APPENDIX M

COMPUTATIONAL SOFTWARE USER'S GUIDE

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INTRODUCTION

The risk evaluation software described below was developed to complement and follow the procedures and policies described in the *Idaho Risk Evaluation Manual* (REM). It is intended to perform many but not all of the calculations for RE-1 and RE-2 evaluations at typical release sites. For example, calculation of exposure point concentrations from field data, such as the 95 percent UCL and calculations of risk for pathways not explicitly included in the REM or using more complex models must be completed separately. Likewise calculations for the initial screening or emergency response steps are also not included.

This user's guide is intended to provide guidance regarding the layout and procedures programmed into the software in order to facilitate its application in evaluating contaminated sites. This user's guide is not intended to provide guidance regarding the selection of appropriate input parameters.

The REM computational software is a Microsoft (MS) Excel file (ID_REM_V1.xls) and is available to download from the Department of Environmental Quality (DEQ) Web site at http://www.deq.state.id.us

MODELS AND EQUATIONS

The models and equations programmed into the REM software are presented in Appendix H.

HARDWARE AND SOFTWARE REQUIREMENTS

The following hardware and software are necessary to run the spreadsheet program:

- An 80386-based computer or better.
- A monitor with VGA capabilities or better. A monitor with 800 x 600 resolution is highly recommended.
- A mouse.
- MS Windows 3.1 (or later version).
- MS Excel 5.0 (or later version).
- Eight megabytes of random access memory (RAM).
- Ten megabytes of disk space for each workbook saved for individual sites.

Note: On some older computers that are at the lower end of the minimum hardware requirements, operations involving the selection of chemicals from the database may run slowly.

PREREQUISITES

An operating knowledge and intermediate level of experience with MS Excel is necessary to run the program. Familiarity with the Idaho RBDM program is also highly recommended.

INSTALLATION

- Download the idrbdm.zip file to a directory of choice.
- Extract the idrbdm.xls Excel file and save it to a directory of choice using the WinZip or PKZip utilities.

SPECIAL INSTRUCTIONS

- The "Analysis ToolPak" in MS Excel is a **required add-in.** Use ***"Tools"*** from the main toolbar in an open workbook and click on ***"Add-ins…."*** In the checkbox menu, select both ***"Analysis ToolPak"*** and ***"Analysis ToolPak - VBA"*** (consult an MS Excel manual for further help on "Add-ins").

COLOR CODING

- Buttons with black inscription are command buttons.
- Buttons with blue inscription are help/instruction buttons. Click these buttons to access information associated with that subject.
- Red input values are internally calculated by the software.
- Green cells are intended for user entries as appropriate. No other cells are intended for user entry.

OPERATING THE SPREADSHEET PROGRAM

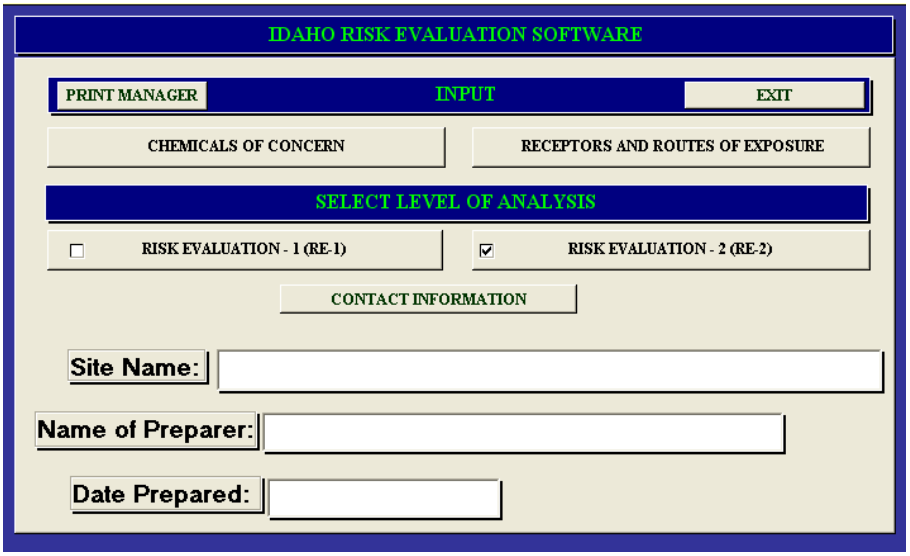
Consult an MS Excel manual for basic spreadsheet operations.

- Use ***"File"*** and ***"Open"*** commands from the MS Excel menu to open the file. The software will open with a title page. Press the "***Continue***" button to continue.
- The "***Continue***" button on the title page will take the user to the main menu (Figure 1). From the main menu, the user can go to:
  - The **Chemicals of Concern** sheet where chemicals of concern (COCs) are selected from a built-in database.
  - The **Receptors and Routes of Exposure** sheet where receptors and complete or potentially complete routes of exposure are selected.
  - The **Risk Evaluation - 1 (RE-1) Main Menu**
  - The **Risk Evaluation - 2 (RE-2) Main Menu**

Contact information for technical support is also provided on this main menu. The "*Main Menu*" button provided on all the individual sheets enables the user to get back to the main menu.

The **Chemicals of Concern** and **Receptors and Routes of Exposure** inputs and sheets are common to both the RE-1 and RE-2 evaluations. These sheets should be completed prior to selecting the specific level of analysis (RE-1 or RE-2) to be performed.

Figure 1. Main Menu Screen.



Chemicals of Concern Sheet

Upon clicking the *"Chemicals of Concern"* button on the main menu, the sheet shown in Figure 2 will appear. From this sheet chemicals included in the RBDM evaluation can be selected and their physical, chemical, and toxicological properties can be viewed. The master list of chemicals is presented in the body of the sheet in white while the list of chemicals currently selected is shown in the gray area on the left.

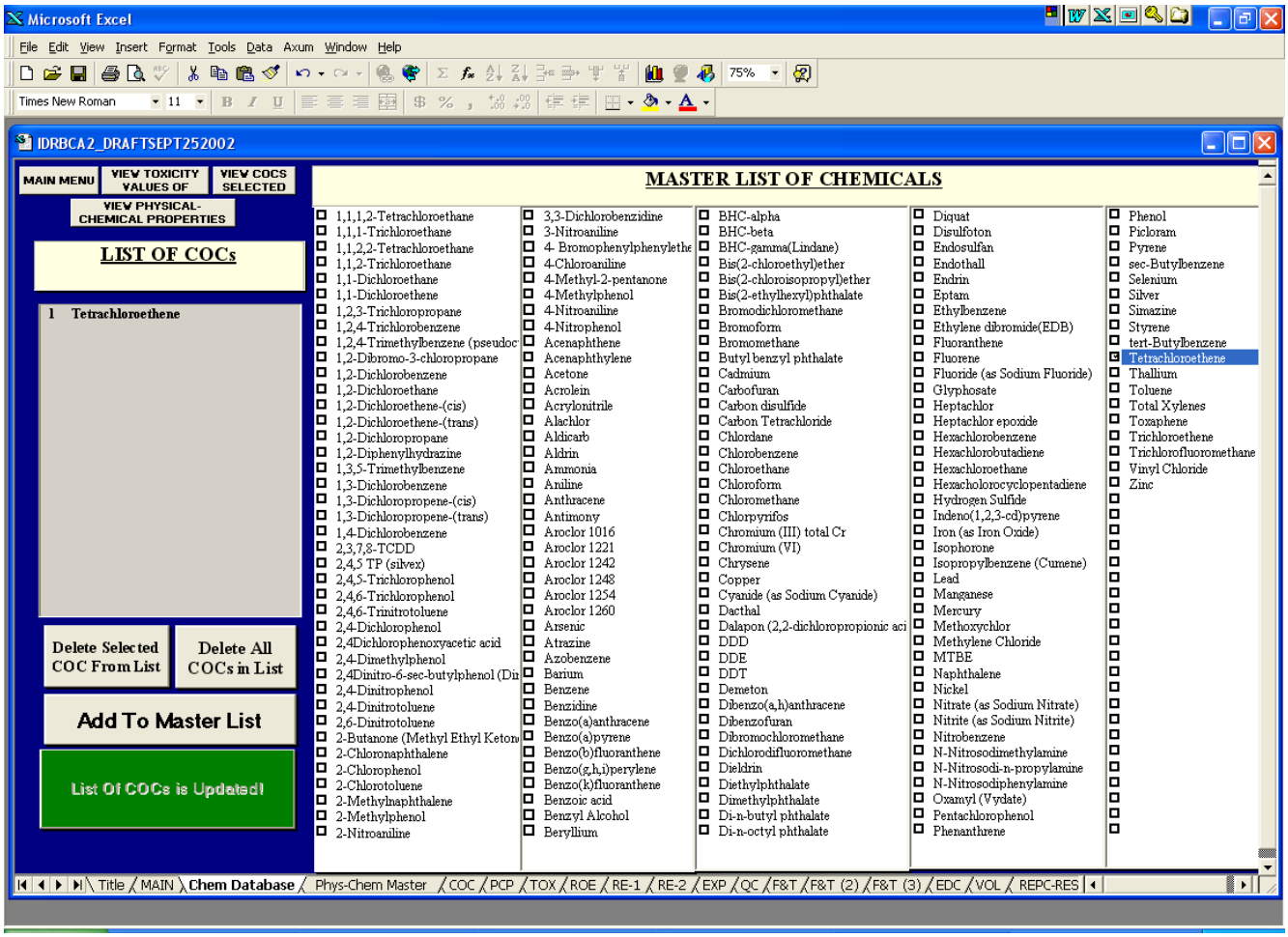


Figure 2. Chemicals of Concern Sheet.

Chemicals are initially selected by using the master list, clicking on the checkboxes associated with the desired chemicals, and then clicking the large button in the lower left titled *"Update List of COCs?"* (appearing red in the software). Upon updating the red button will turn green and will indicate *"List of COCs is Updated!"*, as is shown in Figure 2. The chemicals selected will now appear in the gray area above entitled *"List of COCs."* Properties of the COCs selected can be viewed by clicking the appropriately labeled buttons in the upper right. If the user is starting a new project with different chemicals, it is recommended that the list be cleared before selecting new chemicals. This is accomplished by clicking the *"Delete All COCs In List"* button and answering YES to the question box *"Do you want to DELETE ALL COCS from list?"*

Once the list of chemicals is selected, it can be modified in two ways. Additional individual chemicals can be added to or deleted from the list using the checkbox procedure described above. To delete simply uncheck the box for a given chemical and update. Chemicals can also be deleted by selecting the chemical from the gray ***"List of COCs"*** box and then clicking on the "***Delete Selected COC From List"*** button.

If a chemical is not present on the master list of chemicals it can be added. Before this is done the user should have all the necessary physical, chemical, and toxicological properties for that chemical available and those values must have been approved by DEQ. The chemical is added by first clicking the "***Add To Master List"*** button. This takes the user to the **Master Chemical Database** sheet. The user then scrolls to the next available blank row in the list of chemicals, adds the data for that chemical, and returns to the **Chemicals of Concern** sheet by clicking the "***Chem database"*** button at the upper left corner of the **Master Chemical Database** sheet. The chemical should now appear in the master list of chemicals.

Receptors and Routes of Exposure Sheet

Upon clicking the ***"Receptors and Routes of Exposure"*** button on the main menu, the sheet shown in Figure 3 will appear.

This sheet allows the user to select the receptors and routes of exposure and the ground water and/or surface water protection pathways (resulting from leaching of chemicals through soil), if these are appropriate for the site under evaluation. Selections are made through the use of checkboxes. For residential receptors, typically both child and age-adjusted receptors should be selected. The soil vapor route of exposure for indoor inhalation should only be checked if an RE-2 evaluation is being completed and the appropriate soil vapor data is available.

If the ground water or surface water protection pathways are to be included, one should first check the box (with blue inscription) associated with that pathway and then complete the options and other questions associated with that pathway. In the case of ground water protection two options are available. One must determine whether the aquifer in question has a high or low probability of use for drinking water. The software will then select the appropriate target concentration for use in fate and transport calculations. Justification for the selection should be provided by the person conducting the risk evaluation in the
accompanying REM report.

Figure 3. Receptors and Routes of Exposure Sheet.

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MAIN MENU | PRINT

RECEPTOR(S) AND ROUTE(S) OF EXPOSURE

(Select by clicking the checkboxes)

ROUTES OF EXPOSURE BY MEDIA	RECEPTORS			
	RESIDENT		NON-RESIDENTIAL	CONSTRUCTION WORKER
	CHILD	AGE-ADJUSTED		
Surficial Soil Ingestion of Soil, Outdoor Inhalation of Vapor Emissions and Particulates, and Dermal Contact with Soil	☑	☑	☑	☑
Subsurface Soil Indoor Inhalation of Vapor Emissions	☑	☑	☑	
Groundwater Indoor Inhalation of Vapor Emissions	☑	☑	☑	
Soil-Vapor (RE-2 only) Indoor Inhalation of Vapor Emissions	☐	☐	☐	

☑ **Groundwater Protection**

☑ **Option 1.** **Groundwater with Current Use or High Probability of Future Use as Drinking Water**: The Maximum Contaminant Levels (MCLs) are used as the target concentrations at the POE. For chemicals without MCLs, risk-based ingestion standard for an age-adjusted adult is used.

☐ **Option 2.** **Groundwater with Low Probability of Future Use as Drinking Water**: Groundwater concentrations protective of off-site receptors resulting from exposure via pathways other than direct ingestion. These pathways include but are not limited to volatilization to indoor air, irrigation water use with crop uptake and ingestion, and irrigation water use without crop uptake.

☑ **Surface Water Protection**

If a surface water body is impacted or threatened, complete the following:

Surface water is used for drinking/water quality is appropriate for drinking water supplies?	☐
Surface water supports aquatic life?	☑
Surface water is used for recreational activities?	☑

If Ammonia is a potential COC for surface water, complete the following:

Surface water supports cold water aquatic species?	☑
Surface water supports warm water aquatic species?	☑

For surface water protection two additional sections must be completed. First, the designated beneficial uses for the surface water body in question must be determined and selected. The beneficial uses for most surface water bodies in the state are listed in the Idaho Water Quality Standards and Wastewater Treatment Requirements (IDAPA 58.01.02, Sections 110-160). If the beneficial uses for a specific water body are not known, at a minimum the aquatic life and recreational uses should be checked. Secondly, if ammonia is a COC the questions of whether the water body is designated to support cold or warm water aquatic species must be answered so that calculation of the appropriate ammonia standard can be made.

Risk Evaluation Main Menu

After the COC and the complete exposure pathways are selected, the user will return to the main menu, and select the desired level of analysis to be performed in order to calculate risk and target levels under RE-1 or RE-2. In order to select between RE-1 and RE-2, the user must check the appropriate checkbox and then click on the appropriate button.

Risk Evaluation-1 Main Menu

From the main menu, the ***"Risk Evaluation-1"*** button will take the user to the **Risk Evaluation-1 Main Menu** as shown in Figure 4 below.

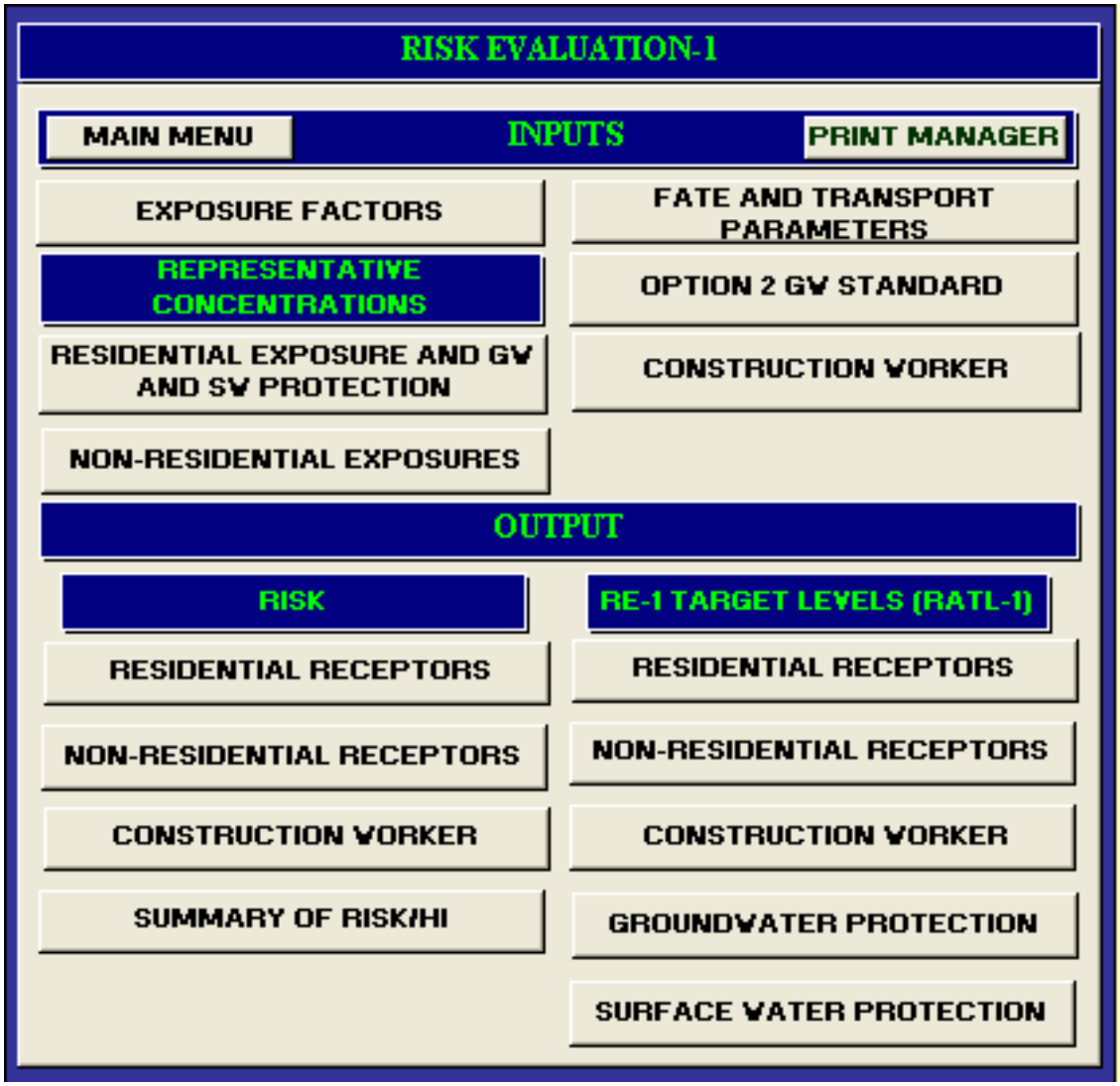


Figure 4. Risk Evaluation-1 Main Menu Screen..

Within the **Risk Evaluation-1 Main Menu**, the buttons are arranged under "Inputs" and "Outputs." Clicking the ***"Exposure Factors"*** button takes one to the sheet listing the exposure factors and the default values for each exposure scenario. It is not expected that the exposure factor values will be modified under RE-1.

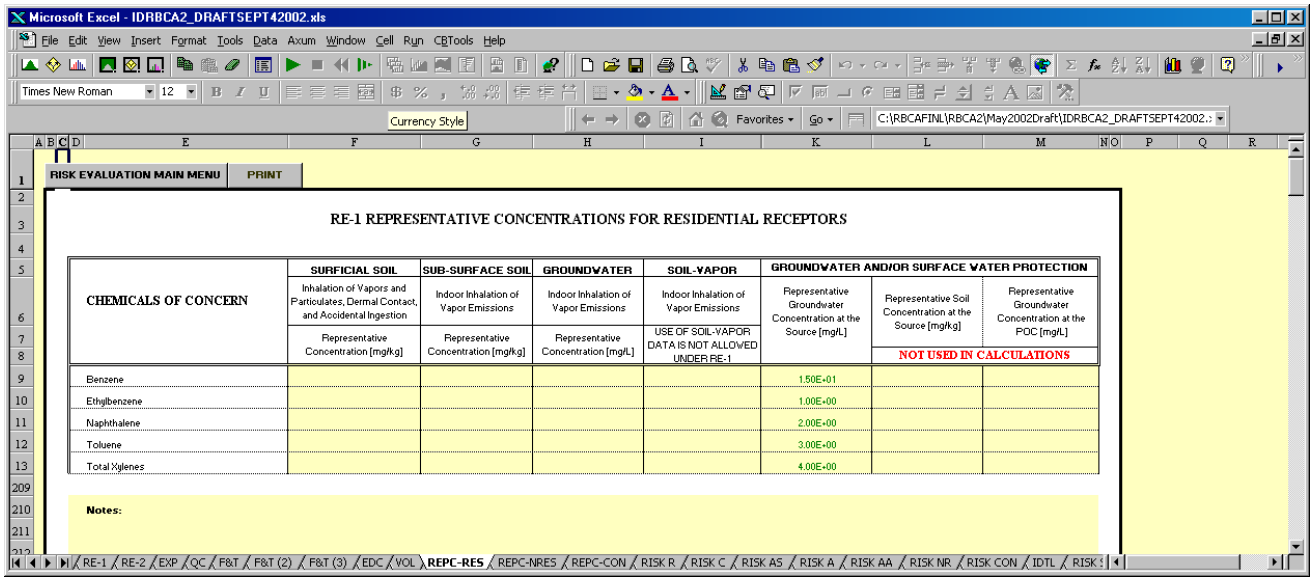
Clicking the ***"Fate and Transport Parameters"*** button takes one to a series of three **Fate and Transport Input** sheets where input cells are available for the parameters used in fate and transport, and risk calculations and parameter default values are listed. At the top of each sheet are buttons that will take the user between any of the three sheets. The first and third sheets list parameters needed to evaluate the indoor air inhalation of vapors from soil and/or ground water. The second sheet lists parameters for the ground water and surface water protection pathways. It is expected that under RE-1 the default values

will be used for many of the fate and transport parameters. For any parameter, when a value other than a default value is entered, a note is indicated in the comment field for DEQ reviewers that appropriate justification for the use of that value should be provided in the REM report. Additional information on the selection and input of data in these sheets is provided in the Fate and Transport section under RE-2 below.

Representative concentrations for each pathway and receptor checked as complete in the **Receptors and Routes of Exposure** sheet must be entered by the user. Individual representative concentration buttons, labeled ***"Residential Exposure and GW and SW Protection," "Non-Residential Exposures,"*** and ***"Construction Worker"*** are provided for residential, nonresidential, and construction worker receptors. Clicking any of these buttons leads to a sheet where the representative concentrations for that receptor and specific routes of exposure can be entered. For example, clicking on the *"**Residential Exposure and GW and SW Protection"*** button leads to the sheet shown in Figure 5.

Appropriate representative concentration values for each chemical and pathway are entered in the appropriate cells. If a pathway was not selected as complete, a notation indicating that no entry for that pathway is needed is displayed in the cell. In RE-1 the use of soil vapor data is not allowed and a note to that effect is shown. Input areas are also available for ground water concentrations in the source area, soil concentrations in the source area, and ground water concentrations at an alternate point of compliance. These inputs are related to the protection of ground water and surface water pathways. The ground water source area concentration is used to calculate transport in the saturated zone and estimate ground water concentrations at specified point of compliance, point of exposure, or point of discharge locations. These outputs are provided in the GW Protection and SW Protection sheets for each level of analysis.

The latter two inputs (soil source area concentration and ground water concentration at the point of compliance) are for informational purposes only and **are not used in calculations**. They provide a basis for comparison with the allowable concentration values calculated by the software via the backward mode to determine if exceedances exist. These allowable concentration values are provided in the **GW Protection** and **SW Protection** output sheets.



RISK EVALUATION MAIN MENU | PRINT

RE-1 REPRESENTATIVE CONCENTRATIONS FOR RESIDENTIAL RECEPTORS

CHEMICALS OF CONCERN	SURFICIAL SOIL	SUB-SURFACE SOIL	GROUNDWATER	SOIL-VAPOR	GROUNDWATER AND/OR SURFACE WATER PROTECTION		
	Inhalation of Vapors and Particulates, Dermal Contact, and Accidental Ingestion	Indoor Inhalation of Vapor Emissions	Indoor Inhalation of Vapor Emissions	Indoor Inhalation of Vapor Emissions	Representative Groundwater Concentration at the Source [mg/L]	Representative Soil Concentration at the Source [mg/kg]	Representative Groundwater Concentration at the POC [mg/L]
	Representative Concentration [mg/kg]	Representative Concentration [mg/kg]	Representative Concentration [mg/L]	USE OF SOIL-VAPOR DATA IS NOT ALLOWED UNDER RE-1		NOT USED IN CALCULATIONS	
Benzene					1.50E+01		
Ethylbenzene					1.00E+00		
Naphthalene					2.00E+00		
Toluene					3.00E+00		
Total Xylenes					4.00E+00		

Notes:

Figure 5. Example Representative Concentrations Input Sheet.

Also included in the "Inputs" section of the **Risk Evaluation-1** (and **Risk Evaluation-2**) **Main Menu** is the "Option 2 GW Standard" button. The sheet accessed by this button provides an area to input target groundwater concentrations for downgradient receptors potentially impacted by groundwater pathways other than drinking water. This sheet is described in more detail under the **RE-2 Evaluation Main Menu** below.

Risk Evaluation-2 Main Menu

The ***"Risk Evaluation-2"*** button under the main menu will take the user to the **Risk Evaluation-2 Main Menu** as shown in Figure 6.

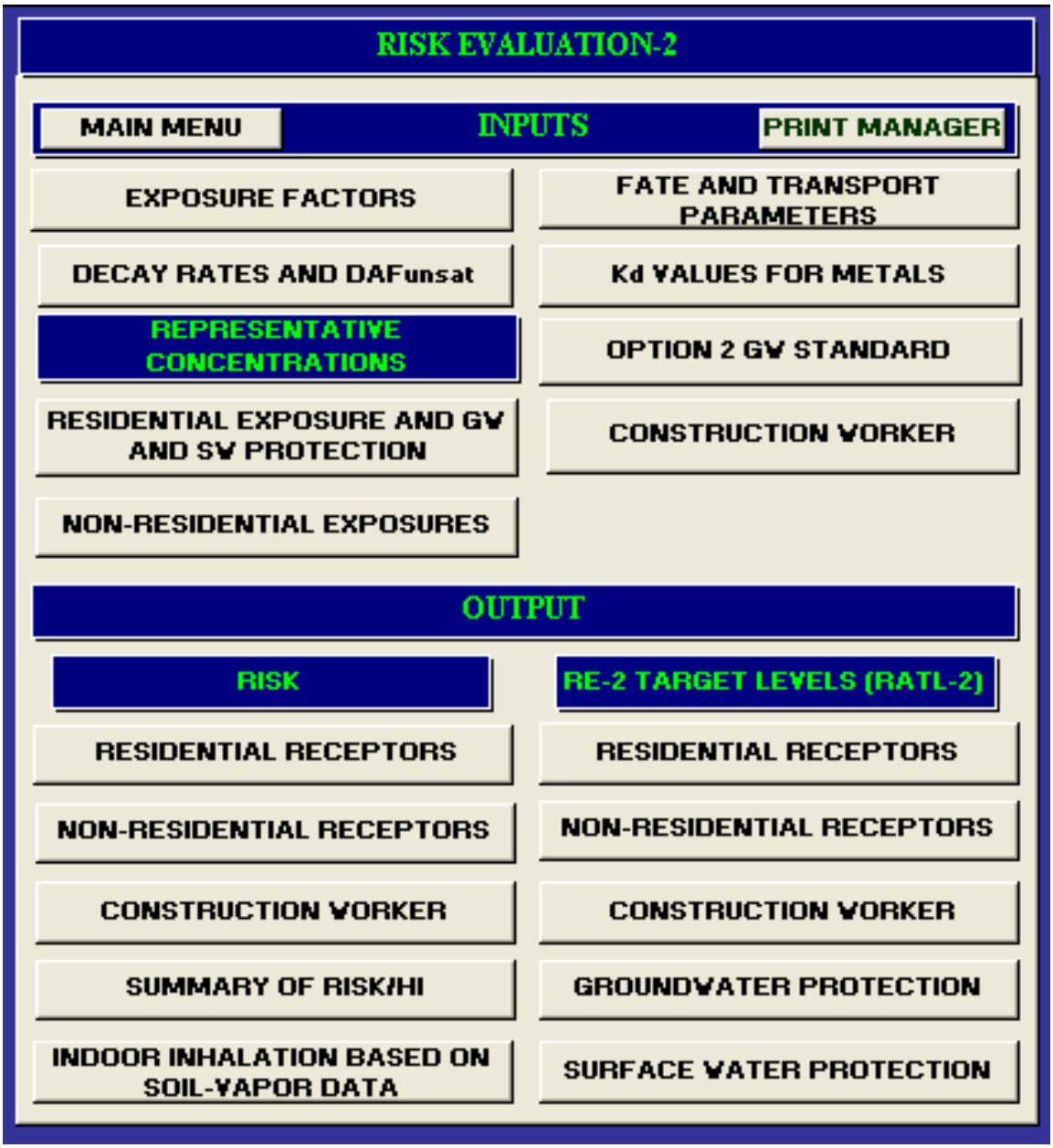


Figure 6. Risk Evaluation-2 Main Menu Screen.

Similar to the **Risk Evaluation-1 Main Menu**, the **Risk Evaluation-2 Main Menu** also has the buttons arranged under "Inputs" and "Outputs."

Input procedures are similar to those described for RE-1 with the following differences:

- Under RE-2, the user may enter representative soil vapor concentrations in the space provided within the input sheets for representative concentrations and develop soil vapor target levels.
- RE-2 has two more input sheets than RE-1; one allows user entry of chemical specific/site-specific decay rates and unsaturated zone dilution attenuation factor (DAF) values calculated using other fate and transport models and the other allows the entry of site-specific partition coefficient (Kd) values for metals. In both instances any site-specific data for decay rates, DAF values, or Kd values for metals should be supported in the REM report with appropriate documentation.

Fate and Transport Input Sheets

With the exception of the additional input sheets noted above, the Fate and Transport Input sheets for both RE-1 and RE-2 evaluations are similar. Each sheet consists of three pages of input fields. An example of one of the pages (page 2 of 3) from the Fate and Transport Input sheet is shown in Figure 7. Information that will assist in the completion of the specific pages is provided below.

<u>Page 1</u>

The soil and ground water data input fields on this page are for use in the indoor air calculations. These input fields describe the separation distance between the soil and ground water sources and the bottom of the foundation of any building in question. The distance for ground water sources includes the capillary fringe thickness. The conceptual model for the pathway assumes the source lies directly below the structure. The number of strata refers to the number of soil layers between the **top** of the soil source (or the water table in the case of a ground water source) and the structure.

Input fields are also provided for enclosed space parameters used to estimate the inflow of air and vapor into the structure and to calculate the amount of dilution of soil vapor that occurs. Several of these fields, such as the building ventilation rate and the soil gas flow rate into the building, are calculated within the software. Typically, for RE-1, the enclosed space parameters are not changed.

Finally in Page 1 are input parameters used to calculate the particulate emission factor to include when estimating surficial soil exposures.
The default value of the dispersion parameter (Q/C) used in the Cowherd particulate emission factor calculation is for a 0.5-acre site located in Boise, and was taken from Table 3 of the U.S. Environmental Protection Agency's *Soil Screening Guidance* (EPA, 1996). If information to support the use of another value from this table is available, it can be selected by clicking the dark gray box titled ***"Inverse of Mean Concentration in the Middle of a Square Source".*** A reproduction of Table 3 will appear. The user can then select the checkbox for the appropriate city and source size, and return to the **Fate and Transport Input** sheet.

Page 2

Page 2 allows the user to input aquifer properties, soil properties of the source zone and the saturated zone, and distances from the source to either a point of exposure or point of compliance (if different from the point of exposure). These data are used to calculate target levels for both ground water and surface water protection.

The ability to input site-specific data for selected surface water properties (pH, temperature, and hardness) needed to calculate chemical-specific standards is also provided.

The point of compliance distance should always be equal to or less than the point of exposure distance (or the point of discharge in the case of surface water protection). This data is used to estimate dispersivity values for ground water transport from the source.

Page 3

Page 3 allows the user to input stratum-specific thickness and soil properties for up to three layers of soil and the capillary fringe (for ground water sources) to use in the indoor air calculations. The soil properties for which stratum-specific data can be entered are moisture content, bulk density, organic carbon content, and porosity. If the vapor permeability of the soil layer directly beneath the building (Soil Stratum 1), is known it can also be entered.

When entering strata thickness information for soil sources, be sure that the total thickness of individual strata equals the value entered on Sheet 1 for the distance between the top of the source and the bottom of the building. The total thickness of individual strata should include the capillary fringe thickness in ground water sources. This value should also equal the top of source to building separation distance value entered on Sheet1.

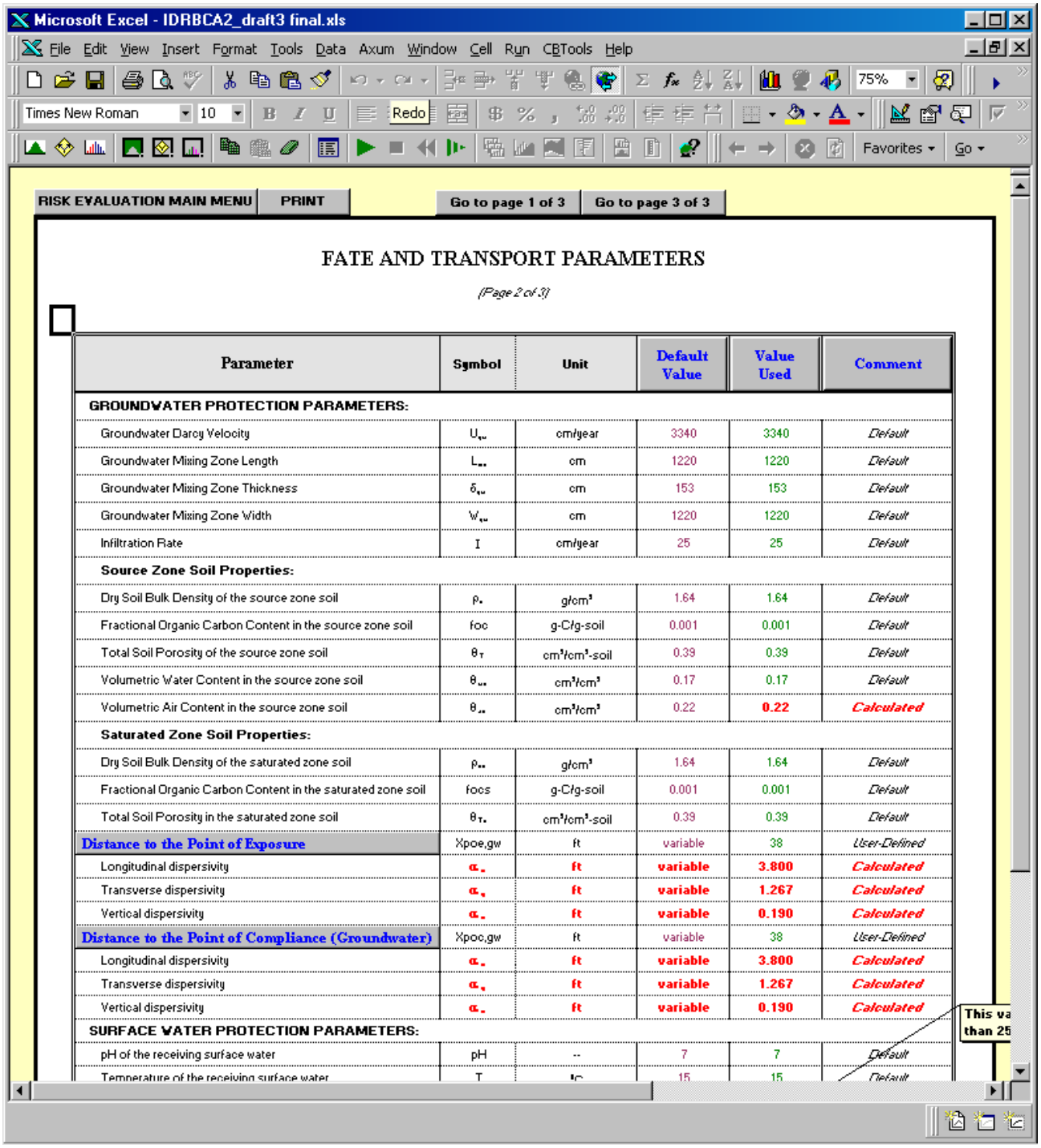
The user must enter the stratum-specific properties of porosity and volumetric moisture content. The software will use the difference to calculate the volumetric air content.

The capillary zone thickness and moisture content of capillary fringe soil are estimated using equations taken from *User's Guide for the Johnson-Ettinger Model* (EPA, 2000). The capillary zone thickness is dependant primarily on the mean particle diameter of soil in this zone. The capillary zone moisture content calculation requires values for the soil residual moisture content, saturated soil moisture content (estimated by total porosity), and the van Genuchten N value, which describes the shape of the moisture retention curve when using the van Genuchten model (van Genuchten, 1980). Values of mean particle diameter, residual moisture content, and the van Genuchten N for various soil types are provided in Table 1, which was adapted from Tables 2 and 3 of the *User's Guide forEvaluating Subsurface Vapor Intrusion into Buildings* (EPA, 2003). Documentation for all values that vary from the default values should be provided to DEQ for evaluation and approval.

Table 1. Class Average Values of Residual Water Content, Mean Particle Diameter, and Van Genuchten N Soil Water Retention Parameter for 12 Soil Conservation Service Soil Textural Classifications (adapted from EPA, 2003).

Soil Texture (USDA[a])	Residual Water Content	Mean Particle Diameter (cm)	van Genuchten N Parameter
Clay	0.098	0.0092	1.253
Clay Loam	0.079	0.016	1.416
Loam	0.061	0.020	1.472
Loamy Sand	0.049	0.040	1.746
Silt	0.050	0.0046	1.679
Silt Loam	0.065	0.011	1.663
Silty Clay	0.111	0.0039	1.321
Silty Clay Loam	0.090	0.0056	1.521
Sand	0.053	0.044	3.177
Sandy Clay	0.117	0.025	1.208
Sandy Clay Loam	0.063	0.029	1.330
Sandy Loam	0.039	0.030	1.449

[a]United States Department of Agriculture



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FATE AND TRANSPORT PARAMETERS

(Page 2 of 3)

Parameter	Symbol	Unit	Default Value	Value Used	Comment
GROUNDWATER PROTECTION PARAMETERS:					
Groundwater Darcy Velocity	U_{gw}	cm/year	3340	3340	*Default*
Groundwater Mixing Zone Length	L_{gw}	cm	1220	1220	*Default*
Groundwater Mixing Zone Thickness	δ_{gw}	cm	153	153	*Default*
Groundwater Mixing Zone Width	W_{gw}	cm	1220	1220	*Default*
Infiltration Rate	I	cm/year	25	25	*Default*
Source Zone Soil Properties:					
Dry Soil Bulk Density of the source zone soil	ρ_s	g/cm³	1.64	1.64	*Default*
Fractional Organic Carbon Content in the source zone soil	foc	g-C/g-soil	0.001	0.001	*Default*
Total Soil Porosity of the source zone soil	θ_T	cm³/cm³-soil	0.39	0.39	*Default*
Volumetric Water Content in the source zone soil	θ_{w}	cm³/cm³	0.17	0.17	*Default*
Volumetric Air Content in the source zone soil	θ_{a}	cm³/cm³	0.22	**0.22**	***Calculated***
Saturated Zone Soil Properties:					
Dry Soil Bulk Density of the saturated zone soil	ρ_{sz}	g/cm³	1.64	1.64	*Default*
Fractional Organic Carbon Content in the saturated zone soil	focs	g-C/g-soil	0.001	0.001	*Default*
Total Soil Porosity in the saturated zone soil	θ_{Tz}	cm³/cm³-soil	0.39	0.39	*Default*
Distance to the Point of Exposure	Xpoe,gw	ft	variable	38	*User-Defined*
Longitudinal dispersivity	α_x	**ft**	**variable**	**3.800**	***Calculated***
Transverse dispersivity	α_y	**ft**	**variable**	**1.267**	***Calculated***
Vertical dispersivity	α_z	**ft**	**variable**	**0.190**	***Calculated***
Distance to the Point of Compliance (Groundwater)	Xpoc,gw	ft	variable	38	*User-Defined*
Longitudinal dispersivity	α_x	**ft**	**variable**	**3.800**	***Calculated***
Transverse dispersivity	α_y	**ft**	**variable**	**1.267**	***Calculated***
Vertical dispersivity	α_z	**ft**	**variable**	**0.190**	***Calculated***
SURFACE WATER PROTECTION PARAMETERS:					
pH of the receiving surface water	pH	--	7	7	*Default*
Temperature of the receiving surface water	T	°C	15	15	*Default*

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than 25

Figure 7. Example Fate and Transport Input Sheet (Page 2 of 3 Shown).

Option 2 Groundwater Standard Sheet

If Option 2 (low probability of use for drinking water) was selected in the Receptors and Routes of Exposure Sheet for Groundwater Protection additional information must be input. These input screens are accessed by clicking the Option 2 Groundwater Standard buttons from either the RE-1 or RE-2 main menu screens. This screen has the general appearance shown in Figure 8 below.

RISK EVALUATION MAIN MENU | PRINT

RE-1 OPTION 2 GROUNDWATER STANDARD

CHEMICALS OF CONCERN	Option 2 Groundwater Standard (mg/l)	Critical Pathway	Off-Site Receptor	Rationale
1,2-Dichloroethane	9.90E+01	Volatilization to Indoor Air	Residential	
2-Methylnaphthalene	3.14E+00	Volatilization to Indoor Air	Non-Residential	
Acenaphthene	1.23E+00	Volatilization to Indoor Air	Non-Residential	
Anthracene	3.21E+02	Volatilization to Indoor Air	Residential	
Benzene	3.21E+05	Volatilization to Indoor Air	Residential	
Benzo(a)anthracene	6.54E+02	Irrigation-With Crop Uptake	Residential	
Benzo(a)pyrene	5.60E+01	Irrigation-With Crop Uptake	Residential	
Benzo(b)fluoranthene	2.16E+02	Irrigation-With Crop Uptake	Residential	
Benzo(g,h,i)perylene	6.00E+00	Irrigation-With Crop Uptake	Residential	
Benzo(k)fluoranthene	4.40E+01	Irrigation-With Crop Uptake	Residential	
Chrysene	6.45E+03	Irrigation-With Crop Uptake	Residential	
Ethylbenzene	6.64E+02	Irrigation-With Crop Uptake	Residential	
Ethylene dibromide(EDB)	1.00E+02	Irrigation-With Crop Uptake	Residential	
Fluoranthene		Irrigation-With Crop Uptake	Residential	
Fluorene		Irrigation-With Crop Uptake	Residential	
MTBE		Irrigation-With Crop Uptake	Residential	
Naphthalene		Irrigation-With Crop Uptake	Residential	
Phenanthrene		Irrigation-With Crop Uptake	Residential	
Pyrene		Irrigation-With Crop Uptake	Residential	
Toluene		Irrigation-With Crop Uptake	Residential	
Total Xylenes		Irrigation-With Crop Uptake	Residential	

Figure 8. Option 2 Groundwater Standard Sheet.

If a groundwater pathway or route of exposure other than groundwater ingestion is potentially complete for off-site receptors and a target concentration has been calculated this sheet allows the input of that target concentration along with the critical pathway, the receptor, and a rationale for those choices.

Critical pathways are available for selection via a drop down box for each chemical. Pathways include volatilization of vapors from groundwater to indoor air, exposure to irrigation water with crop uptake, and exposure to irrigation water alone. Target concentrations can be determined outside of the software and input in this column. In the case of volatilization to indoor air target levels should be calculated within the software and then transposed to this column from the RATL sheets.

Receptors that can be selected include residential and non-residential individuals.

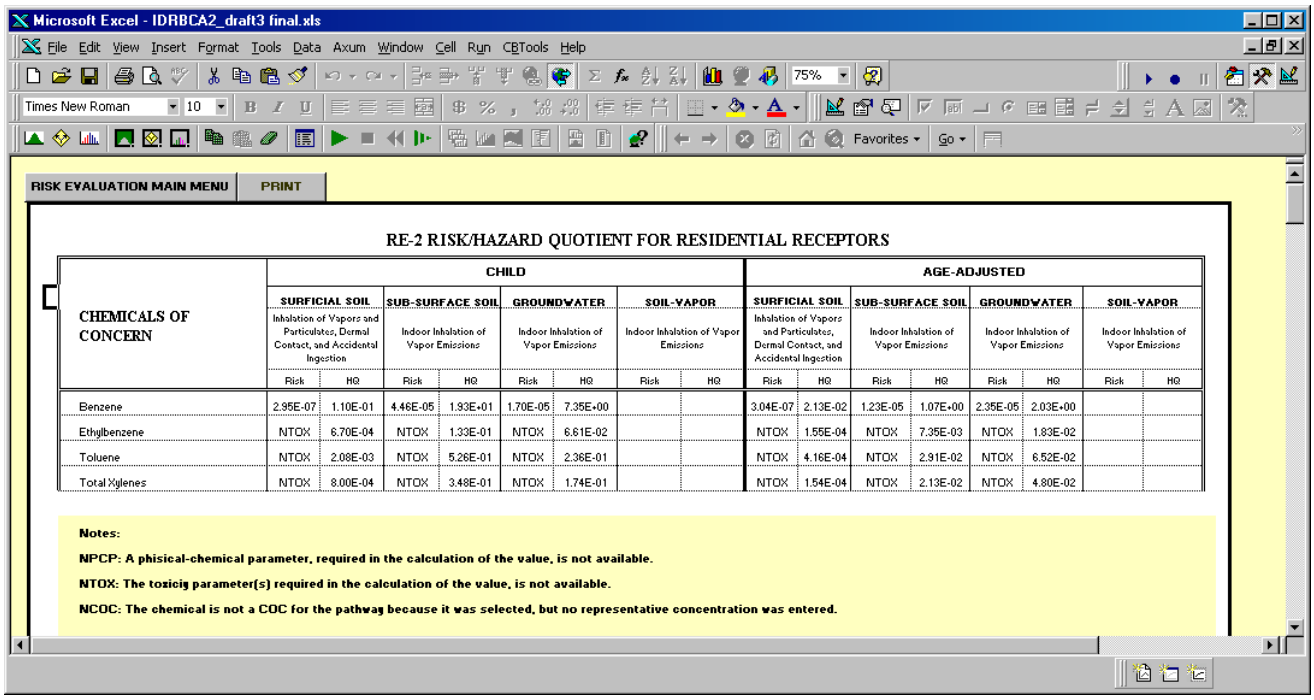
Once the appropriate data is entered into this sheet the target concentrations are automatically transferred to the Groundwater Protection sheet. Source area or point of compliance groundwater concentrations that will meet the specified target concentrations at the point of exposure will then be calculated

Output Sheets

Once the input sheets are properly and completely filled in, one may use the output buttons in either the **Risk Evaluation-1** or **Risk Evaluation-2 Main Menus** (see Figure 4) to view calculated risk levels and target levels (Remedial Action Target Levels-1 and -2 [RATL-1 and RATL-2]). Note that the **Risk-Evauation-2 Main Menu** has an additional output sheet for risk calculated from soil vapor concentrations, when those are available. For both risk and target levels, individual buttons are provided to access results by receptor type (residential, nonresidential, and construction worker). Each sheet under both RE-1 and RE-2 has a "*Risk Evaluation Main Menu"* button located in the upper left that will take the user back to the respective **Risk-Evauation-1 or Risk Evaluation-2 Main Menu**.

Risk Output Sheets

Clicking on the risk output button for any receptor type takes one to the sheet with calculated risk and hazard values. An example for the residential receptor type is shown in Figure 9. Individual results are shown for both child and age-adjusted residential receptors. Results on the sheets for specific receptor types do not sum the risk or hazard across chemicals, pathways, or the site. The ***"Summary of Risk/HI"*** button on the **Risk Evaluation-1 and -2 Main Menus** accesses the summary sheet (Figure 10) that sums risk across chemicals for each pathway and across pathways to yield site-wide risk for each receptor type. Also shown on this sheet is an indication as to which routes of exposure and receptors exceed the REM cumulative risk and hazard criteria.



Microsoft Excel - IDRBCA2_draft3 final.xls

RISK EVALUATION MAIN MENU | PRINT

RE-2 RISK/HAZARD QUOTIENT FOR RESIDENTIAL RECEPTORS

CHEMICALS OF CONCERN	CHILD								AGE-ADJUSTED							
	SURFICIAL SOIL		SUB-SURFACE SOIL		GROUNDWATER		SOIL-VAPOR		SURFICIAL SOIL		SUB-SURFACE SOIL		GROUNDWATER		SOIL-VAPOR	
	Inhalation of Vapors and Particulates, Dermal Contact, and Accidental Ingestion		Indoor Inhalation of Vapor Emissions		Indoor Inhalation of Vapor Emissions		Indoor Inhalation of Vapor Emissions		Inhalation of Vapors and Particulates, Dermal Contact, and Accidental Ingestion		Indoor Inhalation of Vapor Emissions		Indoor Inhalation of Vapor Emissions		Indoor Inhalation of Vapor Emissions	
	Risk	HQ	Risk	HQ	Risk	HQ	Risk	HQ	Risk	HQ	Risk	HQ	Risk	HQ	Risk	HQ
Benzene	2.95E-07	1.10E-01	4.46E-05	1.93E+01	1.70E-05	7.35E+00			3.04E-07	2.13E-02	1.23E-05	1.07E+00	2.35E-05	2.03E+00		
Ethylbenzene	NTOX	6.70E-04	NTOX	1.33E-01	NTOX	6.61E-02			NTOX	1.55E-04	NTOX	7.35E-03	NTOX	1.83E-02		
Toluene	NTOX	2.08E-03	NTOX	5.26E-01	NTOX	2.36E-01			NTOX	4.16E-04	NTOX	2.91E-02	NTOX	6.52E-02		
Total Xylenes	NTOX	8.00E-04	NTOX	3.48E-01	NTOX	1.74E-01			NTOX	1.54E-04	NTOX	2.13E-02	NTOX	4.80E-02		

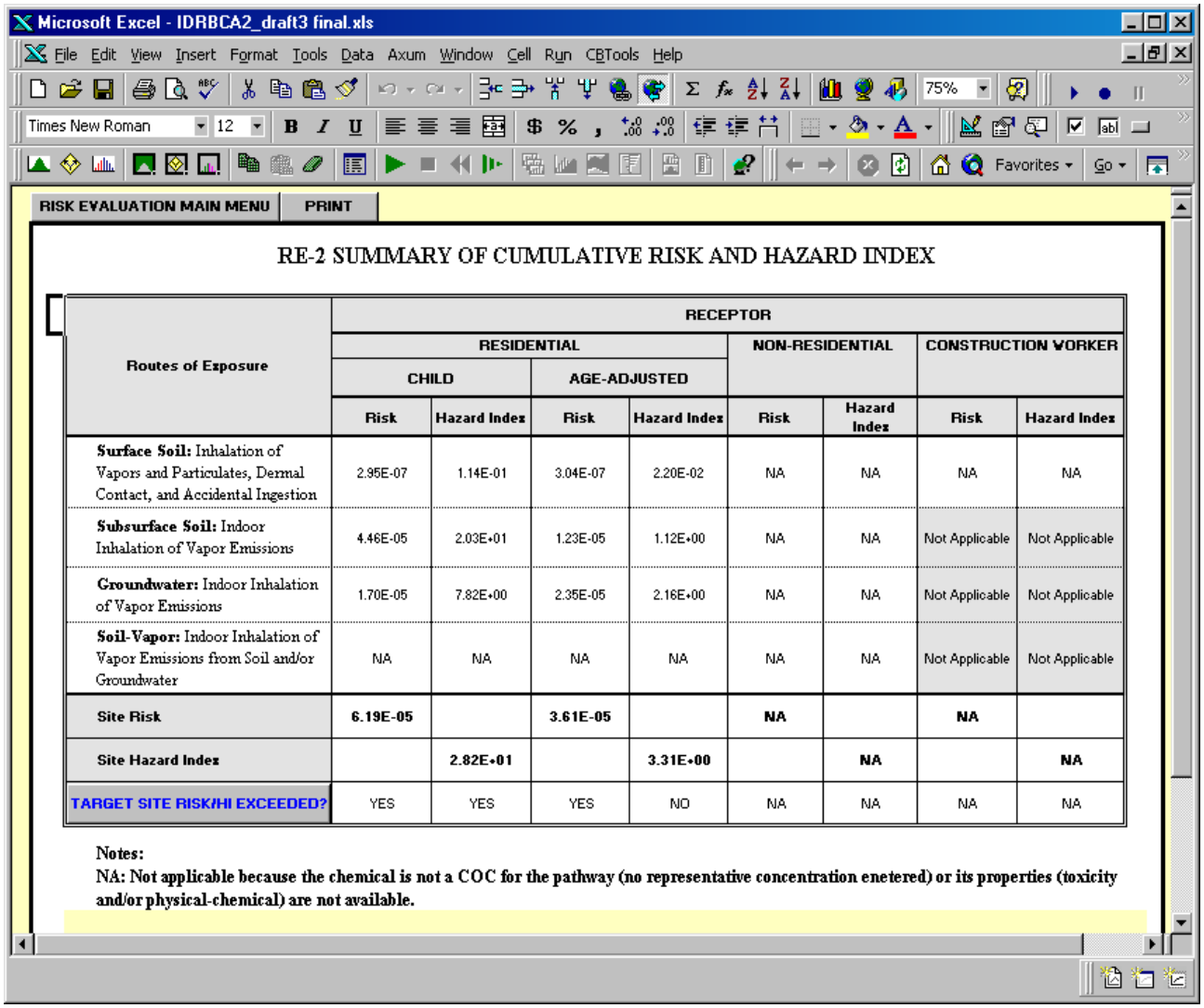
Notes:

NPCP: A phisical-chemical parameter, required in the calculation of the value, is not available.

NTOX: The toxicig parameter(s) required in the calculation of the value, is not available.

NCOC: The chemical is not a COC for the pathway because it was selected, but no representative concentration was entered.

Figure 9. Example Risk Output Sheet.



RISK EVALUATION MAIN MENU | PRINT

RE-2 SUMMARY OF CUMULATIVE RISK AND HAZARD INDEX

Routes of Exposure	RECEPTOR							
	RESIDENTIAL				NON-RESIDENTIAL		CONSTRUCTION WORKER	
	CHILD		AGE-ADJUSTED					
	Risk	Hazard Index	Risk	Hazard Index	Risk	Hazard Index	Risk	Hazard Index
Surface Soil: Inhalation of Vapors and Particulates, Dermal Contact, and Accidental Ingestion	2.95E-07	1.14E-01	3.04E-07	2.20E-02	NA	NA	NA	NA
Subsurface Soil: Indoor Inhalation of Vapor Emissions	4.46E-05	2.03E+01	1.23E-05	1.12E+00	NA	NA	Not Applicable	Not Applicable
Groundwater: Indoor Inhalation of Vapor Emissions	1.70E-05	7.82E+00	2.35E-05	2.16E+00	NA	NA	Not Applicable	Not Applicable
Soil-Vapor: Indoor Inhalation of Vapor Emissions from Soil and/or Groundwater	NA	NA	NA	NA	NA	NA	Not Applicable	Not Applicable
Site Risk	**6.19E-05**		**3.61E-05**		**NA**		**NA**	
Site Hazard Index		**2.82E+01**		**3.31E+00**		**NA**		**NA**
TARGET SITE RISK/HI EXCEEDED?	YES	YES	YES	NO	NA	NA	NA	NA

Notes:
NA: Not applicable because the chemical is not a COC for the pathway (no representative concentration enetered) or its properties (toxicity and/or physical-chemical) are not available.

Figure 10. Example of a RE-2 Summary of Cumulative Risk and Hazard Index Sheet.

Under RE-2, if soil vapor concentrations are available and are used to estimate risk for the inhalation of vapors from the indoor air route of exposure, risks are calculated using this data instead of soils or ground water data and are substituted in the summary sheet in the appropriate route of exposure area. The detailed, chemical-specific calculations for indoor inhalation risk, when using soil vapor data under RE-2, are found by clicking the *"Indoor Inhalation Based on Soil-Vapor Data"* button in the Risk Evaluation-2 Main Menu.

Target Level Output Sheets

In the **Risk Evaluation-1** and **Risk Evaluation-2 Main Menus**, output buttons for viewing target levels (RATL-1 and RATL-2) calculated by the software are arranged similar to those for risk calculations, by specific receptor types. In addition, there are

buttons that access the calculations for ground water and surface water protection target levels.

Clicking the ***"Groundwater Protection"*** button in the **Risk Evaluation-1** and **-2 Main Menus** accesses the sheets with the calculations used in developing ground water protection target levels, an example of which is shown in Figure 11 (**RE-1 Groundwater Protection** sheet). Located on the left side of this sheet are the Option 1 or Option 2 groundwater standards upon which the calculations are based. The column label indicates which option is currently selected. Depending on which Option was selected for groundwater protection in the **Receptors and ROE** sheet either the ingestion based standards (Option 1) or target concentrations derived from other groundwater pathways (Option 2) are provided. In the case of Option 2 these target concentrations were initially input in the **Option 2 GW Standard** sheet.

The calculated dilution attenuation factors (DAF) for the various parts of the transport pathway (from source to point of exposure) are presented moving from left to right in the sheet. These DAF were calculated from the values input for the relevant fate and transport properties. The target levels are expressed as ground water and soil concentrations allowable at both the source and at an alternate point of compliance (the distances for which are specified in the **Fate and Transport Input** sheets) that will meet the specified ingestion standard.

The two rightmost columns of the **Groundwater** and **Surface Water Protection** output sheets provide calculated estimates of ground water concentrations at the specified points of compliance and point of exposure/point of discharge resulting from saturated zone transport from the source area. These estimates are based on the representative concentrations for chemicals in the ground water source area input earlier.

The **Surface Water Protection** target levels sheet is similar to the **Groundwater Protection** sheet with the exception that the appropriate surface water standard, based on the most restrictive designated beneficial use, replaces the ground water ingestion standard. Target levels are expressed as the ground water or soil concentrations at the source that result in the surface water standard being met at the point of discharge into the surface water body.

RISK EVALUATION MAIN MENU | PRINT

RE-2 GROUNDWATER PROTECTION

CHEMICALS OF CONCERN	Groundwater Standard,Option 1 [mg/L]	First Order Biodecay Rate [day⁻¹]	Retardation Factor	Unsaturated Zone DAF [--]	Mixing Zone DAF [--]	Saturated Zone DAF at POC [--]	Saturated Zone DAF at POE [--]	Overall DAF at POC [--]	Overall DAF at POE [--]	Allowable Groundwater concentration [mg/L] protective of POE: AT POC	Allowable Groundwater concentration [mg/L] protective of POE: AT SOURCE	Soil concentration directly beneath the source protective of GW at POE [mg/kg]	Predicted Groundwater Concentration at POC [mg/L]	Predicted Groundwater Concentration at POE [mg/L]
1,2-Dichloroethane	5.00E-03	0.00E+00	1.06E+00	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	5.00E-03	5.00E-03	1.09E-02	0.00E+00	0.00E+00
2-Methylnaphthalene	4.17E-02	0.00E+00	1.94E+01	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	4.17E-02	4.17E-02	3.31E+00	0.00E+00	0.00E+00
Acenaphthene	6.26E-01	0.00E+00	2.03E+01	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	6.26E-01	6.26E-01	5.23E+01	0.00E+00	0.00E+00
Anthracene	3.13E+00	0.00E+00	7.93E+01	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	3.13E+00	3.13E+00	1.04E+03	0.00E+00	0.00E+00
Benzene	5.00E-03	0.00E+00	1.28E+00	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	5.00E-03	5.00E-03	1.78E-02	0.00E+00	0.00E+00
Benzo(a)anthracene	7.65E-05	0.00E+00	5.81E+03	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	7.65E-05	7.65E-05	1.88E+00	0.00E+00	0.00E+00
Benzo(a)pyrene	2.00E-04	0.00E+00	4.01E+03	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	2.00E-04	2.00E-04	3.39E+00	0.00E+00	0.00E+00
Benzo(b)fluoranthene	7.65E-05	0.00E+00	2.31E+03	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	7.65E-05	7.65E-05	7.47E-01	0.00E+00	0.00E+00
Benzo(g,h,i)perylene	3.13E-01	0.00E+00	6.67E+03	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	3.13E-01	3.13E-01	8.80E+03	0.00E+00	0.00E+00
Benzo(k)fluoranthene	7.65E-04	0.00E+00	4.31E+03	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	7.65E-04	7.65E-04	1.39E+01	0.00E+00	0.00E+00
Chrysene	7.65E-03	0.00E+00	1.03E+03	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	7.65E-03	7.65E-03	3.34E+01	0.00E+00	0.00E+00
Ethylbenzene	7.00E-01	0.00E+00	3.84E+00	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	7.00E-01	7.00E-01	1.02E+01	0.00E+00	0.00E+00
Ethylene dibromide(EDB)	5.00E-05	0.00E+00	1.23E+00	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	5.00E-05	5.00E-05	1.43E-04	0.00E+00	0.00E+00
Fluoranthene	4.17E-01	0.00E+00	2.07E+02	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	4.17E-01	4.17E-01	3.64E+02	0.00E+00	0.00E+00
Fluorene	4.17E-01	0.00E+00	3.17E+01	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	4.17E-01	4.17E-01	5.48E+01	0.00E+00	0.00E+00
MTBE	1.69E-02	0.00E+00	1.06E+00	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	1.69E-02	1.69E-02	3.64E-02	0.00E+00	0.00E+00
Naphthalene	2.09E-01	0.00E+00	6.42E+00	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	2.09E-01	2.09E-01	5.16E+00	0.00E+00	0.00E+00
Phenanthrene	3.13E-01	0.00E+00	6.04E+01	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	3.13E-01	3.13E-01	7.90E+01	0.00E+00	0.00E+00
Pyrene	3.13E-01	0.00E+00	2.73E+02	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	3.13E-01	3.13E-01	3.59E+02	0.00E+00	0.00E+00
Toluene	1.00E+00	0.00E+00	1.57E+00	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	1.00E+00	1.00E+00	4.89E+00	0.00E+00	0.00E+00
Total Xylenes	1.00E+01	0.00E+00	3.91E+00	1	1.78E+01	1.00E+00	1.00E+00	1.78E+01	1.78E+01	1.00E+01	1.00E+01	1.48E+02	0.00E+00	0.00E+00

Figure 11. Example Groundwater Protection Target Level Output Sheet.

PRINTING

Individual sheets can be printed using the ***"Print"*** button provided or using the ***"Print"*** icon on the Excel toolbar. To print selected sheets or all of the sheets under RE-1 or RE-2, click on the ***"Print Manager"*** button on the **Risk Evaluation-1** and **Risk Evluation-2 Main Menus.** A **Print Manager** sheet as shown in Figure 12 will appear. The user has several options available from this sheet:

- Select sheets for printing individually by checking the appropriate checkboxes or select all of the sheets by clicking the ***"Select All"*** button.
- Print the selected sheets using the ***"Print"*** button.
- Undo the selection using the ***"Deselect All"*** button.
- Return to the appropriate main menu using the ***"Main"*** button.

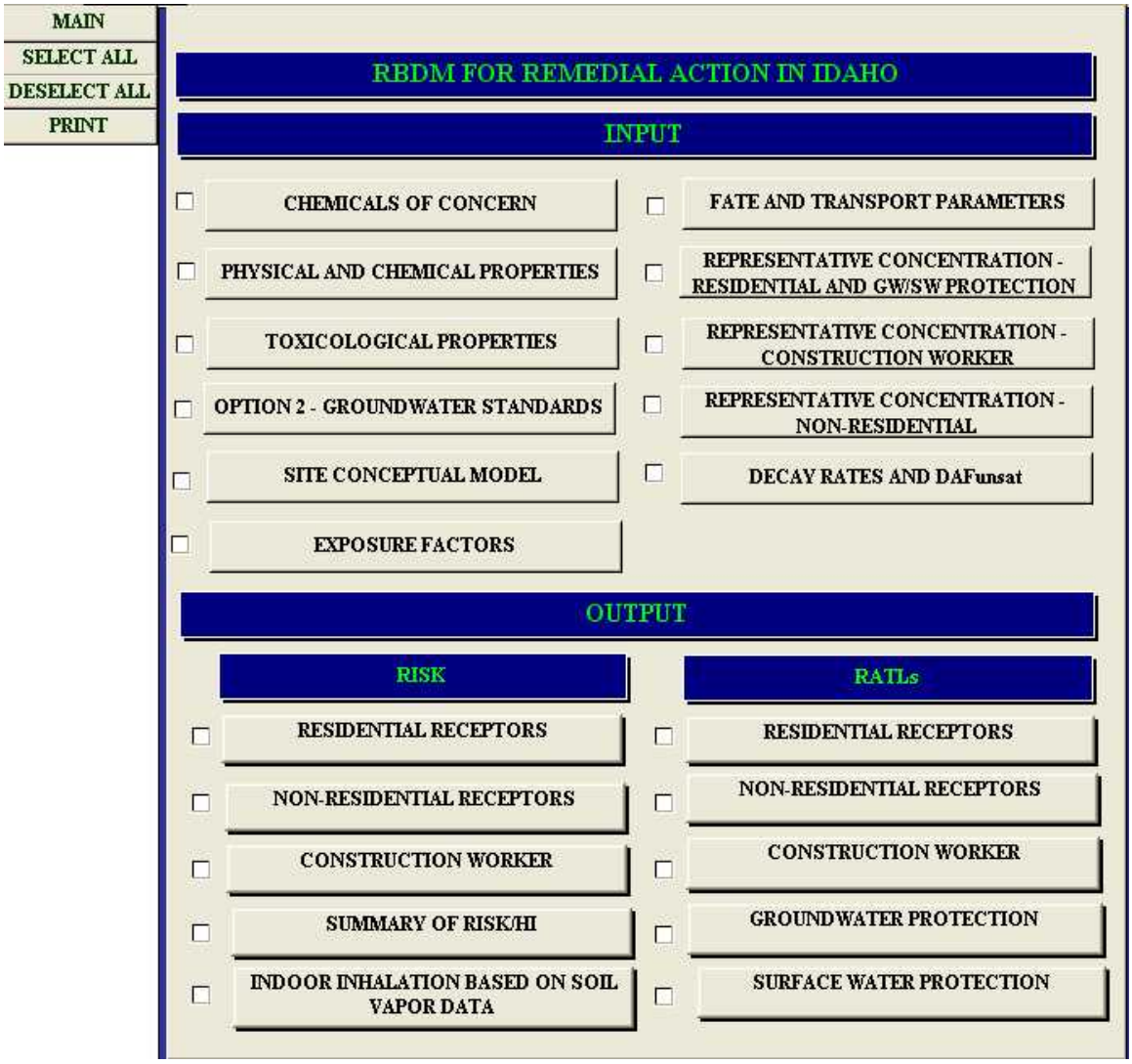


Figure 12. Print Manager Sheet.

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