother and the progeny
- For the Phase for the mother effects to the progeny are coded as reproductive endpoints (REP)
- Enter the exposure duration as the time chemical was administered during lactation. If exact time is not reported estimate based on lactation time for the test animal.
- If it is possible to quantify exposures for progeny during lactation (i.e. the concentration of contaminant is measured in the mother's milk) then enter exposure duration as the time during lactation that the progeny was exposed.

The general rules for determining the exposure duration for each LOAEL/NOAEL are as follows:

1. The exposure duration coded should be for the first occurrence of an adverse effect. If no clear dose response exists at the shortest exposure duration, the User should move to the next exposure duration and reassess the dose-response relationship.

2.. The first (shortest) exposure duration reporting an adverse should be coded, as long as a clear dose response relationship is evident in the data collected at this time point. The User should record in the exposure duration comment field the exposure durations at which further (later) measurements are reported.

3. If none of the exposure durations are associated with an adverse effect, the longest exposure duration is selected.

Table 14. Exposure Duration and Age Units

s	second
mi	minute
h	hour
d	day
w	week
mo	month
yr	year
lf	lifetime
NR	Not Reported

Age with Units

The User enters the age of the test organism at the beginning of the study in the numeric field provided. For example, if the study reports that two-week-old ducklings are exposed at the start of the study, the User enters the number 2. The appropriate units are selected from the pull down list provided. The list of available age units is shown in Table 14. For designation between adult, juvenile, sexually mature, sexually immature, the user should assign the terms juvenile, adult and sexually mature according to the guidelines in Table 20. If the author identifies the test organisms as sexually mature or sexually immature this should be preferentially assigned.

Sex

The User selects the sex of the test organism from the pull down list provided. "M" is selected for male organisms. "F" is selected for female organisms. If organisms of both sexes are tested, "BH" is selected for "Both Male and Female". "NR" is selected for Not Reported if the sex of the test organisms is not specified.

Lifestage

The lifestage of the test organism is selected from the pull down list provided. The list of available lifestages is shown as Table 15. If the lifestage of the test organism is not reported then it can be estimated based on the reported body weight of the organism using the default body weight table. If the lifestage is not evident from the study, then "NR" is selected for Not Reported. The lifestage in which the result is reported is used when an organism is dosed through multiple lifestages. For example, if a female is exposed before mating, through gestation, and into lactation, the lactation (LC) lifestage is used. For laboratory rodents not exposed during gestation or lactation (rat, mouse, gerbil) the lifestage is labeled as juvenile if the age is less than one year.

The User should note that the pull down list for lifestage includes larvae (LV), nauplii (NU) and pupa (PU) lifestages for terrestrial insects. These are included for possible future applications and do not apply to the coding process for Wildlife TRVs.

Is This a Critical Lifestage?

A lifestage is defined as "critical" if it is critical to the survival and reproduction of the species. These lifestages may or may not be more sensitive to contaminant exposure. Exposures during these critical lifestages are preferred in the derivation of wildlife TRVs. Table 15 identifies the lifestages from the pull down list considered to be "critical". The User selects "Yes" or "No" by checking the appropriate box. If the lifestage is not specified, the User should check "NR" for Not Reported. There may be some cases where the User must use professional judgement to classify certain exposures as critical; these cases should be documented by comments. Critical exposure periods include those during lactation and gestation. When reproductive effects are reported for adult males or females, the lifestage is identified as critical.

Determination of whether a lifestage in avian studies is critical is done in the following way. The lifestage code LB is used for birds that are producing eggs during the study period. The lifestage LB is applied only to REP endpoints. This is by definition a critical lifestage that applies to all measured REP endpoints. The AD lifestage code is assigned to adult birds that are not laying eggs during the study period. The User should note that the relevant lifestage code for birds that stop producing eggs as a result of treatment is LB.

Table 15. Lifestage Code Descriptions

Code	Lifestage	Critical (Yes or No)
AD	adult	No
EG	egg	Yes
EM	embryo	Yes
IM	immature	Yes
JV	juvenile; includes yearling, fledgling, hatchling, weanling	Yes
LB	egg laying bird	Yes
MA	mature	No
NR	not reported	No
SA	subadult	No
SI	sexually immature	No
SM	sexually mature	No
YO	young	Yes
YY	young of year	Yes
GE	Gestational Exposures	Yes
LC	Lactation	Yes

Effect Group

Exposure of test organisms to contaminants can result in both positive and adverse effects. The reviewer should code only potentially adverse effects. Possible adverse effects that may be reported in toxicological studies are divided into nine Effect Groups. These groups were developed as part of the coding system devised for ECOTOX by EPA Duluth. The nine Effect Groups are accumulation (ACC), behavior (BEH), biochemistry (BIO), growth (GRO), mortality (MOR), pathology (PTH), physiology (PHY), population (POP), and reproduction (REP). A brief description of each effect group is provided under the description link to the right of the pull down list. The list of available Effect Groups is shown and described in Table 16.

The User selects the appropriate effect group from the pull down list provided. The User should consult both Tables 16 and 17, which provide the Effect Types and Measures that are specific to the Effect Groups to identify the appropriate Effect Group for the endpoint described in the study under review.

Table 16. Effect Group Descriptions	
Code	**Description**
ACC	**Accumulation**: a general term describing the process (bioaccumulation) by which contaminants are taken into and stored in plants or animals; bioaccumulation occurs when the rate of contaminant uptake exceeds the rate of elimination of the same contaminant; therefore accumulation measurements include uptake (UPTK) and elimination (ELIM) rates as well as actual tissue concentrations (RSDE); accumulation endpoints include the asymptotic threshold concentration (ATCN), bioconcentration factor (BCF) and bioaccumulation factor (BAF).
BEH	**Behavior:** a general term characterizing overt activity of an organism represented by three effect groups - avoidance (AVO), general behavior (BEH), and feeding behavior (FDB). Examples of behavioral measurements include stimulus avoidance (STIM), feeding changes (FDNG), general reproductive success (RSUC), and general activity levels (ACTV).
BIO	**Biochemical:** measurement of biotransformation or metabolism of chemical compounds, modes of toxic action, and biochemical responses in animals including three effect groups - chemical (CHM), enzyme (ENZ) and hormone (HRM) effects. Examples of biochemical measurements include chemical parameters such as cell (CCHG) or amino acid (AMAC) changes, enzyme parameters such as transferase, oxidase or hydrolase reactions, and measurements of hormone response levels. NOTE: Biochemical responses associated with heavy metal accumulation (e.g., zinc content) should not be coded. Responses that are indicative of a target tissue response (e.g., calcium content in bone) should be coded.
GRO	**Growth**: a broad category which encompasses measures of weight and length and includes effects on development (DVP), growth (GRO) and morphology (MPH). Morphology: measurements and endpoints which address the structure (bones) and form (organ/tissue development) of an organism, at any stage of its life history.
MOR	**Mortality:** measurements and endpoints where the cause of death is by direct action of the contaminant; e.g. an endpoint such as the LD50 estimates the lethal dose to 50% of the exposed population whereas measurements count the actual number dead or the percentage reduction within a population as a result of the exposure.
PTH	**Pathology:** measurements and endpoints regarding the causes, nature and effects of diseases and other abnormalities; the four effect groups include histology (HIS), immunotoxicity (IMM), intoxication (ITX), and gross wasting effects (GRS). Immunotoxicity, parasites and tumor effects are not coded for TRVs for the Eco-SSLs. Ovary and testes weight changes and histology are coded as REP effects. Other measures in reproductive organs are coded as PTH endpoints.
POP	**Population:** measurements and endpoints regarding a group of organisms or plants of the same species occupying the same area at a given time. Measurements include abundance, biomass, size and age class structures.
PHY	**Physiology:** measurements and endpoints regarding changes and activity in cells and tissues of plants or animals.
REP	**Reproduction:** measurements and endpoints to track the effect of toxicants on the reproductive cycle.

Effect Type

The available Effect Types are provided in a pull down list. The listed Effect Types are specific to the Effect Group previously selected by the User. The appropriate Effect Type for the endpoint is selected from the pull down list provided. The available selections are listed in Table 17.

Effect Measure

The effect measure is a variable used to determine organism response to contaminant exposure. The available Effect Measures in the pull down list correspond to the previously selected Effect Type. The User selects the Effect Measure from the pull down list. The measurement code "XXXX" denotes a temporary code that needs to be validated and assigned an acronym. The list of available selections is provided in Table 17. To avoid repetitive entries of NOAEL and

LOAEL values and to make the coding process more efficient, the User is instructed to record only **one result** per Effect Group. The most conservative result (lowest NOAEL or LOAEL) should be recorded. In cases where there are biochemical, behavior, or pathology changes reported in offspring then two reproduction endpoints can be coded one reporting these effects in the progeny and a second reporting effects for the parent(s).

Table 17. Effect Groups, Types and Measures	
BEHAVIOR EFFECT GROUP (BEH)	
(AVO) Avoidance Effect Type Measurement Code and Definition	
CHEM	contaminant avoidance
FOOD	food avoidance
STIM	stimulus avoidance
WATR	water avoidance
(BEH) General Behavior Effect Type Measurement Code and Definition	
ACTP	accuracy of learned behavior
ACTV	activity, general
AGGT	aggression
AMBU	ambulatory/circadian rhythm
EQUL	balance and equilibrium
GBHV	behavioral changes
LOCO	distance
DPLY	displaying behavior
DRMT	dormant, adverse condition
FRZG	freezing behavior
GBHV	general behavior
GPRD	general production
INST	induced sleeping time
NMVM	number of movements
NVOC	number of vocalizations
RRSP	righting response
RSPT	response time to stimulus
VCLF	visual cliff
(FDB) Feeding Behavior Effect Type Measurement Code and Definition	
BGNB	begging behavior
CAIN	caloric intake
FCNS	food consumption
FDNG	feeding behavior

Table 17. Effect Groups, Types and Measures	
FEFF	feeding efficiency
FSTR	food storage
FTIM	feeding time
GFDB	general feeding behavior
WCON	water consumption
BIOCHEMISTRY EFFECT GROUP (BIO)	
(CHM) Biochemical Effect Type Measurement Code and Definition	
5HAA	5-hydroxyindole acetic acid
AABA	alpha-aminobutyric acid
ALAN	alanine
ALBM	albumins
ALBE	albumen energy
AMAC	amino acids, general term
AMMO	ammonia
AMNH	p-amino hippurate
ANBC	aniline binding capability
ARGI	arginine
ASCA	ascorbic acid
ASHC	ash content
ASIS	amyloidosis
ASPA	apartate
ATPT	adenosine triphosphate
B2MG	beta2-microglobulin
BASO	basophil
BIOT	biotin content
BUNT	blood urea nitrogen
CALC	calcium
CAPH	calcium/phosphorus ratio
CCHG	cell changes
CHLN	choline
CHLR	chloride
CHOL	cholesterol
CREA	creatinine
DISC	dethylsuccinate hdyrolysis
DTBL	direct bilirubin (conjugated)
EOSN	eosinophil
ERTH	erythoroblasts
ESAA	amino acids, essential
FECO	iron content (do not code)
FEPR	free erythrocyte protoporphyrins
FFTA	fatty acids, free
GBCM	general biochemical
GLCN	glycine
GLTH	glutathione
GLUC	glucose
GLYC	glycogen

Table 17. Effect Groups, Types and Measures	
GMIN	glutamine
HEME	heme content
HEMT	general hematology
(CHM) Biochemical Effect Type Measurement Code and Definition	
HIST	histidine
HMCT	hematocrit (anemia)
HMGL	hemoglobin
IBIL	indirect bilirubin (free)
ILEU	isoleucine
LACT	lactate
LCTA	lactic acid
LEUC	leucine
LEUK	leukocytes
LIPD	lipid
LMPH	lymphocyte
LPSA	lipid soluble antioxidants
LYSI	lysine
MCHC	mean corpuscular hemoglobin
MCPR	microsomal proteins
MCPV	mean corpuscular volume
METH	methionine
MONO	monocyte
NADP	nicatinamide-adenine dinucleotide phosphate, reduced
NEAA	amino acides, nonessential
NEFA	fatty acids, nonesterified
NEUT	neutrophil
ORNI	ornithine
OSRS	osmotic resistance/RBC
PCLV	packed cell volume
PHPH	pH
PHEN	phenyalanine
PPHT	phosphate
PHSP	phosphatide phosphorus
PCON	phosphorus
PHST	phospholipid content, total
PORP	porphyrin
KCON	potassium
PRTO	protoporhyrin
PYRV	pyruvate
RGSH	reduced gluthione
NPSH	nonprotein sulfhydryl
RBCE	red blood cell
RBVL	relative blood volume (volume/100g body weight)
RETI	reticulocytes
SERI	serine
NACO	sodium
SOMC	somatomedin C

Table 17. Effect Groups, Types and Measures	
SPLO	splenocytes
SRTN	serotonin
TEAM	tetraethylammonium
(CHM) Biochemical Effect Type Measurement Code and Definition	
TFAA	amino acids, total free
THBA	thiobarbituric acid
THIA	thiamine
THRE	threonine
THRM	thrombocytes
TLBL	bilirubin, total
PRTL	protein, total
TRIB	tributyrin
TRIG	triglycerides
TYRO	tyrosine
TRYP	tryptophan
TTAA	amino acids, total
TWBC	white blood cell count, total
UBWB	white blood cell, undifferentiated blasts
UREA	urea
URIC	uric acid
VALI	valine
VTD3	vitamin D3
VTMA	vitamin A
ZNPR	zinc protoporphyrin
(ENZ) Enzyme Effect Type Measurement Code and Definition	
20HB	2-OH biphenyl hydroxylase
40HB	4-OH biphenyl hydroxylase
450R	Cyt P450 reductase
DHYD	NADPH dehydrogenase
AATT	alanine aminotransferase
ACHE	acetylcholinesterase
ACPH	acid phosphatase
AEPX	aldrin epoxidase
AHHD	aryl hydrocarbon hydrolase
AHDX	aniline hydroxylase
ALAD	(delta) -aminolevulinic acid dehydrogenase
ALAS	(gamma) y-ALA synthetase
ALDO	aldolase
ALPH	alkaline phosphatase
ANAE	alpha naphthyl acetat esterase
APND	aminopyin n-demethylase
ATRP	alanine transpeptidase
ASAT	aspartate aminotransferase
BAPH	benzo(a)pyrene hydroxylase
BCHE	buterylcholinesterase
BCOD	butoxycoumurin O-dealkylase
BHXA	benzpyrene hydroxylase

Table 17. Effect Groups, Types and Measures	
BPND	benzphetamine-n-demethylase
BROD	benzylresorufin O-deethylase
CAAH	carbonic anhydrase
(ENZ) Enzyme Effect Type Measurement Code and Definition	
CACA	choline acetyltransferase
CATP	calcium ATPase
CYB5	cytochrome B-5
CCOX	cytochrome C-oxidase
CEST\	chloinesterase
CRKI	creatine kinase
NCCR	NADPH cytochrome C reductase
EPHY	epoxide hydrase
ECOD	ethoxycoumurin O-deethylase
EROD	7-ethoxyresorufin O-deethylase
ESTE	esterase
FDPA	fructos-diphosphate aldolase
GENZ	general enzyme
G6PD	glucose-6-phosphate dehydrogenase
GGTR	(gamma) Y-glutamyltransferase
GLAD	glutamic acid dehydrogenase
GLPX	gluathione peroxidase
GLRE	gluthione reductase
GLTR	glucouronyl transferase
GOTR	glutamic-oxaloacetic transaminase
GPTR	glutamic pyruvic transaminase
GSTR	glutathione S-transferase
HXBH	hexobarbital hydroxylase
LADH	lactate dehydrogenase
LDMD	lactate dehydrogenase/malic dehydrogenase ratio
MADH	malic dehydrogenase
MCOD	methoxycoumarin O-dealkylase
MG6P	microsomal glucose 6-phosphatase
MAOA	mono amino oxidase
MGAT	magnesium ATPase
NKAT	sodium potassium ATPase
ORCT	ornithine carbamoyl transferase
P450	cytochrome P450 proteins
PBES	phenyl benzoate esterase
PBHD	pentobarbital hydroxylase
PCOD	propoxycoumarin O-dealkylase
PNAD	p-nitroanisole demethylase
PROD	pentylresorufin O-deethylase
SBDH	sorbitol dehydrogenase
(ENZ) Enzyme Effect Type Measurement Code and Definition	
SCDH	succinate dehydrogenase
SGOT	serum glutamate oxalo aetate transaminase
SGPT	serum glutamic pyruvic transaminase

Table 17. Effect Groups, Types and Measures	
THTR	thiotransferase
TRIE	triacetin esterase
(HRM) Hormone Effect Type Measurement Code and Definition	
ANDR	androgen
CORT	corticosterone
CRTS	cortisol
DOPA	dopamine
EPIN	epinephirine
ESDL	17-beta estradiol
ESTR	estrogen
FOSH	follicle stimulating hormone
GHRM	general hormone
GTHH	growth hormone
GHRM	hormone, changes in
LUTH	luteinizing hormone
NORE	norephinephrine
PRGS	progesterone
TSTR	testosterone
THYR	thyroxine
TRII	tridothyronine
Growth Effect Group (GRO)	
(DVP) Development Effect Type Measurement Code and Definition	
EMDV	embryo development
FLDG	fledged/female or /brood
GDPV	general development
LRGN	limb regeneration
WEAN	weaned
(GRO) Growth Effect Type Measurement Code and Definition	
BODL	body length changes - non-adult organisms only (see PTH GRS for adults)
BDWT	body weight changes - non-adult organisms only (see PTH GRS for adults)
GGRO	general growth
(MPH) Morphology Effect Type Measurement Code and Definition	
COSC	caudal ossification center
CRLT	crown-rump length
FRLT	feather length
GMPH	general morphological changes
HULT	humerus length
MOSC	metacarpal ossification center
MUSC	muscle changes
OVLT	oviduct length
RULT	radius-ulna length
SOSC	sternal ossification center

Table 17. Effect Groups, Types and Measures	
(MPH) Morphology Effect Type Measurement Code and Definition	
SRIB	supernumerary ribs
TRLT	tarsus length
TELT	testis length
TTLT	tibiotarsus length
MORTALITY (MOR) EFFECT GROUP	
(MOR) Mortality Effect Type Measurement Code and Definition	
GMOR	general mortality
LFSP	lifespan
MDTH	mean time of death
MORT	mortality
SURV	survival
TDTH	time to death
TKNO	knockdown
PATHOLOGY (PTH) EFFECT GROUP	
(GRS) Gross Wasting Effect Type Measurement Code and Definition	
BODL	body length changes - adult organisms only (see GRO GRO for non-adults (jv, ma, sm, etc.)
BDWT	body weight changes - adult organisms only (see GRO GRO for non-adults (jv, ma, sm, etc.)
(ORW) Organ Weight Effect Type Measurement Code and Definition	
ORWT	organ weight changes
SMIX	organ weight in relationship to body weight
(HIS) Histology Effect Type Measurement Code and Definition	
ARTS	arteriosclerosis
CTYP	percent cell type
EDMA	edema
ENCP	encephalopathy
GHIS	histological changes, general
GLBM	glomerular basement membrane
GLSN	gross lesions
HEMR	hemorrhage
HYPL	hyperplasia
IIBD	intranuclear inclusion bodies
NCRO	necrosis
NPHR	nephrosis
TFLR	tissue fluorescence in UV light
USTR	ultrastructural changes
(ITX) Intoxication Effect Type Measurement Code and Definition	
ANOR	anorexia
ATAX	ataxia
CONV	convulsions
GITX	general intoxication
IMBL	immobile
INCO	incoordination
GITX	intoxication, general
PARL	paralysis
TINT	time to signs of intoxication
TREM	tremors

Table 17. Effect Groups, Types and Measures	
POPULATION (POP) EFFECT GROUP	
(POP) Population Effect Type Measurement Code and Definition	
PBMS	biomass or weight for total population
DVRS	diversity and evenness
GPOP	general population effect
INDX	index to population size, count, number
ABND	number of animals/population and population density (N/area)
NCHG	population change (change in N/change in time)
RCPR	recapture ratio
SEXR	sex ratio
TRAP	trappability
PHYSIOLOGY (PHY) EFFECT GROUP	
(PHY) Physiology Effect Type Measurement Code and Definition	
ADPO	oxidative phosphorylation
BLPR	blood pressure
BTMP	body temperature
CRDY	crop dysfunction
DIFD	digestibility of food
BDVL	blood volume
EECG	electroencephalogram
EXCR	excretion rate
FDCV	food conversion efficiency
GPHY	general physiology
GLFR	glomular filtration rate
HTRT	heart rate
HYDR	hydration
NRGM	metabolizable energy
META	metabolic rate
RPRT	respiratory rate
OSMO	serum/plasma osmolality
PRIN	PR intervals
IRRI	skin irritation
THRG	thermoregulation
PROT	Prothrombin time
REPRODUCTION (REP) EFFECT GROUP	
(REP) Reproduction Effect Type Measurement Code and Definition	
ABNM	abnormal
BEFF	breeding efficiency
BNDG	pair bonding nesting behavior
COUR	courtship behavior
CYNG	care of young, nest attentiveness
DEYO	death of young
EGPN	eggs per nest
FERT	fertility
GREP	general reproduction
GIDX	gestation index

Table 17. Effect Groups, Types and Measures	
(REP) Reproduction Effect Type Measurement Code and Definition	
GSTT	gestation time
HTCH	hatch
LACG	lactating
NANT	nests abandoned
NCLU	corpus lutea, number of
NDAY	number of days between eggs laid
NINC	number of nests incubated
NOPN	number of organisms per nest
NSNT	successful nests
NSTI	nest initiation
NSTS	number of active nests
NTSZ	nest size
NUNT	unsuccessful nests
OBRD	open brood
ODVP	offspring development
OEGP	onset of egg production
OHIS	offspring histology
ORWT	reproductive organ weight
OTHR	other; use this to code any effects (pathology, biochemistry, etc.) reported in offspring of contaminant-exposed mothers
OVRT	ovulation rate
PBEH	progeny behavior
PIPD	pipped
PLBR	pairs with litter or brood
PRFM	pregnant females in a population
PROG	progeny counts/numbers
PRWT	progeny weight (TBWT, LTWT)
PVOP	premature or delayed vaginal opening
RBEH	reproductive behavior changes
SBRD	sealed brood
RHIS	reproductive organ histology
RPRD	reproductive capacity
RSEM	resorbed embryos
RSUC	reproductive success (general)
SPCL	sperm cell counts
SPCV	sperm cell viability
TEDG	testes degeneration
TERA	teratogenic measurements
TEWT	testes weight
TPRD	total production
(EGG) EGG Effect Type Measurement Code and Definition	
ALWT	albumen weight
CRAK	cracked eggs
EGVL	egg volume
EGWT	egg weight
EQUA	egg quality

Table 17. Effect Groups, Types and Measures	
ESIN	eggshell index
(EGG) EGG Effect Type Measurement Code and Definition	
ESLT	eggshell length
ESQU	eggshell quality
ESTH	eggshell thicknes
ESWD	eggshell width
ESWT	eggshell weight
FTEG	fertile egg
GEGG	general egg effects
SHLL	percent shell
SHSZ	shell size
SFYK	soft yolk
YOLK	yolk, percent
YKWT	yolk weight

Response Site

The response site is the specific location (e.g., organ or tissue) where an effect is observed. The response site for mortality (MOR) or behavioral (BEH) effects is not applicable and whole organism should be selected. The response site that is specific to the endpoint is selected from the pull down list. The list of available selections is shown in Table 18. If the response site is not reported, "NR" is selected for Not Reported.

Table 18. Response Sites and Codes			
Code	**Response Site**	**Code**	**Response Site**
AG	Accessory Gland	MK	Milk, lactating females
AD	Adipose Tissue	MT	Multiple Tissue/Organs
AR	Adrenal Gland	MU	Muscle
AS	Air Sac	MB	Muscle+Bone
AL	Albumen (egg white)	MO	Mucous
AT	Alimentary Tract	NG	Nasal Gland
AF	Amniotic Fluid	NE	Nervous Tissue
AP	Appendages	NK	Neck
BI	Bile	NR	Not Reported
BL	Blood	OL	Olfactory
BV	Blood Vessel	OV	Ovaries
BO	Bone	OD	Oviduct
BM	Bone Marrow	PS	Pancreas
BR	Brain	PE	Penis
BT	Breast	PI	Pituitary Gland
BU	Bursa	PC	Placenta
CA	Cartilage	PL	Plasma
CH	Cord, spinal	PG	Prostate Gland
CL	Claw	PR	Proventriculus
CG	Cloacal gland	PY	Progeny
CO	Collagen	RC	Rectum
CR	Crop	RT	Reproductive Tissue

Table 18. Response Sites and Codes			
Code	**Response Site**	**Code**	**Response Site**
DG	Digestive Gland	SV	Seminal Vesicle
DT	Digestive Tract	SE	Sensory Organs
EG	Egg	SR	Serum
EU	Egg Cuticle	SN	Skeleton
EM	Embryo	SK	Skin, Epidermis
EN	Entrails	SG	Shell Gland
ER	Erythrocyte	SL	Shell
ES	Esophagus	SM	Sperm
EY	Eye	SP	Spleen
FE	Feathers	SH	Stomach
FM	Femur	ST	Soft Tissue
FO	Foot	SX	Submaxillary Gland
FT	Fetus	TA	Tail
GB	Gall Bladder	TE	Testes
GT	Gastrointestinal Tract	TG	Thigh muscle
GZ	Gizzard	TH	Teeth
GO	Gonads	TB	Tibia
HA	Hair	TI	Tissue
HD	Head	TS	Thymus
HE	Heart	TY	Thyroid
HM	Humerus	UB	Urinary Bladder
HG	Harderian Gland	UR	Urine
HY	Hypothalamus	UT	Uterus
IN	Intestinal Tract	VA	Vagina
KI	Kidney	VD	Vas Deferens
LD	Lipid, Fat	VE	Vertebra
LG	Leg	VI	Viscera
LI	Liver	WI	Wings
LU	Lungs	WO	Whole Organism
MM	Mammary Tissue	YO	Yolk
MS	Mesenteric Lymph Node	XX	Temporary code, requires validation
MC	Microsome		

Endpoint Comments

The endpoint comment field allows the User to enter specific notes concerning the selected endpoint. In cases where multiple effect types are reported, the User records only one measurement and response site. The User enters the rationale for selection of a particular endpoint for data entry in the comments field. The comment field is also used to record other effect types, measurements, and/or response sites in the same effect group that are not chosen for coding. Abbreviations are used as much as possible in the comment field.

Identify the NOAEL and or LOAEL

The User is required to review each toxicological study and to identify No Observed Adverse Effect Level (NOAEL) and/or Lowest Observed Adverse Effect Level (LOAEL) values. The NOAEL is defined as the highest concentration (or dose) used in a study for which there is no

statistically significant adverse effect observed in the test organism. The LOAEL is defined as the lowest concentration (or dose) at which a statistically significant adverse effect is observed in contaminant-exposed organisms when compared to controls. The identification of the NOAEL and LOAEL is the most critical step in the data entry process, as these values will be ultimately be used to derive the Wildlife TRVs.

It is important to note that the NOAEL and LOAEL are endpoint specific. For example, the selected LOAEL for a growth endpoint may be 5.7 mg/kg BW/day whereas the LOAEL for a pathological endpoint may be 2.3 mg/kg BW/day.

Publications or documents which report studies of interest to the regulatory community may identify both a NOAEL and a LOAEL, only a NOAEL, or only a LOAEL. In cases where values are identified by the study author, this fact should be noted in the NOAEL/LOAEL comments field. The User should note NOAEL and LOAEL values are often reported only for the most sensitive endpoint in the study. If NOAEL and/or LOAEL values are identified by the study authors, these are considered to be the default values for entry into the TRV database. However, NOAEL and LOAEL values identified by the study authors should be carefully reviewed by the User for consistency with TRV coding guidelines.

Many publications, particularly those reporting basic toxicological research, do not identify NOAEL or LOAEL values. In these cases, the User must determine whether there are sufficient data available to determine NOAEL and/or LOAEL values. Four general cases are possible for data adequacy:

- The data have been analyzed using appropriate statistical methods
- The data have been analyzed, but the statistical methods are not appropriate
- No statistical analysis was performed, but sufficient data are available to perform an independent analysis
- No statistical analysis was reported and insufficient data are available to perform an independent analysis

The process of identifying a NOAEL and/or LOAEL begins by determining whether statistical analysis of the data was performed. This may be obvious from presentation of data in summary tables. However, the User should be prepared to carefully examine the text in the methods section, text of the results section, and footnotes in data tables for information on statistical analysis and results. In cases were no statistically significant results were observed, the only indication that statistical analysis was performed may be a description provided in the methods section. If an appropriate statistical analysis has been performed, the User applies the general rules below to identify NOAEL and/or LOAEL values.

The general rules for determining each LOAEL/NOAEL and their exposure durations are as follows:

1. The User identifies a NOAEL in the following cases where: 1) there are sporadic, statistically significant differences, but no clear dose response (e.g., a statistically significant difference is

reported at a low or mid dose but not at higher doses); and/or 2) there is anecdotal information to suggest that the apparent difference is a statistical artifact rather than a real effect. Statistical significance must be at least a p value of 0.10 or less.

2. In individual studies which report results at multiple time points, the exposure duration coded should be the first (earliest) occurrence of an adverse effect. The concentration or dose at which the adverse effect occurs is the LOAEL. If a clear dose-response relationship is not evident at the shortest exposure duration, the User examines data for the subsequent exposure durations in a stepwise manner to identify the LOAEL.

3. When selecting among multiple effect measures for the same effect type, the first (shortest) exposure duration resulting in the lowest LOAEL should be coded, provided a clear dose response relationship is evident.

4. If there is no adverse effect reported and/or a dose-response relationship is not evident, the User selects the highest dose (or concentration) at the longest duration as a NOAEL value.

The User should carefully review the methods and results sections and footnotes of the data summary tables before making a determination that statistical analysis was not conducted.

The following examples are provided to assist reviewers in properly assigning NOAEL and LOAEL values and the corresponding exposure durations:

Example 1

Duration\Doses	10 mg/kg/d	20 mg/kg/d	30 mg/kg/d	TRV Duration NOAEL/LOAEL
1 week	no	no	no	2 week LOAEL 10
2 weeks	sig	sig	sig	
3 weeks	no	no	no	

Example 2

Duration\Doses	10 mg/kg/d	20 mg/kg/d	30 mg/kg/d	TRV Duration NOAEL/LOAEL:
1 week	no	no	sig	1 week NOAEL 20; LOAEL 30
2 weeks	no	sig	no	
3 weeks	no	no	sig	

Example 3

Duration\Doses	10 mg/kg/d	20 mg/kg/d	30 mg/kg/d	TRV Duration NOAEL/LOAEL:
1 week	no	sig	no	2 week NOAEL 20 LOAEL 30
2 weeks	no	no	sig	
3 weeks	no	sig	no	

Example 4

Duration\Doses	10 mg/kg/d	20 mg/kg/d	30 mg/kg/d	TRV Duration NOAEL/LOAEL:
1 week	sig	no	no	3 week NOAEL 20 LOAEL 30
2 weeks	no	sig	no	
3 weeks	no	no	sig	

Example 5

Duration\Doses	10 mg/kg/d	20 mg/kg/d	30 mg/kg/d	TRV Duration NOAEL/LOAEL:
1 week	no	no	sig	1 week NOAEL 20 LOAEL 30
2 weeks	no	sig	no	
3 weeks	sig	no	no	

Example 6

Duration\Doses	10 mg/kg/d	20 mg/kg/d	30 mg/kg/d	TRV Duration NOAEL/LOAEL:
1 week	no	no	no	3 week NOAEL 30
2 weeks	no	no	no	
3 weeks	no	no	no	

Example 7

Duration/Doses	10 mg/kg/d	20 mg/kg/d	30 mg/kg/d	TRV Duration NOAEL/LOAEL:
1 week	no	sig	no	3 week NOAEL 30 (No dose response)
2 weeks	no	sig	no	
3 weeks	sig	no	no	

Example 8

Duration\Doses	10 mg/kg/d	20 mg/kg/d	30 mg/kg/d	TRV Duration NOAEL/LOAEL:
1 week	no	sig	no	3 week NOAEL 30 (No dose response)
2 weeks	no	sig	no	
3 weeks	no	no	no	

Example 9

Duration\Doses	10 mg/kg/d	20 mg/kg/d	30 mg/kg/d	TRV Duration NOAEL/LOAEL:
1 week	no	sig	no	3 week NOAEL 30 (No dose response)
2 weeks	no	sig	no	
3 weeks	no	sig	no	

In order to identify a NOAEL or LOAEL it is required that the author report the test result data. These study results are rejected as having No Data (Table 1). An exception to this rule are text statements concerning the presence/absence of genereal intoxication, general pathology, and mortality. These effects can be coded without reported data.

The User should take special care in identifying NOAEL and LOAEL values for nutrients. In some cases, contaminants that are also nutrients may give a biphasic dose-response curve, with the lower doses eliciting a positive effect and higher doses causing a negative response. The User selects the NOAEL and LOAEL for the second (adverse) phase of the dose response curve in these instances. For purposes of the Wildlife TRV effort, only data for no effects or adverse effects are recorded.

A nutrient study that examines a relevant endpoint (i.e., one with the potential for adverse effects) is coded, even in the absence of observed adverse effects. In this case, the User selects the highest dose as a NOAEL. Beneficial effects are not coded.

In some cases, the statistical analyses used in a study may not be appropriate or adequate for the particular study design. Alternatively, the study authors may not have performed a statistical analysis of the data. In either case, the User has three options. The first option is to analyze or re-analyze the data using appropriate statistical procedures and record the results (Figure 4-1) (Gad, 1998). The second option is to determine a NOAEL or LOAEL based on the preponderance of the data. The third option is rejection of the study and assignment of a data evaluation score of 0. In this case, the study result would be rejected and not used in the derivation of wildlife TRVs. In most cases a statistical analyses of the data will be completed in cases where the study does not use any statistics. There are expected to be very few instances where statistical analyses is recalculated by the User because the original method was inadequate. The statistical re-analyses or application of these three options can be completed by the user but will more often be the responsibility of the quality assurance reviewer.

If no statistical analysis was performed in a study and insufficient data are available to perform an independent analysis, the User should reject the study and assign a data evaluation score of zero. In this case, the study result would be rejected and not used in the derivation of wildlife TRVs. This action is based on a low degree of confidence in studies which do not adequately report the details of experimental design and results.

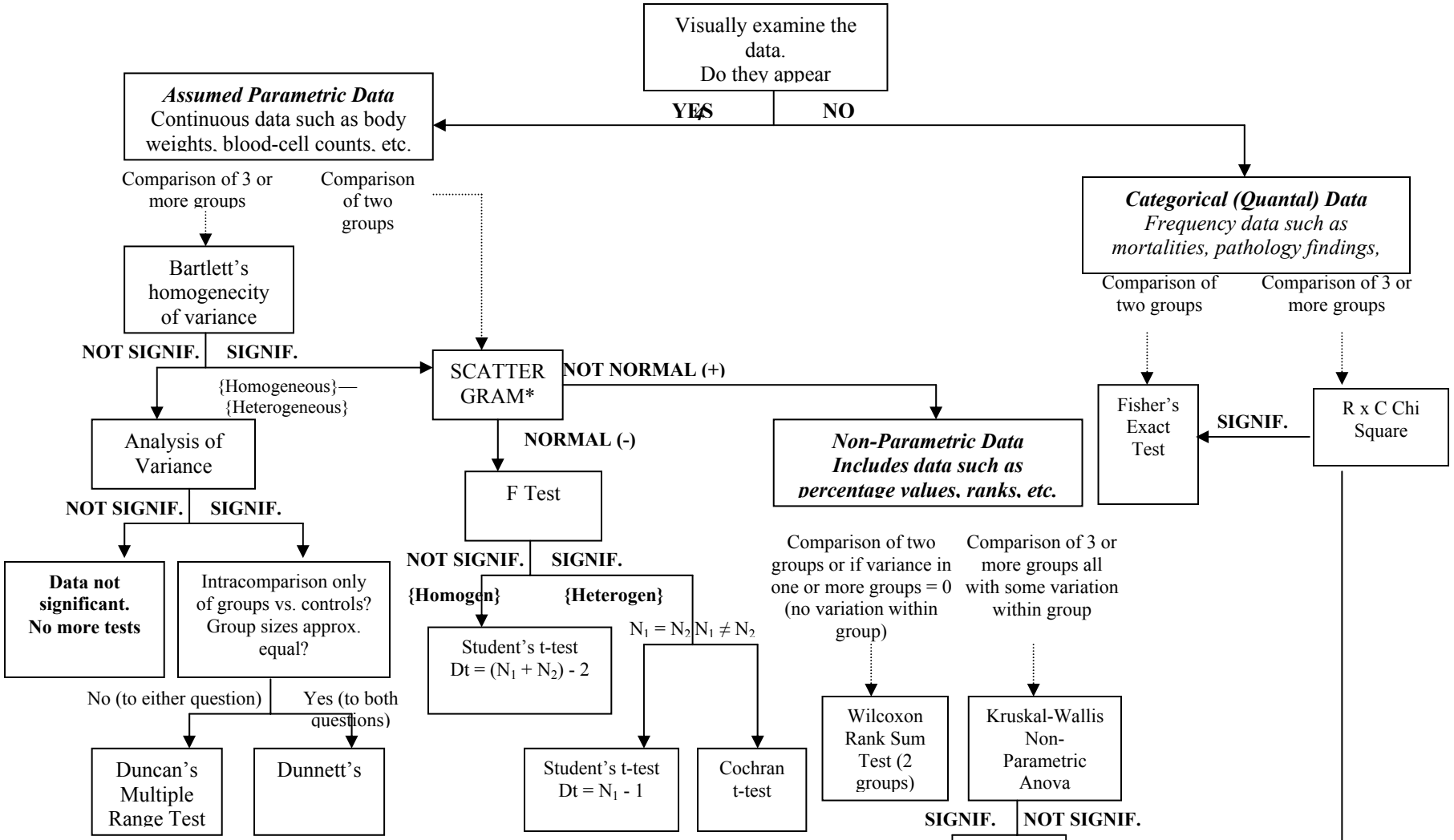
In theory, the threshold for the particular adverse effect lies between the NOAEL and the LOAEL. Recent publications have reviewed the weaknesses of the use of NOAELs in risk assessments (e.g., USEPA, 1995). Some analyses of acute toxicity data have shown that NOAELs can represent as much as a 30% or 40% difference from control (as a result of low statistical power), while other studies have identified LOAELs that are incorrectly low as a result of statistical artifacts. While it is hoped that NOAELs and LOAELs bracket the threshold concentration, their determination is a function of the spacing of dietary concentration and the statistical power of the test.

NOAEL and LOAEL Units

The units associated with the NOAEL and LOAEL are automatically assigned by the application based upon the units previously selected when describing the exposure concentrations or doses (see the Exposure Information section). If measured concentrations are entered, these units are preferentially returned as the units for the NOAEL field.

Is the NOAEL or LOAEL Reported by the Author?

If the NOAEL and/or the LOAEL are identified and reported by the author, the User selects "Yes" by checking the appropriate box. If the NOAEL and/or LOAEL are assigned by the reviewer, based on information provided in text, tables or figures, the User selects "No" by checking the appropriate box.



*If plot does not clearly demonstrate, lack of normality exact tests may be employed.
If continuous data, Kalmogorov Smirnov test.
If discontinuous data, Chi-Square Goodness of Fit test may be used.

Figure 4-1.
Decision tree for selecting hypothesis-testing procedures (from Gad, 1998)

NOAEL and LOAEL Comments

The NOAEL/LOAEL comment field is used to record any specific information pertaining to the selection of NOAEL and/or LOAEL. Statistical analysis information, including p-values (when applicable), is entered in this field. Any information regarding lack of statistical significance at different exposure durations during the test is noted here (i.e, no significance). The specific location of the NOAEL and LOAEL results in the paper, including references to the text page number and table or figure numbers, is recorded by the User in this comment field.

Is Wet Weight Reported?

The Eco-SSL for wildlife is reported as a "safe concentration" in soil on a dry weight basis. The estimation (or back calculation) from a safe dose to an associated safe soil concentration requires the TRV to be expressed on a dry weight basis. The requires that the estimation of a dose (mg of contaminant per kg BW of the test organism per day) from dietary exposure concentrations be based on units per dry weight diet.

If the study reports that the dietary exposure concentrations are expressed on a wet weight basis, then the User should select "Yes" by checking the appropriate box. If the dietary concentration units are reported as dry weight, select "No" by checking the appropriate box. If the dietary concentration units are not specified as wet weight or dry weight, select "NR" for Not Reported. Also select "NR" if a drinking water, gavage or other oral study is being entered. For studies where NR is entered, the entered results are assumed to be reported in dry weight and are not converted by the application. This is assumed to be conservative as conversion to dry-weight results in higher LOAEL and NOAEL dose values.

If Wet Weight is Reported, Is the Percent Moisture Reported?

If the dietary concentration level units are reported as wet weight and the percent moisture is also reported, the User selects "Yes" by checking the appropriate box. If percent moisture is not reported, the User selects "No" by checking the appropriate box. For drinking water studies, the User selects "NR" by checking the appropriate box.

Percent Moisture (%)

If the percent moisture in the exposure media is reported, the User enters the percent moisture in the numeric field provided. For example, if the percent moisture for laboratory rat chow is reported as 3 percent, the number 3 is entered. The number 100 should be entered for drinking water studies. If the percent moisture is not report the application assumes 5%.

Is the Body Weight Reported?

The User should review the study to determine if the test organism body weights are reported. If body weights are reported, the User selects "Yes" by checking the appropriate box. If body weights are not reported, the User selects "No" by checking the appropriate box. In cases where a

body weight is reported in the citation (e.g., initial weight) but is not specific for the age or time the endpoint measurement was made, the body weight is still considered to be "reported". In cases where body weight data are used from a different experiment within the same citation, the user identifies the body weight as "not reported".

Body Weight with Units

If body weight data are reported in the study, the User selects an appropriate value to be used by the application to calculate either a NOAEL or LOAEL dose. The User should select the body weight reported for the appropriate NOAEL or LOAEL exposure level group. The highest body weight should be used if both NOAEL and LOAEL exposure level groups are identified. If results are reported for both male and female organisms, the User should record the highest body weight for the appropriate NOAEL or LOAEL exposure (body weights are not averaged). If authors report total weight gain, that amount is used to adjust the appropriate initial weight to the approximate body weight at the time the endpoint was evaluated. This calculation should be documented in the body weight comments section. The body weight is entered in the numeric field provided. The User then selects the appropriate units for the reported body weight from the pull down list. The list of available units and conversion factors is provided in Table 19.

In cases where the study reports an initial weight, but does not report body weight or body weight gain for interim or terminal time points in the study, the User enters the initial body weight. Use of this data represents a conservative approach to calculation of the intake rate of the medium and subsequent calculation of the NOAEL and/or LOAEL value.

Table 19. Body Weight Units and Conversions

Body Weight Fields		Conversion to BW in kg
ng bw	nanograms body weight	multiply by 0.000000000001
ug bw	micrograms body weight	multiply by 0.000000001
mg bw	milligrams body weight	multiply by 0.000001
g bw	grams body weight	multiply by 0.001
kg bw	kilograms body weight	none
lb bw	pounds body weight	multiply by 0.4535924

If body weight data are not reported in the study, the User must select an appropriate default body weight. Table 20 provides a summary of default body weight values that are organism-, sex- and age-specific. The User selects the appropriate default body weight and enters the result in the numeric field provided. The largest body weight corresponding to the lifestage(s) used in the experiment should be used. Default body weight units are reported in kilograms (kg). If a default body weight value is not available in Table 20, the User may enter an appropriate value identified from another source. If an alternate value is entered, the User should enter the value in units of kg and provide a description of the value and reference in the body weight comment field.

Body Weight Comments

The User enters information specific to any of the following in the comment field provided for the body weights:

1) A description of the body weight selected or calculated from the study for entry. The description should include the rationale for selection, sex of the organism, any calculations and appropriate references to study table (including dose or concentration, exposure duration if relevant, figure and page numbers).

2) A description of any value selected from the default table and rationale for selection.

3) A description of any alternative value selected from additional sources and the appropriate reference.

Table 20. Default Body Weights

General Organism Type	Specific Organism Type	Sex	Age	Lifestage	Default BW (kg)	Reference
cat	unspecified	M	weaning to 90 days	juvenile	1.72	USEPA, 1987
cat	unspecified	M	90 days to 1 year	sexually mature	3.66	USEPA, 1987
cat	unspecified	M	1 year or older	adult	4	USEPA, 1987
cat	unspecified	F	weaning to 90 days	juvenile	1.49	USEPA, 1987
cat	unspecified	F	90 days to 1 year	sexually mature	2.96	USEPA, 1987
cat	unspecified	F	1 year or older	adult	3.1	USEPA, 1987
cattle	unspecified	BH	3 to 7 days	juvenile	67	USEPA, 2005
cattle	unspecified	BH	6 to 8 weeks	juvenile	119	USEPA, 2005
cattle	unspecified	BH	8 to 10 weeks	juvenile	137	USEPA, 2005
cattle	unspecified	BH	13 to 16 weeks	juvenile	198	USEPA, 2005
cattle	unspecified	BH	22 to 51 weeks	juvenile	260	USEPA, 2005
cattle	Beef	BH	weaning	juvenile	220	Jurgens, 1972
cattle	Beef	F	Pregnant	gestation	409	Jurgens, 1972
cattle	Beef	F	Lactating	lactation	454	Jurgens, 1972
cattle	Beef	BH	> 1 year	Adult	454	Jurgens, 1972
cattle	Fresian	F	10 months	juvenile	99	Maro et al., 1980
cattle	Holstein	F	Lactating, 58 months	Adult	680	NRC (2001)
cattle	Jersey	F	Lactating, 58 months	Adult	454	NRC (2001)
chicken	unspecified	M	Older than 30 days	adult	1.3	USEPA, 1987
chicken	unspecified	F	Older than 30 days	adult	1.6	USEPA, 1987
chicken	domestic	BH	1 day	juvenile	0.0397	Diaz et al 1994
chicken	domestic	BH	3 days	juvenile	0.0543	Franson and Custer, 1982
chicken	domestic	BH	7 days	juvenile	0.084	Southern and Baker, 1981

Table 20. Default Body Weights						
General Organism Type	**Specific Organism Type**	**Sex**	**Age**	**Lifestage**	**Default BW (kg)**	**Reference**
chicken	domestic	BH	14 days	juvenile	0.328	Southern and Baker, 1981
chicken	domestic	BH	20 days	juvenile	0.564	Donaldson and McGowan, 1989
chicken	domestic	BH	28 days	juvenile	1.042	Diaz et al., 1994
dog	unspecified	M	weaning to 90 days	juvenile	2.4	USEPA, 1987
dog	unspecified	M	90 days to 1 year	sexually mature	10.8	USEPA, 1987
dog	unspecified	M	1 year or older	adult	14	USEPA, 1987
dog	unspecified	F	weaning to 90 days	juvenile	1.97	USEPA, 1987
dog	unspecified	F	90 days to 1 year	sexually mature	10.1	USEPA, 1987
dog	unspecified	F	1 year or older	adult	14	USEPA, 1987
dove	ringed turtle	B	0 days	juvenile	0.010	Carriere et al., 1986
dove	ringed turtle	B	7 days	juvenile	0.057	Carriere et al., 1986; Kendall and Scanlon, 1981
dove	ringed turtle	B	14 days	juvenile	0.092	Carriere et al., 1986; Kendall and Scanlon, 1981
dove	ringed turtle	B	21 days	juvenile	0.117	Carriere et al., 1986; Kendall and Scanlon, 1981
dove	ringed turtle	B	28 days	juvenile	0.134	Carriere et al., 1986
dove	ringed turtle	B	Adult	adult	0.144	Carriere et al., 1986; Kendall and Scanlon, 1981; Keith and Mitchell, 1993
duck	mallard	F	Adult	adult	1.1	USEPA, 1993
duck	mallard	M	Adult	adult	1.2	USEPA, 1993
duck	mallard	JV	10 days	juvenile	0.092	USEPA, 1993
duck	mallard	JV	30 days	juvenile	0.46	USEPA, 1993
duck	white pekin	B	0 days	juvenile	0.06	NRC, 1994
duck	white pekin	B	7 days	juvenile	0.27	NRC, 1994
duck	white pekin	M	14 days	juvenile	0.78	NRC, 1994
duck	white pekin	F	14 days	juvenile	0.74	NRC, 1994
duck	white pekin	M	21 days	juvenile	1.38	NRC, 1994
duck	white pekin	F	21 days	juvenile	1.28	NRC, 1994
duck	white pekin	M	28 days	juvenile	1.96	NRC, 1994
duck	white pekin	F	28 days	juvenile	1.82	NRC, 1994
duck	white pekin	M	35 days	juvenile	2.49	NRC, 1994
duck	white pekin	F	35 days	juvenile	2.30	NRC, 1994
duck	white pekin	M	42 days	juvenile	2.96	NRC, 1994
duck	white pekin	F	42 days	juvenile	2.73	NRC, 1994
duck	white pekin	M	49 days	juvenile	3.34	NRC, 1994
duck	white pekin	F	49 days	juvenile	3.06	NRC, 1994
duck	white pekin	M	56 days	juvenile	3.61	NRC, 1994
duck	white pekin	F	56 days	juvenile	3.29	NRC, 1994
eagle	bald eagle	M	Adult	adult	4.13	Dunning, 1993

Table 20. Default Body Weights						
General Organism Type	**Specific Organism Type**	**Sex**	**Age**	**Lifestage**	**Default BW (kg)**	**Reference**
eagle	bald eagle	F	Adult	adult	5.35	Dunning, 1993
gerbil	unspecified	M	weaning to 90 days	juvenile	0.048	USEPA, 1987
gerbil	unspecified	M	90 days to 1 year	juvenile	0.084	USEPA, 1987
gerbil	unspecified	M	1 year or older	adult	0.1	USEPA, 1987
gerbil	unspecified	F	weaning to 90 days	juvenile	0.04	USEPA, 1987
gerbil	unspecified	F	90 days to 1 year	juvenile	0.073	USEPA, 1987
gerbil	unspecified	F	1 year or older	adult	0.09	USEPA, 1987
guinea pig	unspecified	M	weaning to 90 days	juvenile	0.48	USEPA, 1987
guinea pig	unspecified	M	90 days to 1 year	juvenile	0.89	USEPA, 1987
guinea pig	unspecified	M	1 year or older	adult	1	USEPA, 1987
guinea pig	unspecified	F	weaning to 90 days	juvenile	0.39	USEPA, 1987
guinea pig	unspecified	F	90 days to 1 year	juvenile	0.86	USEPA, 1987
guinea pig	unspecified	F	1 year or older	adult	0.9	USEPA, 1987
hamster	golden Syrian	M	weaning to 90 days	juvenile	0.097	USEPA, 1987
hamster	golden Syrian	M	90 days to 1 year	juvenile	0.134	USEPA, 1987
hamster	golden Syrian	M	1 year or older	adult	0.15	USEPA, 1987
hamster	golden Syrian	F	weaning to 90 days	juvenile	0.095	USEPA, 1987
hamster	golden Syrian	F	90 days to 1 year	juvenile	0.145	USEPA, 1987
hamster	golden Syrian	F	1 year or older	adult	0.16	USEPA, 1987
hamster	Chinese & Djungarain	M	weaning to 90 days	juvenile	0.03	USEPA, 1987
hamster	Chinese & Djungarain	M	90 days to 1 year	juvenile	0.041	USEPA, 1987
hamster	Chinese & Djungarain	M	1 year or older	adult	0.04	USEPA, 1987
hamster	Chinese & Djungarain	F	weaning to 90 days	juvenile	0.025	USEPA, 1987
hamster	Chinese & Djungarain	F	90 days to 1 year	juvenile	0.038	USEPA, 1987
hamster	Chinese & Djungarain	F	1 year or older	adult	0.035	USEPA, 1987
hamster	unspecified	M	weaning to 90 days	juvenile	0.0635	USEPA, 1987
hamster	unspecified	M	90 days to 1 year	juvenile	0.0875	USEPA, 1987
hamster	unspecified	M	1 year or older	adult	0.095	USEPA, 1987
hamster	unspecified	F	weaning to 90 days	juvenile	0.2425	USEPA, 1987
hamster	unspecified	F	90 days to 1 year	juvenile	0.5025	USEPA, 1987
hamster	unspecified	F	1 year or older	adult	1.03	USEPA, 1987
horse	unspecified	B	> 2 year	adult	498.95	Jurgens (1993)
horse	unspecified	M	2 to 5 months	foal	181.44	Jurgens (1993)
horse	unspecified	M	5 to 12 months	weanling	317.51	Jurgens (1993)
horse	unspecified	M	12 to 24 months	yearling	408.23	Jurgens (1993)
mink	unspecified	M	weaning to 49 days	juvenile	1.02	USEPA 1993
mink	unspecified	F	weaning to 49 days	juvenile	0.583	USEPA 1993
mink	unspecified	M	> 1 year	adult	1.18	USEPA 1993
mink	unspecified	F	> 1 year	adult	0.596	USEPA 1993

Table 20. Default Body Weights						
General Organism Type	**Specific Organism Type**	**Sex**	**Age**	**Lifestage**	**Default BW (kg)**	**Reference**
mouse	BAF1	M	weaning to 90 days	juvenile	0.0223	USEPA, 1987
mouse	BAF1	M	90 days to 1 year	juvenile	0.0261	USEPA, 1987
mouse	BAF1	M	1 year or older	adult	0.035	USEPA, 1987
mouse	BAF1	F	weaning to 90 days	juvenile	0.0204	USEPA, 1987
mouse	BAF1	F	90 days to 1 year	juvenile	0.0222	USEPA, 1987
mouse	BAF1	F	1 year or older	adult	0.03	USEPA, 1987
mouse	B6C3F1	M	weaning to 90 days	juvenile	0.0316	USEPA, 1987
mouse	B6C3F1	M	90 days to 1 year	juvenile	0.0373	USEPA, 1987
mouse	B6C3F1	M	1 year or older	adult	0.04	USEPA, 1987
mouse	B6C3F1	F	weaning to 90 days	juvenile	0.0246	USEPA, 1987
mouse	B6C3F1	F	90 days to 1 year	juvenile	0.0353	USEPA, 1987
mouse	B6C3F1	F	1 year or older	adult	0.035	USEPA, 1987
mouse	deer mouse	M	Adult	adult	0.02	USEPA, 1993
mouse	deer mouse	F	Adult	adult	0.019	USEPA, 1993
mouse	unspecified	M	weaning to 90 days	juvenile	0.02695	USEPA, 1987
mouse	unspecified	M	90 days to 1 year	juvenile	0.0317	USEPA, 1987
mouse	unspecified	M	1 year or older	adult	0.0375	USEPA, 1987
mouse	unspecified	F	weaning to 90 days	juvenile	0.0225	USEPA, 1987
mouse	unspecified	F	90 days to 1 year	juvenile	0.02875	USEPA, 1987
mouse	unspecified	F	1 year or older	adult	0.0325	USEPA, 1987
pheasant	ring-necked	F	Adult	adult	0.95	Dunning, 1993
pheasant	ring-necked	M	Adult	adult	1.3	Dunning, 1993
owl	barn owl	M	Adult	adult	0.479	Dunning, 1993
owl	barn owl	F	Adult	adult	0.568	Dunning, 1993
pigeon	pigeon	F	Adult	adult	0.340	Dunning, 1993
pigeon	pigeon	M	Adult	adult	0.369	Dunning, 1993
pig	miniature	M	Adult	adult	72.5	USEPA, 1987
pig	miniature	F	Adult	adult	72.5	USEPA, 1987
pig	unspecified	BH	1 d	juvenile	1.2	**Spears et al, 1984**
pig	unspecified	BH	21 to 25 days	juvenile	6.6	**USEPA 2005**
pig	unspecified	BH	26 to 29 days	juvenile	7.9	**USEPA 2005**
pig	**unspecified**	**BH**	**30 to 35 days**	juvenile	9.3	**USEPA 2005**
pig	unspecified	BH	36 to 66 days	juvenile	31.5	**USEPA 2005**
pig	unspecified	BH	67 to 150 days	juvenile	61	**USEPA 2005**
pig	unspecified	BH	151 to 299 days	juvenile	61	**USEPA 2005**
pig	unspecified	BH	> 299 days	adult	104	**USEPA 2005**
pig	unspecified	F	Adult	Gestation	152	**Cromwell et al., 1993**
quail	Japanese	F	Adult	adult	0.1	Dunning, 1993
quail	Japanese	M	Adult	adult	0.09	Dunning, 1993
quail	Japanese	BH	0 to 1 days	juvenile	0.07045	USEPA, 2005
quail	Japanese	BH	7 to 8 days	juvenile	0.103	USEPA, 2005
quail	Japanese	BH	14 to 28 days	juvenile	0.120	USEPA, 2005
quail	Japanese	BH	29 to 59 days	juvenile	0.132	USEPA, 2005

Table 20. Default Body Weights						
General Organism Type	**Specific Organism Type**	**Sex**	**Age**	**Lifestage**	**Default BW (kg)**	**Reference**
quail	Japanese	BH	60 to 154 days	juvenile	0.135	USEPA, 2005
quail	bobwhite	F	Adult	adult	0.17	USEPA, 1993
quail	bobwhite	M	Adult	adult	0.16	USEPA, 1993
quail	bobwhite	JV	10 days	juvenile	0.012	USEPA, 1993
quail	bobwhite	BH	18 days	juvenile	0.034	Landis Assoc.Inc, 1985
quail	bobwhite	JV	30 days	juvenile	0.04	USEPA, 1993
rabbit	unspecified	M	weaning to 90 days	juvenile	2.86	USEPA, 1987
rabbit	unspecified	M	90 days to 1 year	juvenile	3.76	USEPA, 1987
rabbit	unspecified	M	1 year or older	adult	4	USEPA, 1987
rabbit	unspecified	F	weaning to 90 days	juvenile	3.1	USEPA, 1987
rabbit	unspecified	F	90 days to 1 year	juvenile	3.93	USEPA, 1987
rabbit	unspecified	F	1 year or older	adult	4.1	USEPA, 1987
rat	Fischer 344	M	weaning to 90 days	juvenile	0.18	USEPA, 1987
rat	Fischer 344	M	90 days to 1 year	juvenile	0.38	USEPA, 1987
rat	Fischer 344	M	1 year or older	adult	0.4	USEPA, 1987
rat	Fischer 344	F	weaning to 90 days	juvenile	0.124	USEPA, 1987
rat	Fischer 344	F	90 days to 1 year	juvenile	0.229	USEPA, 1987
rat	Fischer 344	F	1 year or older	adult	0.25	USEPA, 1987
rat	Long-Evans	M	weaning to 90 days	juvenile	0.248	USEPA, 1987
rat	Long-Evans	M	90 days to 1 year	juvenile	0.472	USEPA, 1987
rat	Long-Evans	M	1 year or older	adult	0.5	USEPA, 1987
rat	Long-Evans	F	weaning to 90 days	juvenile	0.179	USEPA, 1987
rat	Long-Evans	F	90 days to 1 year	juvenile	0.344	USEPA, 1987
rat	Long-Evans	F	1 year or older	adult	0.35	USEPA, 1987
rat	Osborne-Mendel	M	weaning to 90 days	juvenile	0.263	USEPA, 1987
rat	Osborne-Mendel	M	90 days to 1 year	juvenile	0.514	USEPA, 1987
rat	Osborne-Mendel	M	1 year or older	adult	0.55	USEPA, 1987
rat	Osborne-Mendel	F	weaning to 90 days	juvenile	0.201	USEPA, 1987
rat	Osborne-Mendel	F	90 days to 1 year	juvenile	0.389	USEPA, 1987
rat	Osborne-Mendel	F	1 year or older	adult	0.4	USEPA, 1987
rat	Sprague-Dawley	M	weaning to 90 days	juvenile	0.267	USEPA, 1987
rat	Sprague-Dawley	M	90 days to 1 year	juvenile	0.523	USEPA, 1987
rat	Sprague-Dawley	M	1 year or older	adult	0.6	USEPA, 1987
rat	Sprague-Dawley	F	weaning to 90 days	juvenile	0.204	USEPA, 1987
rat	Sprague-Dawley	F	90 days to 1 year	juvenile	0.338	USEPA, 1987
rat	Sprague-Dawley	F	1 year or older	adult	0.35	USEPA, 1987
rat	Wistar	M	weaning to 90 days	juvenile	0.217	USEPA, 1987
rat	Wistar	M	90 days to 1 year	juvenile	0.462	USEPA, 1987
rat	Wistar	M	1 year or older	adult	0.5	USEPA, 1987
rat	Wistar	F	weaning to 90 days	juvenile	0.156	USEPA, 1987
rat	Wistar	F	90 days to 1 year	juvenile	0.297	USEPA, 1987
rat	Wistar	F	1 year or older	adult	0.32	USEPA, 1987
rat	unspecified	M	weaning to 90 days	juvenile	0.235	USEPA, 1987

Table 20. Default Body Weights						
General Organism Type	**Specific Organism Type**	**Sex**	**Age**	**Lifestage**	**Default BW (kg)**	**Reference**
rat	unspecified	M	90 days to 1 year	juvenile	0.4702	USEPA, 1987
rat	unspecified	M	1 year or older	adult	0.51	USEPA, 1987
rat	unspecified	F	weaning to 90 days	juvenile	0.2024	USEPA, 1987
rat	unspecified	F	90 days to 1 year	juvenile	0.3846	USEPA, 1987
rat	unspecified	F	1 year or older	adult	0.4	USEPA, 1987
sheep	domestic	BH	1 week	juvenile	46.81	Steinheim et al., 2002
sheep	unspecified	BH	112 to 189 days	juvenile	34	USEPA, 2005
sheep	unspecified	BH	189 to 224 days	juvenile	40.6	USEPA, 2005
sheep	unspecified	BH	225 to 252 days	juvenile	59.1	USEPA, 2005
sheep	unspecified	BH	> 252 days	adult	65.1	USEPA, 2005
sheep	unspecified	F	Gestation	Gestation	70	USEPA, 2005
sheep	Chun forest	BH	Juvenile	Juvenile	24	www.ansi.okstate.edu/breeds/sheep/ based on data for related strain (Kerry Hill)
sheep	Chun forest	M	Adult	Adult	91.5	www.ansi.okstate.edu/breeds/sheep/ based on data for related strain (mean of Kerry Hill and Shropshire)
sheep	Chun forest	F	Adult	Adult	73	www.ansi.okstate.edu/breeds/sheep/ based on data for related strain (mean of Kerry Hill and Shropshire)
sheep	Dala	M	Adult	adult	115	Geertman, 2001
sheep	Dala	F	Adult	adult	80	Geertman, 2001
sheep	Old Norse	M	Adult	adult	43	www.ansi.okstate.edu/breeds/sheep/
sheep	Old Norse	F	Adult	adult	32	www.ansi.okstate.edu/breeds/sheep/
shrew	short-tailed	M	Adult	adult	0.017	USEPA, 1993
shrew	short-tailed	F	Adult	adult	0.017	USEPA, 1993
sparrow	white-throated	BH	Adult	adult	0.0259	Dunning, 1993
starling	starling	M	Adult	adult	0.0847	Dunning, 1993
starling	starling	F	Adult	adult	0.0799	Dunning, 1993
turkey	domestic	BH	1 w	juvenile	0.12	NRC, 1994
turkey	domestic	M	2 w	juvenile	0.25	NRC, 1994
turkey	domestic	F	2 w	juvenile	0.24	NRC, 1994
turkey	domestic	M	3 w	juvenile	0.50	NRC, 1994
turkey	domestic	F	3 w	juvenile	0.46	NRC, 1994
turkey	domestic	M	4 w	juvenile	1.0	NRC, 1994
turkey	domestic	F	4 w	juvenile	0.90	NRC, 1994
turkey	domestic	M	5 w	juvenile	1.6	NRC, 1994
turkey	domestic	F	5 w	juvenile	1.4	NRC, 1994
turkey	domestic	M	6 w	juvenile	2.2	NRC, 1994

Table 20. Default Body Weights						
General Organism Type	**Specific Organism Type**	**Sex**	**Age**	**Lifestage**	**Default BW (kg)**	**Reference**
turkey	domestic	F	6 w	juvenile	1.8	NRC, 1994
turkey	domestic	M	7 w	juvenile	3.1	NRC, 1994
turkey	domestic	F	7 w	juvenile	2.3	NRC, 1994
turkey	domestic	M	8 w	juvenile	4.0	NRC, 1994
turkey	domestic	F	8 w	juvenile	3.0	NRC, 1994
turkey	domestic	M	9 w	juvenile	5.0	NRC, 1994
turkey	domestic	F	9 w	juvenile	3.7	NRC, 1994
turkey	domestic	M	10 w	juvenile	6.0	NRC, 1994
turkey	domestic	F	10 w	juvenile	4.4	NRC, 1994
turkey	domestic	M	11 w	juvenile	7.1	NRC, 1994
turkey	domestic	F	11 w	juvenile	5.2	NRC, 1994
turkey	domestic	M	12 w	juvenile	8.2	NRC, 1994
turkey	domestic	F	12 w	juvenile	6.0	NRC, 1994
turkey	domestic	M	13 w	juvenile	9.3	NRC, 1994
turkey	domestic	F	13 w	juvenile	6.8	NRC, 1994
turkey	domestic	M	14 w	juvenile	10.5	NRC, 1994
turkey	domestic	F	14 w	juvenile	7.5	NRC, 1994
turkey	domestic	M	15 w	juvenile	11.5	NRC, 1994
turkey	domestic	F	15 w	juvenile	8.3	NRC, 1994
turkey	domestic	M	16 w	juvenile	12.6	NRC, 1994
turkey	domestic	F	16 w	juvenile	8.9	NRC, 1994
turkey	domestic	M	17 w	juvenile	13.5	NRC, 1994
turkey	domestic	F	17 w	juvenile	9.6	NRC, 1994
turkey	domestic	M	18 w	juvenile	14.4	NRC, 1994
turkey	domestic	F	18 w	juvenile	10.2	NRC, 1994
turkey	domestic	M	19 w	juvenile	15.2	NRC, 1994
turkey	domestic	F	19 w	juvenile	10.9	NRC, 1994
turkey	domestic	M	20 w	juvenile	16.1	NRC, 1994
turkey	domestic	F	20 w	juvenile	11.5	NRC, 1994
turkey	domestic	M	21 w	juvenile	17.0	NRC, 1994
turkey	domestic	M	22 w	juvenile	17.9	NRC, 1994
turkey	domestic	M	23 w	juvenile	18.6	NRC, 1994
turkey	domestic	M	24 w	juvenile	19.4	NRC, 1994
turkey	domestic	M	> 24 w	adult	19.4	NRC, 1994
turkey	domestic	F	20 w	egg laying bird	8.4	NRC, 1994
turkey	domestic	M	25 w	breeding (juvenile)	16.4	NRC, 1994
turkey	domestic	F	25 w	egg laying bird	9.8	NRC, 1994
turkey	domestic	M	30 w	breeding (juvenile)	19.1	NRC, 1994
turkey	domestic	F	30 w	egg laying bird	11.1	NRC, 1994
turkey	domestic	M	35 w	breeding (juvenile)	20.7	NRC, 1994
turkey	domestic	F	35 w	egg laying bird	11.1	NRC, 1994
turkey	domestic	M	40 w	breeding (juvenile)	21.8	NRC, 1994
turkey	domestic	F	40 w	egg laying bird	10.8	NRC, 1994

Table 20. Default Body Weights						
General Organism Type	**Specific Organism Type**	**Sex**	**Age**	**Lifestage**	**Default BW (kg)**	**Reference**
turkey	domestic	M	45 w	breeding (juvenile)	22.5	NRC, 1994
turkey	domestic	F	45 w	egg laying bird	10.5	NRC, 1994
turkey	domestic	M	50 w	breeding (juvenile)	23.2	NRC, 1994
turkey	domestic	F	50 w	egg laying bird	10.5	NRC, 1994
turkey	domestic	M	55 w	breeding (adult)	23.9	NRC, 1994
turkey	domestic	F	55 w	egg laying bird	10.5	NRC, 1994
turkey	domestic	M	60 w	breeding (adult)	24.5	NRC, 1994
turkey	domestic	F	60 w	egg laying bird	10.6	NRC, 1994
vole	prairie vole	BH	Adult	adult	0.042	USEPA, 1993
vole	meadow vole	M	Adult	adult	0.043	USEPA, 1993
vole	meadow vole	F	Adult	adult	0.039	USEPA, 1993
finch	zebra finch	B	Adult	adult	12	Dunning, 1993

Is the Intake Rate Reported?

The Intake Rate fields refer to the intake rate of the exposure medium (diet or drinking water), not the contaminant. The intake rate is used to convert contaminant concentration data to a contaminant dose. If intake rates are reported, the User selects "Yes" by checking the appropriate box. If intake rates are not reported, the User selects "No" by checking the appropriate box. In gavage or other oral exposures (capsule), the User selects “No” by checking the appropriate box, but overrides the dose quantification score to reflect that intake rate was “reported.”

Intake Rate with Units

If the intake rate is reported in the study, the User selects the appropriate value to be used by the application to calculate either a NOAEL or LOAEL dose. If the study reports doses, the intake rate does not need to be entered. If the intake rate for a treatment group is variable over the course of the experiment, enter the average rate and note this in the comments field. The User should select the intake rate reported for the appropriate NOAEL or LOAEL exposure level group. The highest intake rate should be used if both NOAEL and LOAEL exposure level groups are identified. The intake rate is entered in the numeric field provided. The application assumes that the intake rate entered (for dietary studies) is dry weight-based. If the User gathers information from the study that reports otherwise, then the User should convert the intake rate to a dry weight basis and report in detail the necessary conversion in the Intake Rate Comment Field. Next the User selects the appropriate units associated with the intake rate from the pull down list. The list of intake rate units is provided in Table 21.

If the intake rate is not reported. The User does not enter an intake rate, the application calculates the intake rate automatically using allometric equations based on the body weight, specific class and exposure route for the test organism. The intake rate is calculated and reported in the Score Information Screen in units of kg bw per day or L per day (see Appendix A).

Table 21. Units and Conversions for Intake Rate of Medium		
Intake Rate Fields		**Conversion to kg/day or L/day**
kg/d (or L/d)	kilograms or liters per day	multiply by 1
kg/kg BW/day or L/kg BW/day	kilograms or liters per kilogram BW per day	multiply by BW in kg
kg/org/d or L/org/d	kilograms or liters per organism per day	multiply by 1
g/d or ml/day	grams per day	multiply by 0.001
g/kg BW/d or ml/kg BW/d	grams per kilogram BW per day	multiply by 0.001 then multiply by BW in kg
g/org/d or ml/org/d	grams per organism per day	multiply by 0.001
mg/d or ul/d	milligrams per day	multiply by 0.000001
mg/kg BW/d or ul/kg BW/d	milligrams per kilogram BW per day	multiply by 0.000001 then multiply by BW in kg
mg/org/d or ul/org/d	milligrams per organism per day	multiply by 0.000001
ug/d	micrograms per day	multiply by 0.000000001
ug/kg bw/d	micrograms per kilogram BW per day	multiply by 0.000000001 then multiply by BW in kg
ug/org/d	micrograms per organism per day	multiply by 0.000000001
ng/d	nanograms per day	multiply by 0.000000000001
ng/kg bw/d	nanograms per kilogram BW per day	multiply by 0.000000000001 then multiply by BW in kg
ng/org/d	nanograms per organism per day	multiply by 0.000000000001

Intake Rate Comments

In the comment field provided for the body weights, the User enters information specific to any of the following:

- A description of the intake rate selected or calculated from the study for entry. The description should include the rationale for selection, any calculations and appropriate references to study table, figure and page numbers.
- A description of any value selected from the default table and rationale.
- A description of any alternative value selected from additional sources and the appropriate reference.

Endpoint Sample Size

The user enters information in this field on the number of experimental animals for the specific endpoint entered for each exposure concentration or dose. Any specific reasons for loss of experimental animals not associated with exposure to the contaminant should be noted.

Results for the NOAEL

These fields allow the User to enter information concerning the experimental results for the NOAEL exposure (dose) level. The User enters information here in instances where ONLY A NOAEL is reported and no LOAEL is reported. In these instances, it is important to evaluate the power of a study design to detect an adverse effect, if it were present. A detailed description of the power calculation is provided as Appendix B. Statistical power is calculated using the number of test organisms, the mean endpoint response for control and treated organisms, and the standard deviations of the means as inputs. If the distribution of values in the control group and the exposed group are both approximately normal and the variance is similar for both, the power of the study can be estimated from the information entered below. The numeric fields provided for power calculation data entry cannot be blank. If any of the required input data are missing (i.e., because they are not reported for the endpoint), the study power is not calculated and the application reports "not calculated".

The User should note that data from figures are not used to calculate power.

Number of Exposed Organisms. The User enters the total number of organisms exposed in the numeric field provided. If the total number of exposed organisms is not reported, the User leaves the numeric field blank. A blank field is evaluated as null and power is not calculated.

Number of Control Organisms. The User enters the total number of control organisms exposed at the NOAEL dose in the numeric field provided. If the total number of control organisms is not reported, the field is left blank. The blank field is evaluated as null and power is not calculated by the application.

Mean of Endpoint in Exposed Organisms. The User enters the mean of the NOAEL result for the exposed organisms in the numeric field provided. If a mean value is not reported, -99 is entered in the field. This value is evaluated as null and power is not calculated.

Mean of Endpoint in Control Organisms. The User enters the mean for the control group in the numeric field provided. If a mean value is not reported, -99 is entered in the field. This value is evaluated by the system as null and power is not calculated.

Standard Deviation of Endpoint in Exposed Organisms. The standard deviation is required for calculation of statistical power. The database permits entry of either the standard deviation or the standard error of the mean for the endpoint of interest. The User selects the appropriate data type and enters the value in the numeric field provided. If a standard error is entered, the database automatically estimates the standard deviation as the product of the standard error multiplied by the square root of the sample size *n*. If neither a standard deviation nor standard error value is provided, -99 is entered in the field. The field is evaluated as null and power is not calculated.

Standard Deviation of Endpoint in Control Organisms.

The standard deviation is required for calculation of statistical power. The database permits entry of either the standard deviation or the standard error of the control mean for the endpoint of interest. The User selects the appropriate data type and enters the value in the numeric field provided. If a standard error is entered, the database automatically estimates the standard deviation as the product of the standard error multiplied by the square root of the sample size *n*. If neither a standard deviation nor standard error value is provided, -99 is entered in the field. The field is evaluated as null and power is not calculated.

Confidence Alpha. This is the statistical significance level chosen to declare a treatment response as significantly different different from the control response. **The default value of alpha is 0.05.** However, the system allows the User to select other statistical significance levels from the pull-down list provided. The User should seek approval from an Administrator before using alpha values other than the default of 0.05.

At this point in the data entry process, the "Endpoint Information" screen is now complete. The User verifies that all entered data are correct and clicks on the "Next" button at the bottom of the screen to continue. The User **should not** use the browser back arrow to return to a previous data entry screen to correct errors, as deletion of data results.

4.5 Data Evaluation Score

For the convenience of the User, the Data Evaluation screen provides a summary of the information required to determine a data evaluation score for each endpoint entered. This summary is provided at the top of the Score Information screen. The Data Evaluation Scoring system is described in SOP #7 (Attachment 4-5).

For this summary screen, the data previously entered for body weight, intake rate, and the NOAEL and/or LOAEL are converted to the appropriate units for calculation of a final NOAEL and/or LOAEL value expressed as mg/kg-day. Each of these conversions are described in detail below:

- **Body Weight**. The application automatically converts body weights and units entered by the User to units of kilograms. The equations used for the conversion of body weight data are presented in Table 19.

- **Intake Rate.** The application converts the exposure medium intake rate entered by the user to units of kilograms of food or liters of drinking water per organism per day. The equations that are used for this conversion are presented in Table 21. If the intake rate is assigned by the application, based on the default allometric equations for food and water ingestion, no conversion is required as the equations estimate intake rates in the appropriate units.

- **Conversion to Dose.** The application converts the entered NOAEL and/or LOAEL concentration or dose values to the appropriate units of mg of contaminant per kg BW per day. The equations used for these conversions are provided in Table 9. If the NOAEL and/or LOAEL concentrations are expressed on a wet weight basis in the study, the application makes the appropriate conversion to dry weight based on the moisture content entered by the User.

The final data evaluation score assigned to the NOAEL and/or LOAEL is based on the addition of individual scores for ten study attributes. These ten attribute scores are described in the following subsection and are summarized in Table 22. For each attribute, a score is assigned ranging from 0 (no merit for derivation of a TRV) to 10 (extremely valuable and relevant for derivation of a TRV). It is important to note that a low score does not imply that the study is poor, only that it is not optimal for deriving a TRV.

To determine the final data evaluation score, the User selects the appropriate score from the pull down list provided for each of the study attributes. The application defaults to the appropriate score based on the information entered. The User can, however, alter the default scores under special circumstances. If any of the individual attribute scores are equal to 0 the total score is equal to 0 and the study is not used for the derivation of Wildlife TRVs.

Table 22. Summary of Data Evaluation Scoring System

Attribute	Description	Score
1. Data source "Source Score"	Primary	10
	Secondary	0
2. Contaminant Form "Chemical Form Score"	Contaminant form is known and is the same or similar to the of medium of concern	10
	Contaminant form is irrelevant to absorption or biological activity	10
	Contaminant form is known and is different from that found in the medium of concern	5
	Contaminant form is not reported (this includes situations when the contaminant is just listed as "Lead" or "Selenium")	4
3. Test Substrate "Test Substrate Score"	Test substance concentrations reported as actual measured values (M), verified nominal (UX) and/or doses administered by gavage	10
	Test substance concentrations reported as nominal values (U)	5
	Test substance concentrations not reported	0
4. Dose Quantification "Dose Quantification Score"	Administered doses reported as mg/kg-BW (includes gavage doses reported in these units)	10
	Administered doses need to be calculated and intake rates and body weights provided	7
	Administered doses need to be calculated and only one value (intake or body weight) provided (if study is gavage or other capsule, intake is "provided")	6
	Administered doses need to be calculated based on estimated intake rates and body weights	5
	Administered doses cannot be calculated from the information provided	0
5. Dose Range "Dose Range Score"	Both a NOAEL and a LOAEL are identified; values are within a factor of 3	10
	Both a NOAEL and a LOAEL are identified; values are within a factor of 10	8
	Both a NOAEL and a LOAEL are identified; values are not within a factor of 10	6
	Only a NOAEL or a LOAEL is identified	4
	Study lacks a suitable control group	0
6. Dose Route "Dose Route Score"	Chemical incorporated into food (including mother's milk)	10
	Other oral (gavage, capsule)	8
	Chemical incorporated into drinking water	5
	Not dietary, other oral, or drinking water or not reported or choice of treated and non treated food or water	0
7. Endpoint	Reported endpoint is a reproductive or population effect (REP) (POP)	10

Table 22. Summary of Data Evaluation Scoring System		
Attribute	**Description**	**Score**
"Endpoint Score"	Reported endpoint is lethality (chronic or subchronic exposures (MOR)	9
	Reported endpoint is reduction in growth (GRO)	8
	Reported endpoint is sublethal change in organ function, behavior or neurological function (BEH, PHY, PTH)	4
	Reported endpoint is a biomarker of exposure with unknown relationship to fitness (BIO)	1
8. Exposure Duration "Exposure Duration Score"	Exposure duration encompasses multiple lifestages of test species	10
	Exposure duration is at least 0.1 times the expected life span of the test species or occurs during a critical life phase	10
	Exposure duration is shorter than 0.1 times the expected life span of the test species and multiple doses or concentrations are administered	6
	Exposure duration is shorter than 0.1 times the expected life span of the test species and only a single dose or concentration is administered.	3
	Exposure duration is acute or not reported	0
9. Statistical Power "Power Score"	At least 90% chance of seeing a difference that is biologically significant	10
	NOAEL and LOAEL available or LOAEL only available	10
	At least 75% chance of seeing a difference that is biologically significant	8
	At least 50% chance of seeing a difference that is biologically significant	6
	Less than a 50% chance of detecting a difference that is biologically significant	3
	Only NOAEL available; insufficient data reported to determine statistical power of study	1
10. Test Conditions "Test Parameter Score"	Follows a standard guideline and reports all test parameters	10
	Does not follow a standard guideline, but does report all test parameters	10
	Follows a standard guideline but does not report test parameters	7
	Does not follow a standard guideline and reports some, but not all of the test parameters	4
	Does not report any test parameters	2

1. Data Source Score

All studies considered for TRV derivation are from primary sources. Secondary sources of data are not used to derive Wildlife TRVs. The application automatically assigns a Source score based on the Primary Source entry. If the "No" box is selected, the application exits completely from the program. Since the User has progressed to this point of the data entry process, the application assumes that the study is a primary source and a score of 10 is assigned.

2. Contaminant Form Score

The wildlife TRVs are expressed in units of ingested dose (mg/kg BW/day or mg/L/day). Expression as units of ingested dose implicitly assumes that absorption of the contaminant from the test medium is the same as for the site medium. This assumption may be reasonable when the two media are the same (e.g., both water or both similar food items), but may not be true if the two media are different (e.g., test medium = water, site medium = soil). To account for the potential difference in absorption between different media, it is necessary to convert both the ingested dose and the TRV to units of absorbed dose:

Site Dose (absorbed) = Site Dose (ingested) * Absorption fraction from site medium

TRV(absorbed dose) = TRV(ingested dose)* Absorption fraction in test medium

Some contaminants are better absorbed and more biologically active than others. The best known examples are differences between inorganic and organic mercury, and inorganic and organic arsenic. Studies reporting oral absorption fraction from the test medium are preferred to those where the absorption fraction is unknown. In the absence of oral absorption data, the assumption of equal absorption of the contaminant from the test and site medium is reasonable when the form of the contaminant is the same in the test medium versus the site medium. Therefore, studies which use the same chemical form of a contaminant in the exposure medium as that typically found on a waste site are preferred.

The User assigns a Contaminant Form score based upon the similarity of the contaminant form used in the study to contaminant forms found in environmental media. A summary of common contaminant forms found in environmental media is provided in Table 3. If the contaminant form used in the study is the same or similar to that in environmental media, a score of 10 is selected by the User. If the contaminant form is not relevant to absorption or biological activity, a score of 10 is selected. If the contaminant form is different from that in environmental media, a score of 5 is selected. If the contaminant form is not reported (NR), a score of 4 is selected by the User.

3. Test Substrate Score

Studies that report contaminant exposure concentrations or doses in the diet or drinking water confirmed by analytical measurement - "measured"- are preferred compared to those that do not measure or verify the exposure doses or concentrations.

The application automatically assigns a Test Substance score based on the value the User entered under "Method of Contaminant Analysis". If the method of contaminant analysis is measured (M) or unmeasured but analytically verified (UX), a score of 10 is assigned. If unmeasured (U) is entered, a score of 5 is assigned. If calculated (C) is entered, a score of 1 is assigned. Gavage studies are considered measured, and are scored as a 10.

4. Dose Quantification Score

Some toxicological studies report contaminant exposures in terms of dose (mg of contaminant per unit of body weight), but some only report the concentration of the contaminant in the exposure medium (food or drinking water). In these cases, it is necessary to convert the concentrations to a dose using an intake rate (food or water) and a body weight. Studies that report results as doses are preferred over those that report concentrations and the application automatically assigns these studies a Dose Quantification Score of 10. Studies that report exposure on a concentration basis are scored in the following manner according to preference:

- If both body weight and intake rates are reported at any point of the exposure for the test organisms in the study (the User is prompted to enter this information earlier in the data entry process), the study endpoint receives a score of 7. The application automatically uses the body weight and intake rate values entered previously to convert the exposure concentrations to doses.

- If only one value (intake rate or body weight) is provided for the test organisms, a score of 6 is assigned.

- If the study does not report either body weights or intake rates for the test organism, the application assigns a score of 5. Doses are automatically calculated based on the default body weight and intake rate values previously entered by the User.

- If the administered doses cannot be calculated from the information provided, a score of 0 is assigned by the User from the pull down menu.

If the study uses an exposure method of where the administered amount is reported as a dose in amount of chemical per unit of body weight, the User selects the dose quantification score from the provided pull down list as follows:

- If the amount administered is reported for any exposure route in units of mg/kg body weight, a score of 10 is assigned.

- If the amount administered is in units of mg/organism, it must be divided by body weight to convert to dose units of mg/kg/day. If the body weight is reported in the study, a score of 7 is assigned.

- If the body weight is not reported and the value needs to be estimated based on a default, a score of 5 is assigned.

5. Dose Range Score

The TRV represents a threshold on the dose-response curve between the absence and presence of the adverse effect of concern. Establishing this threshold involves identification of two values from the toxicological study: a no observed adverse effect level (NOAEL) and a lowest observed adverse effect level (LOAEL). The NOAEL is defined as the highest administered dose that does not cause a significant adverse effect. The LOAEL is defined as the lowest administered dose that causes a significant adverse effect. Experimentally, the threshold value is estimated by assuming it lies between the NOAEL and the LOAEL. Therefore, a study which identifies both a NOAEL and a LOAEL is more valuable than a study that identifies only a NOAEL or LOAEL. Studies which use a larger number and/or more closely spaced doses may provide a more refined estimate of the NOAEL and LOAEL and are preferred.

The application automatically assigns a Dose Range score based upon the NOAEL and/or LOAEL values entered previously by the User. This assignment appears in the pull down menu on the score sheet. The User, however, may assign a different score from among the choices provided.

If both a NOAEL and a LOAEL are identified and the values are within a factor of 3, a score of 10 is assigned. If both a NOAEL and a LOAEL are identified and the values are within a factor of 10, a score of 8 is assigned. If both a NOAEL and a LOAEL are identified, but the values are not within a factor of 10, a score of 6 is assigned. If only a NOAEL or a LOAEL is identified, a score

of 4 is assigned. If the study lacks a suitable control group, a score of 0 is assigned by the User. Unsuitable control groups include: Historical (H), No Methodology (K), and Positive (P). If the control type is not reported (NR), a score of 0 is assigned.

6. Dose Route Score

The Eco-SSLs reflect the concentrations of contaminants in soil protective of oral exposure via ingestion of soil or food items. Therefore, toxicological studies that use oral exposure (food, water, gavage, or capsule) are considered to be relevant compared to studies that use other non-oral methods of administration (inhalation, dermal, and injection routes). Studies that report results for non-oral exposures are not used to establish TRVs and should be labeled as "non oral" using the literature rejection criteria discussed in Section 2.0.

Dietary studies are preferred to oral exposure via gavage or capsule because they represent the closest approximation of the intake route under natural conditions. Gavage and capsule studies are less desirable because they do not generally reflect natural feeding behaviors and the vehicle used to deliver the gavage dose can alter the kinetics of absorption. Drinking water is the least desirable among the acceptable routes of administration because the Wildlife TRVs are derived for use in assessments conducted in terrestrial rather than aquatic environments.

The application automatically assigns a Dose Route score based upon the Exposure Type and Route of Exposure information previously entered by the User. If the Route of Exposure is via food (FD), a score of 10 is assigned. If the route of exposure is via other oral routes (OR) or gavage (GV), a score of 8 is assigned. If the route of exposure is via drinking water (DW), a score of 5 is assigned. If the route of exposure is a choice between contaminated and non contaminated media (CH), a score of 0 is assigned. If the route of exposure is not reported (NR), a score of 0 is assigned.

7. Endpoint Score

In most ecological risk assessments (ERAs), assessment endpoints focus on the effects of long term exposures of contaminants on population sustainability. The specific toxicological endpoints used as measurements of population sustainability in ERAs are site-specific. For the purposes of identification and derivation of a TRV for calculation of an Eco-SSL, the endpoints are predefined. The following endpoints are selected in order of preference for derivation of TRVs.

- Studies measuring reproductive endpoints are considered the most appropriate and are preferred. Reproductive endpoints are assigned a score of 10. Within the coding system, this includes any endpoint within the reproduction (REP) effect group (Table 17).

- Studies measuring mortality or survival (chronic) as an endpoint are also considered appropriate but are less preferable to reproductive endpoints. These study

endpoints are assigned a score of 9. Within the coding system, this includes any endpoint within the mortality (MOR) effect group (Table 17).

- Studies measuring growth are also considered appropriate for establishing TRVs. These study endpoints are assigned a score of 8. Within the coding system, this includes any endpoint within the (GRO) effect group (Table 17).

- Studies measuring organ function, behavior or neurological function are considered less useful in establishing TRVs. This applies to endpoints within the pathology (PTH), behavior (BEH) or physiology (PHY) effect groups in the TRV coding system. These study endpoints are assigned a score of 4. The User may elect to score such studies lower if it is decided that the effect does not have an adverse effect on organism "fitness" or health (Table 17).

- Studies measuring biochemical effects or changes that are either hormonal, chemical or enzymatic in nature are considered the least useful in establishing TRVs. These study endpoints are assigned a score of 1. This evaluation includes any endpoint in the biochemical (BIO) effect group of the Wildlife TRV coding system. The User may elect to score such study measures higher if it is decided that the measure can be related to organism "fitness" or health. Biomarkers of exposure should always be scored as a 1.

8. Exposure Duration Score

The usefulness of a study result for derivation of a TRV is partially dependent on the duration of the exposure. Chronic and multiple generation exposures are preferred to subchronic or acute exposures. Chronic exposures are generally more representative of the type of exposure which may occur at a contaminated site.

The User assigns an Exposure Duration score based upon the duration of the study exposure and the life span of the test organism. A summary of typical laboratory test organism life spans is provided in Table 23. Data for representative species of wildlife are also included. In some cases, a range of values has been presented for the longevity of wildlife species. The User should preferentially select the average life span, if given, and secondarily select the minimum value from that range if the exposure occurs also at a critical lifestage.

To assess if the exposure duration is representative of the expected lifespan, the User multiplies the test organism lifespan by 0.1 and compares the result to information in Table 23. For example, if the test organism is a gerbil with an assumed lifespan of 2.5 years (2.5 years * 0.1 = 0.25 years or 12 weeks), an exposure duration of 9 weeks is less than 0.1 times the expected lifespan. If the duration of the study exposure encompasses multiple generations of the test organism, a score of 10 is selected. If the duration of exposure is at least 0.1 times the expected lifespan of the test organism or occurs during a critical lifestage, a score of 10 is selected. If the duration of exposure is less that 0.1 times the expected lifespan of the test organism and multiple dose or concentration groups are included in the study, a score of 6 is selected. If the duration of exposure is less that 0.1

times the expected lifespan and only a single dose or concentration group is used in addition to controls, a score of 3 is assigned. If the exposure duration is acute (a single oral dose), a score of 0 is selected.

Table 23. Default Weaning, Puberty, and Lifespan Values for TRV Species

Group	Species	Weaning (days)	Puberty (days)	Lifespan (years)	Reference
Laboratory Rodents	Mice	21	50	2*	USEPA, 1987
	Rats	21	56	2*	USEPA, 1987
	Guinea Pigs	14	70	6	USEPA, 1987
	Hamsters	21	60	2.5	USEPA, 1987
	Gerbils	21	70	3	USEPA, 1987
Other Laboratory Mammals	Cats	49	240	15	USEPA, 1987
	Dogs, Beagles	42	240	15	USEPA, 1987
	Rabbits, New Zealand	56	190	6	USEPA, 1987
Other Tested Animals	Vole, meadow	21	>21 (male) >42 (female)	0.1-0.25 (mean) Use 0.25	Golley, 1962 Johnson and Johnson, 1982 Beer and Mcleod, 1961
	Shrew, short-tailed	25-30	$65 (male, lab) $83 (male) <365 (female)	0.37-0.38 (lab) Use 1.04 <1.7	Blus, 1971 Pearson, 1944 French, 1984 Dapson, 1968
	Pig	NR	150	27	
	Mink	56	300	7 (mean) 10-11 (max) Use 9	Enders (1952) Ewer (1973)
	Pheasant	7-12[a]	330	<3	Giudice and Ratti, 2001
Other Tested Animals	Mallard	52-60 56	330	23	Clapp et al., 1982 Bellrose, 1976 Loekmoen et al., 1990 Krapu and Doty, 1979
	Chicken	NA	NA	24	USEPA, 1987
	Dove, mourning	15	80(males) 90 (females)	31 (max) 1.5 (mean) Use 1.5	Clapp et al. 1983 White et al., 1987 Mirarchi and Basket, 1994
	Quail, bobwhite	14	330	6.5 (max)	Rosene, 1969
	Quail, Japanese	NR	NR	3	Porter and Terril, 1986

* Substantial strain variability
NA = Not Applicable
NR = Not Reported
a Pheasant chicks can first take flight at 7 to 12 days; broodomg by hen is important for the first two weeks after hatching. Broods remain intact with hen for an indefinite period.

9. Power Score

A NOAEL is defined as the highest dose that does not cause a significant effect in the selected endpoint when compared to the control. However, the ability to detect an effect (i.e., the reliability of the NOAEL) depends on a number of factors. The most important are:

1) the variability of the measurement endpoint in both the control and the dosed groups
2) the number of animals in each group

That is, as variability in the measurement endpoint goes up and the number of experimental animals goes down, the ability to detect an effect becomes very poor, and a dose which actually causes an effect may be incorrectly identified as a NOAEL.

Statistical power is a measure of the ability to detect an effect. There are a number of standard statistical procedures available for calculating the power of a study to detect an effect which can be used to evaluate the reliability of NOAEL values. The statistical power test used for the toxicological Data Evaluation process for establishing Wildlife TRVs is described in Appendix B.

If both a NOAEL and a LOAEL are reported or if only a LOAEL is reported, the power calculation is not used and a score of 10 is assigned by the application. In cases where only a NOAEL is reported, scores are assigned as follows. If the calculated power is greater than or equal to 90 percent, a score of 10 is assigned. If the calculated power is greater than or equal to 75 percent, a score of 8 is assigned. If the calculated power is greater than or equal to 50 percent, a score of 6 is assigned. If the calculated power is less than 50 percent, a score of 3 is assigned. If the power cannot be calculated because one or more of the required fields is null, a score of 1 is assigned. In cases where the endpoint reported is mortality and the result is 0 in either the exposed groups or the control, the User should assign a score of 10 as power cannot be calculated. The user should also assign a score of 10 where the author reports a mortality endpoint as not significant in the text but does not report data.

10. Test Condition Score

The User is prompted earlier in the data entry process to identify if the study follows a standard guideline for toxicity testing and if not how many of the parameters the study reports. The standard guidelines and test parameters are provided in Table 13. If the study follows a standard guideline and reports all measurement parameters, then a score of 10 is assigned. If the study does not follow standard guidelines but reports all parameters, a score of 10 is also assigned. If the study follows a standard guideline but does not report all test parameters, then a score of 7 is assigned. If the study does not follow a standard guideline, but reports some but not all of the test parameters, then a score of 4 is assigned. If the study does not report any parameters, a score of 2 is assigned.

Final Total Score

The "Score Information" screen is now complete. The User verifies that all data entered are correct and clicks on the "Calculate Score" button at the bottom of the screen to calculate the final total score. The User should not use the browser back arrow to return to a previous data entry screen to correct errors, this action results in a duplication of information.

The total score is based upon the evaluation of each of the ten attribute scores identified above. The total score is calculated for a specific endpoint by taking the sum of all ten study attribute scores (a "perfect" study is given a score of 100). However, if any one study attribute is given a score of 0, the final score is also be set to equal 0. This ensures minimum standards for study results that are used to derive wildlife TRVs. Studies without appropriate controls, of acute exposure duration, without reported test substance concentrations, and non-oral exposures are excluded from the TRV derivation process.

Several scoring examples are provided below:

Lowest Possible Total Score (all attribute scores are the minimum score without defaulting to 0:

Study Attribute	Score
Source Score:	10
Dose Route Score:	5
Test Substrate Score:	5
Contaminant Form Score:	4
Dose Quantification Score:	5
Endpoint Score:	1
Dose Range Score:	4
Power Score:	1
Exposure Duration Score:	3
Test Parameter Score:	2
Total Score	**40**

Case Where Individual Attribute Score = 0

Study Attribute	Score
Source Score:	10
Dose Route Score:	5
Test Substrate Score:	1
Contaminant Form Score:	4

Dose Quantification Score:	0
Endpoint Score:	1
Dose Range Score:	4
Power Score:	1
Exposure Duration Score:	3
Test Parameter Score:	2
Total Score	**0**

Final Score set to zero, due to Dose Quantification Score

Highest Possible Total Score available (all attribute scores are the maximum score):

Study Attribute	**Score**
Source Score:	10
Dose Route Score:	10
Test Substrate Score:	10
Contaminant Form Score:	10
Dose Quantification Score:	10
Endpoint Score:	10
Dose Range Score:	10
Power Score:	10
Exposure Duration Score:	10
Test Parameter Score:	10
Total Score	**100**

At this point of the data entry process, the User completes data entry and scoring for the selected endpoint and clicks on "Finish this Endpoint" to proceed. The User **should not** use the browser back arrow to return to a previous data entry screen to correct errors as this would result in a duplication of information.

If there is another endpoint associated with the selected phase (the selected phase is provided in the navigation bar at the top of the screen), the User selects "Yes" when prompted for another endpoint and begins entry of that endpoint at the Endpoint Information screen. If there are no other endpoints associated with the selected phase, then the User selects "No".

When the data entry process is completed, the endpoint scores are used to derive TRVs as described in Attachments 4-5 and 4-6. Papers with a total score of 66 or higher are included in the data set used for derivation of Wildlife TRVs. Papers with a score of 65 or less are not used for the derivation of TRVs.

5.0 QUALITY ASSURANCE AND QA REPORTS

Entered data are reviewed and approved for accuracy and completeness prior to use in derivation of Wildlife TRVs. The database provides a QA report option for manual review. Coded data are compiled on a printable screen form. The coded data are cross-checked against the source publication for accuracy and against the TRV coding guidelines for consistency by an administrative user. Any errors noted are corrected in the database prior to QA approval. The database program automatically records the date that changes were made to the TRV database as a result of QA review, but does not track specific edits.

To perform an QA review, an Administrative User accesses the QA report for a given article. If errors are found on the report, the User uses the editing functions available in the TRV database to make corrections (see Section 4 for more information regarding data entry and edits). When the correct data has been entered, the Administrative User chooses View/Edit Articles to approve the article by choosing the "Yes" radio button located beside the text "Article Approved?". A comment must be entered at this time, to signal to the system that the article has been approved. This feature protects against errant clicks that may accidently change the status of the Article Approved? radio button.

6.0 DOWNLOADS

Data contained in the TRV database can be downloaded from the TRV database to a User's computer in Microsoft Access format. To perform a download, select the "Download" function from the Data Entry menu of the TRV database.

APPENDIX A

ALLOMETRIC EQUATIONS FOR DEFAULT INTAKE RATES

Food Ingestion Rates

Where food ingestion rates are not reported in the individual respective toxicological studies, the food ingestion rates are estimated using the allometric equations of Nagy (1987). Nagy (1987) derived equations to estimate dry-weight-based food ingestion rates for mammals and birds based on body mass. Food ingestion rates are derived using the following equations:

For mammals:

$$IR_{food} = 0.0687 x BW^{0.822} \quad (1)$$

where:

IR_{food} = Ingestion rate of food, wet weight basis (Kg/day);
0.0687 = Mathematical constant derived by Nagy (1987);
BW = Body weight of the ROI (Kg); and
0.822 = Mathematical constant derived by Nagy (1987).

For birds:

$$IR_{food} = 0.0582 x BW^{0.651} \quad (2)$$

where:

IR_{food} = Ingestion rate of food, wet weight basis (Kg/day);
0.0582 = Mathematical constant derived by Nagy (1987);
BW = Body weight of the ROI (Kg);
0.651 = Mathematical constant derived by Nagy (1987); and

Water Ingestion Rates

If the water ingestion rate for the test species is not reported in the respective toxicological study under review then the water ingestion rate for the test species is estimated used an allometric equation. For avian species, Calder and Braun (1983) developed an equation for estimation of drinking water ingestion (IRwater) based on the body weight of the bird where:

$$IR_{water} = 0.059 x BW^{0.67} \quad (3)$$

where:

IR_{water}	=	Ingestion rate of water, (L/day);
0.059	=	Mathematical constant derived by Calder and Braun (1983);
BW	=	Body weight of the test species (kg); and
0.67	=	Mathematical constant derived by Calder and Braun (1983).

Calder and Braun (1983) also developed an allometric equation for drinking water ingestion by mammals.

$$IR_{water} = 0.099 x BW^{0.90} \quad (4)$$

where:

IRwater	=	Ingestion rate of water, (L/day);
0.099	=	Mathematical constant derived by Calder and Braun (1983);
BW	=	Body weight of the test species (kg); and
0.90	=	Mathematical constant derived by Calder and Braun (1983).

APPENDIX B

STATISTICAL POWER TEST

(Source: Rosner 1995. Fundamentals of Biostatistics)

The NOAEL is normally defined at the highest exposure level in a study that did not cause a statistically significant difference in mean response from the control group. The test for statistical significance that is most often used to compare the control group and an exposed group is the one-sided t-test assuming equal variance:

$$t = \frac{m_2 - m_1}{s_p \sqrt{1/n_1 + 1/n_2}}$$

where:

$$s_p = \sqrt{\frac{(n_1 - 1) \cdot s_1^{\,2} + (n_2 - 1) \cdot s_2^{\,2}}{n_1 + n_2 - 2}}$$

m = mean response of control group (m_1) or test group (m_2)
s = standard deviation of control group (s_1) or test group (s_2)
s_p = pooled standard deviation
n = number of animals in control group (n_1) or test group (n_2)

Power is the ability of a particular experimental study to detect a statistically significant difference between the control group and the exposed group, if the true difference in the means is some specified value ( )). The method used to calculate power for the difference in the means of two normal distributions with equal variance in a one-tailed test is as follows:

$$Power = \Phi\left(Z_\beta\right) = \Phi\left(\frac{\Delta}{s_p \sqrt{1/n_1 + 1/n_2}} - Z_{1-\alpha}\right)$$

where:

N = Standard normal distribution function

) = Assumed difference between the means of the exposed and control groups (i.e., the difference that is of concern to you as a biologically significant effect). Choosing the value of) to use is this calculation is subjective. For the purposes of evaluating toxicological studies as candidates for derivation of TRVs, **a default value of 20% of control is used as).** This is based on the assumption that most experimental studies cannot detect smaller changes with acceptable power, and that changes of 20% or less will often not result in population level impacts, at least for many endpoints.

" = Statistical significance level used to declare an effect different from control. **The default value of " is 0.05.**

If it is not convenient to calculate the standard normal distribution function of $Z_{\$}$ exactly, the approximate power of a study can be determined using the following table of critical values:

Z_b (Critical)	Power
-0.674	25%
0.000	50%
0.674	75%
0.842	80%
1.282	90%
1.645	95%

For example, if the calculated value of $Z_{\$}$ is 0.93, then the power of the study to detect a difference of size) at the 0.05% confidence level is greater than 80% but less than 90%. A similar approach has been used in the Wildlife TRV database to evaluate the results of the power calculation and assign a power score.

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