PNNL-13806

RAGS Viewer for Generating Tables for RAGS Analysis: Testing Approach and Results

R. N. Kickert
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October 2001

Prepared for
U.S. Army Research and Development Center
Waterways Experiment Station
U.S. Army Corps pf Engineers
Vicksburg, Mississippi 39180
under Contract DE-AC06-76RL01830

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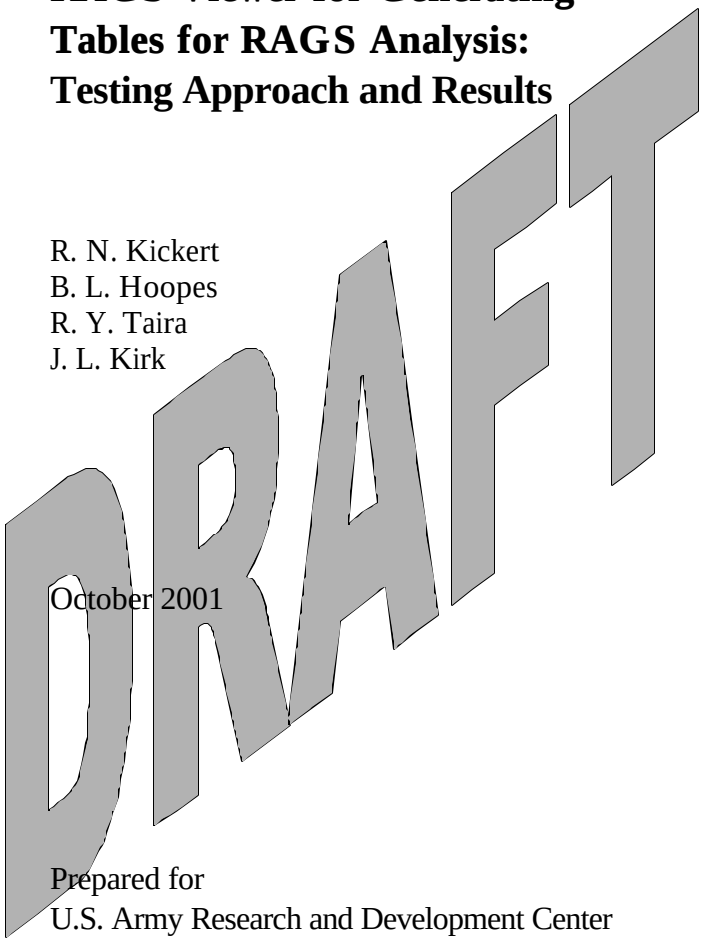

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Summary

The test plan that was designed and conducted for the RAGS Viewer is described. This Viewer is a set of programs that enable the Framework for Analysis of Risk in Multimedia Environmental Systems to generate the tables required for a RAGS analysis. Summaries of the requirements on which testing was based are provided as well as descriptions of test cases and the results of their implementation.

Acronyms

COPC	contaminants of potential concern
CT	Central Tendency
EPA	U.S. Environmental Protection Agency
FRAMES	Framework for Analysis of Risk in Multimedia Environmental Systems
RAGS	Risk Assessment Guidelines for Superfund
RAGS	The D for RAGS is EPA's D-section of the entire RAGS procedure.
RME	Reasonable Maximum Exposure

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Tables

1.0 Introduction

The "RAGS Viewer"[(a)] is a set of programs that will enable the Framework for Analysis of Risk in Multimedia Environmental Systems (FRAMES) system to generate the Tables required for a RAGS analysis as prescribed by the U.S. Environmental Protection Agency (EPA) at: http://epa.gov/superfund/programs/risk/ragsd/tara.htm.

The objective is simply to generate the RAGS tables as worksheets in an EXCEL file that match the structure of a given model. It is not the objective to populate each column and row of each table with the required data for conforming to RAGS requirements as specified by the EPA.

This report describes the test plan designed and conducted for the RAGS Viewer. It includes summaries of the requirements on which testing was based and descriptions of test cases, and it lists the results of their implementation. One test case for the RAGS Viewer was generated for the simple, single medium, Deans Creek Development Company example that is used by the EPA (see above URL) to demonstrate how to fill out the RAGS tables. Another test case uses a more elaborate multiple media example. The "rags.xls" files are included with the test package. The "rags.xls" file generated through independent testing should match these files.

Required program files are:

RAGSgen.exe, 8/13/2001, 10:27 am, 232 KB

RAGS_templates.XLS, 8/13/20001, 8:45 am, 132 KB

RAGSgen.des, 6/5/2001, 12:16 am, 2 KB

XlsChart.exe, 8/13/2001, 11:23 am, 460 KB.

(a) RAGS = Risk Assessment Guidance for Superfund. The D for RAGS refers to EPA's D-section of the entire RAGS procedure.

2.0 Risk Assessment Guidance for Superfund (Rags) Part D Report Generator Viewers

The RAGS Viewers allow the FRAMES user to have FRAMES generate the RAGS Tables after the model is run from the Health Impacts module to the extent that the suggested entries to the Tables are those that are used in running a FRAMES application.

2.1 Summary of Requirements

Requirements for the RAGS Viewers are described in Addendum 2 of the document: Requirements for the FRAMES Specification File Viewer Modules. Table 2.1 lists these requirements. To ensure that the RAGS Viewers meet the requirements shown in table 2.1, two cases were developed to check performance. Table 2.2 shows the relationship between these requirements and the test cases described in Section 2.2.

Table 2.1. Fundamental Requirements for Testing the RAGS Viewers

Requirement Number	Requirement
1	The RAGS Viewer shall be activated at the user's request after running a FRAMES-based model by right-clicking on the Health Impacts module icon to popup a context menu and then moving the cursor over "View/Print Module Output" to popup a sub-menu of applicable viewers and selecting "RAGS Table Generator for Chemicals."
2	The RAGS Viewer shall save to disk in the EXCEL file a worksheet containing: Table 1 - Selection of Exposure Pathways.
3	The RAGS Viewer shall save to disk in the EXCEL file worksheets containing: Tables 2.1 through 2.n—Occurrence, Distribution, and Selection of Chemicals of Potential Concern, one worksheet table for each environmental medium and exposure medium.
4	The RAGS Viewer shall save to disk in the EXCEL file worksheets containing Tables 3.1 through 3.n—Medium-Specific Exposure Point Concentration Summary, one worksheet table for each environmental medium and exposure medium.
5	The RAGS Viewer shall save to disk in the EXCEL file worksheets containing Tables 4.1 through 4.n—Values Used for Daily Intake Calculations, one worksheet table for each environmental medium and exposure medium.

Table 2.1 (Contd)

6	The RAGS Viewer shall save to disk in the EXCEL file worksheets containing Table 5—Non-Cancer Toxicity Data: 5.1—Oral/Dermal, 5.2—Inhalation, 5.3—Special Case Chemicals.
7	The RAGS Viewer shall save to disk in the EXCEL file worksheets containing: Table 6—Cancer Toxicity Data: 6.1—Oral/Dermal, 6.2—Inhalation, 6.3—Special Case Chemicals.
8	The RAGS Viewer shall save to disk in the EXCEL file worksheets containing: Tables 7.1 through 7.n for Reasonable Maximum Exposure (RME) and also for Central Tendency (CT) for Calculation of Non-Cancer Hazards, one worksheet table for each environmental medium and exposure medium.
9	The RAGS Viewer shall save to disk in the EXCEL file worksheets containing: Tables 8.1 through 8.n for RME and also for CT for Calculation of Cancer Risks, one worksheet table for each environmental medium and exposure medium.
10	The RAGS Viewer shall save to disk in the EXCEL file worksheets containing: Tables 9.1 RME and 9.1 CT for RME and also for CT, respectively, for Summary of Receptor Risks and Hazards for contaminants of potential concern (COPCs).
11	The RAGS Viewer shall save to disk in the EXCEL file worksheets containing: Tables 10.1 RME and 10.1 CT for RME and also for CT, respectively, for Risk Assessment Summary.

2.2 Test Cases

2.2.1 RAGS-D_01 (Dean's Creek Development Company)

2.2.1.1 Description and Rationale

This test case addresses the capability of the RAGS Viewer to allow the user to generate the RAGS Tables after running a FRAMES version of the Deans Creek Development Company example that is used by the EPA as seen when selecting Example Tables (.PDF) at: http://epa.gov/superfund/programs/risk/ragsd/tables.htm. Because this example is used by the EPA, it is instructive to apply a FRAMES model to it for comparison of FRAMES RAGS tables output against the Example Tables (.PDF) at the above URL. This simple example does not use a source term, but has the user insert the chemical concentrations directly, thereby bypassing the source-term specification.

A graph of the FRAMES model for the Deans Creek Development Company example is shown in Figure 2.1.

Table 2.2. Relationship Between Test Cases and RAGS Table Viewer Fundamental Requirements

		Test Case Name (RAGS-D_xx)					
		01	**02**				
Requirements	1	X	X				
	2	X	X				
	3	X	X				
	4	X	X				
	5	X	X				
	6	X	X				
	7	X	X				
	8	X	X				
	9	X	X				
	10	X	X				
	11	X	X				

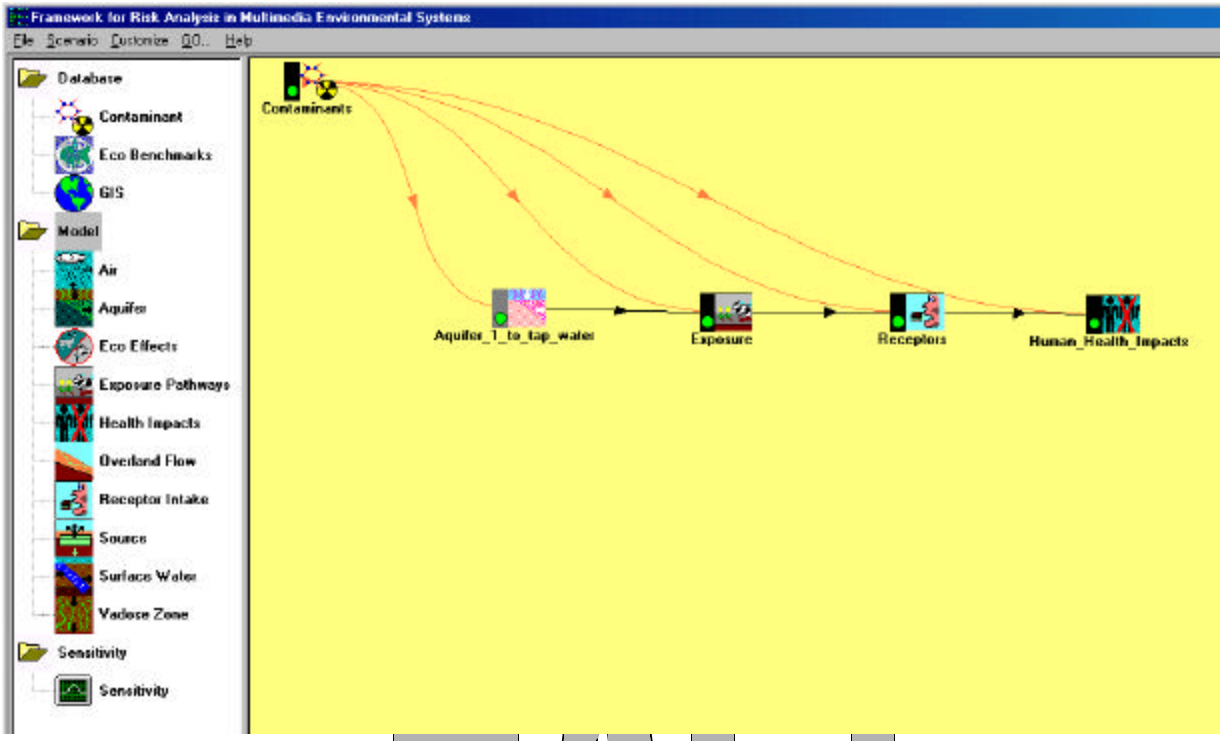


Figure 2.1. FRAMES Model for Deans Creek Development Company Example Used by EPA to Demonstrate the Filling out of RAGS Tables

The requirements addressed are listed below.

1 The RAGS Viewer shall be activated at the user's request after running a FRAMES-based model by right-clicking on the Health Impacts module icon to popup a context menu, then moving the cursor over "View/Print Module Output" to popup a sub-menu of applicable viewers, and selecting "RAGS Table Generator for Chemicals."

2 The RAGS Viewer shall save to disk in the EXCEL file a worksheet containing: Table 1—Selection of Exposure Pathways.

3 The RAGS Viewer shall save to disk in the EXCEL file worksheets containing: Tables 2.1 through 2.n—Occurrence, Distribution, and Selection of Chemicals of Potential Concern, one worksheet table for each environmental medium and exposure medium.

4 The RAGS Viewer shall save to disk in the EXCEL file worksheets containing: Tables 3.1 through 3.n—Medium-Specific Exposure Point Concentration Summary, one worksheet table for each environmental medium and exposure medium.

5 The RAGS Viewer shall save to disk in the EXCEL file worksheets containing: Tables 4.1 through 4.n—Values Used for Daily Intake Calculations, one worksheet table for each environmental medium and exposure medium.

6 The RAGS Viewer shall save to disk in the EXCEL file worksheets containing Table 5—Non-Cancer Toxicity Data: 5.1—Oral/Dermal, 5.2—Inhalation, 5.3—Special Case Chemicals.

7 The RAGS Viewer shall save to disk in the EXCEL file worksheets containing Table 6—Cancer Toxicity Data: 6.1—Oral/Dermal, 6.2—Inhalation, 6.3—Special Case Chemicals.

8 The RAGS Viewer shall save to disk in the EXCEL file worksheets containing: Tables 7.1 through 7.n for RME and also for CT for Calculation of Non-Cancer Hazards, one worksheet table for each environmental medium and exposure medium.

9 The RAGS Viewer shall save to disk in the EXCEL file worksheets containing: Tables 8.1 through 8.n for RME and also for CT for Calculation of Cancer Risks, one worksheet table for each environmental medium and exposure medium.

10 The RAGS Viewer shall save to disk in the EXCEL file worksheets containing: Tables 9.1 RME and 9.1 CT for RME and also for CT, respectively, for Summary of Receptor Risks and Hazards for COPCs.

11 The RAGS Viewer shall save to disk in the EXCEL file worksheets containing: Tables 10.1 RME and 10.1 CT for RME and also for CT, respectively, for Risk Assessment Summary.

2.2.1.2 Input Data

This test case requires that you use the .GID file "Deans.gid" and the RAGS files: "RAGSgen.exe," "RAGS_templates.XLS," "RAGSgen.des," and "XlsChart.exe." All of these files should be located on the computer. All other input will be described in the procedure section below.

2.2.1.3 Expected Results

It is expected that the RAGS Viewer will execute without error and will meet all of the requirements listed in Section 2.2.1.1.

2.2.1.4 Procedure

Place the RAGS Viewer files, RAGSgen.exe, RAGS_templates.XLS, RAGSgen.des, and XlsChart.exe in your FRAMES folder if they are not already there. Then, either place the model file "Deans.gid" in this folder, or create the model by selecting icons from the left side of the screen, as shown in Figure 2.1 and linking or connecting them as shown in the Figure.

If you are not using the Deans.gid file, then, from the Example Tables (.PDF) at: http://epa.gov/superfund/programs/risk/ragsd/tables.htm, use their Table 2.1 to right-click on the Contaminants icon and enter the chemical names (second column from the left in their Table 2.1) for:

aluminum	3.20E+00	mg/L
arsenic	4.20E-08	mg/L
barium	1.73E-01	mg/L
beryllium	2.10E-09	mg/L
calcium ion	3.07E-05	mg/L
1,1-dichloroethylene	7.60E-02	mg/L
1,1,1,2- tetrachloroethene	5.60E-01	mg/L
vinyl chloride	5.00E-03	mg/L

Save and exit.

Next, right-click on the aquifer model icon, select "User Input," and enter concentrations (column labeled as "Concentration Used for Screening" in EPA Table 2.1). Note that EPA's Table 2.1 gives concentration units as ":g/L," and FRAMES requests units as "mg/L" so that the former (EPA's) will need to be divided by 1000 (as shown above) to enter concentration values for the latter into FRAMES.

Enter "time" as shown in Figure 2.2. Save and exit.

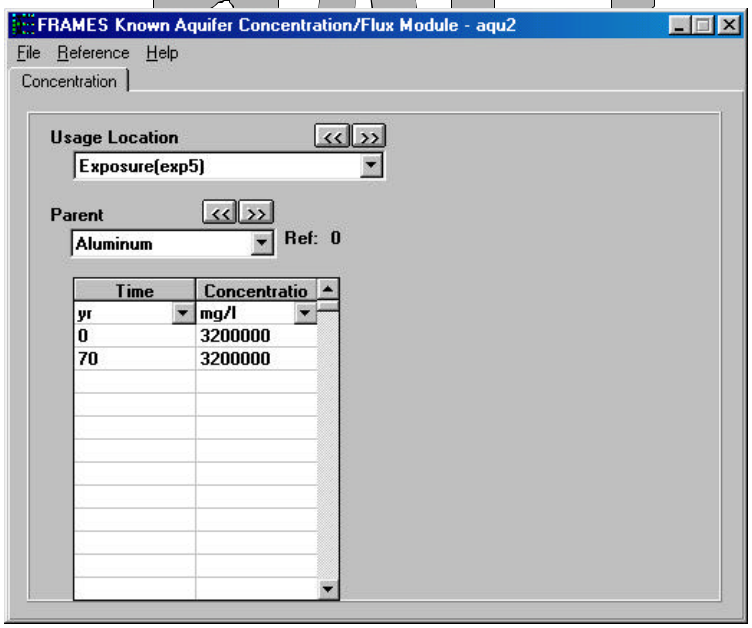


Figure 2.2. Input Display for Entering Chemical Concentrations

Now, right-click on the Exposure icon, “User Input,” and on the Ground Water tab display, enter 24 yr for the Exposure Duration, and click on the boxes to the left of the labels “Other Ingestion - Shower water,” “Dermal - Shower,” “Inhalation - Air - Volatiles from water - Shower - Air.” On the Exposure Controls tab display, set “Maximum time for reporting” as 70 yr, and “Number of time points for evaluation” as 24. Save and exit.

Next, right-click on the Receptor icon, “User Input,”specify body weight as 70 kg, Exposure Duration as 24 yr, Water dermal absorption model as “EPA Model,” Ground Water ingestion rate as 2 L/d, Age of Receptor at start as 0.0, and Age of Receptor at end as 70 yr. Save and exit.

Then, right-click on the Human Health Impact icon, “User Input,” and make sure that all of the boxes show an X in them and “Method for inhalation impact analysis has “Daily Intake” in it’s drop down box. Save and exit.

At this point, all icons shown in Figure 2.1 should display a yellow light. On the command bar at the top of the screen, click on “GO.” After execution of the model, all icons should show green lights.

To produce the RAGS Tables as the “Deans.rags.xls” file, right-click on the Human Health Impacts icon to pop-up a context menu. Then, move the cursor over "View/Print Module Output" to pop-up a sub-menu of applicable viewers, and select “RAGS Table Generator for Chemicals.” Table displays will flash quickly in sequence on the screen as the RAGS Viewer software builds the output EXCEL file. When finished, it will have your display positioned inside of this output file, “Deans.rags.xls,” having already saved a file copy to your working folder.

2.2.1.5 Results

1 The RAGS Viewer was activated at the user’s request after running a FRAMES-based model by right-clicking on the Health Impacts module icon to popup a context menu, then moving the cursor over “View/Print Module Output” to popup a sub-menu of applicable viewers, and selecting “RAGS Table Generator for Chemicals.”

2 The RAGS Viewer saved to disk in the EXCEL file worksheets for 18 Tables as listed in the following Table, and including a worksheet containing Table 1—Selection of Exposure Pathways.

3 The RAGS Viewer saved to disk in the EXCEL file worksheets containing Tables 2.1 through 2.n—Occurrence, Distribution, and Selection of Chemicals of Potential Concern, one worksheet table for each environmental medium and exposure medium.

4 The RAGS Viewer saved to disk in the EXCEL file worksheets containing Tables 3.1 through 3.n—Medium-Specific Exposure Point Concentration Summary, one worksheet table for each environmental medium and exposure medium.

5 The RAGS Viewer saved to disk in the EXCEL file worksheets containing Tables 4.1 through 4.n—Values Used for Daily Intake Calculations, one worksheet table for each environmental medium and exposure medium.

6 The RAGS Viewer saved to disk in the EXCEL file worksheets containing Table 5—Non-Cancer Toxicity Data: 5.1—Oral/Dermal, 5.2—Inhalation, 5.3—Special Case Chemicals.

7 The RAGS Viewer saved to disk in the EXCEL file worksheets containing Table 6—Cancer Toxicity Data: 6.1—Oral/Dermal, 6.2—Inhalation, 6.3—Special Case Chemicals.

8 The RAGS Viewer saved to disk in the EXCEL file worksheets containing Tables 7.1 through 7.n for RME and also for CT for Calculation of Non-Cancer Hazards, one worksheet table for each environmental medium and exposure medium.

9 The RAGS Viewer saved to disk in the EXCEL file worksheets containing Tables 8.1 through 8.n for RME and also for CT for Calculation of Cancer Risks, one worksheet table for each environmental medium and exposure medium.

10 The RAGS Viewer saved to disk in the EXCEL file worksheets containing Tables 9.1 RME and 9.1 CT for RME and also for CT respectively, for Summary of Receptor Risks

RAGS - D Tables Produced for Deans.gid

BOLD indicates Table contains data; Not Bold indicates Table contains no data

TABLE	**1**	**SELECTION OF EXPOSURE PATHWAYS**	
TABLE	2.1	OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN	Aquifer-Shower
TABLE	3.1	MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY	Aquifer-Shower
TABLE	**4.1**	**VALUES USED FOR DAILY INTAKE CALCULATIONS**	**Aquifer-Shower**
TABLE	**5.1**	**NON-CANCER TOXICITY DATA -- ORAL/DERMAL**	
TABLE	**5.2**	**NON-CANCER TOXICITY DATA -- INHALATION**	
TABLE	5.3	NON-CANCER TOXICITY DATA -- SPECIAL CASE CHEMICALS	
TABLE	**6.1**	**CANCER TOXICITY DATA -- ORAL/DERMAL**	
TABLE	6.2	CANCER TOXICITY DATA -- INHALATION	
TABLE	6.3	CANCER TOXICITY DATA -- SPECIAL CASE CHEMICALS	
TABLE	**7.1 RME**	**CALCULATION OF NON-CANCER HAZARDS**	**Aquifer-Shower**
TABLE	**7.1 CT**	**CALCULATION OF NON-CANCER HAZARDS**	**Aquifer-Shower**
TABLE	**8.1 RME**	**CALCULATION OF CANCER RISKS**	**Aquifer-Shower**
TABLE	**8.1 CT**	**CALCULATION OF CANCER RISKS**	**Aquifer-Shower**
TABLE	**9.1 RME**	**SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs**	
TABLE	9.1 CT	SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs	
TABLE	10.1 RME	RISK ASSESSMENT SUMMARY	
TABLE	10.1 CT	RISK ASSESSMENT SUMMARY	

and Hazards for COPCs.

11 The RAGS Viewer saved to disk in the EXCEL file worksheets containing Tables 10.1 RME and 10.1 CT for RME and also for CT respectively, for Risk Assessment Summary.

2.2.2 RAGS-D_02 (Case1_gw)

2.2.2.1 Description and Rationale

This test case uses a FRAMES model that incorporates the definition of a source term, two vadose zones, the air, an aquifer, surface water, and groundwater as environmental media through which human receptors are exposed. This is a more complex set of exposure pathways than the previous simple model. The graphic model for this case is shown in Figure 2.3.

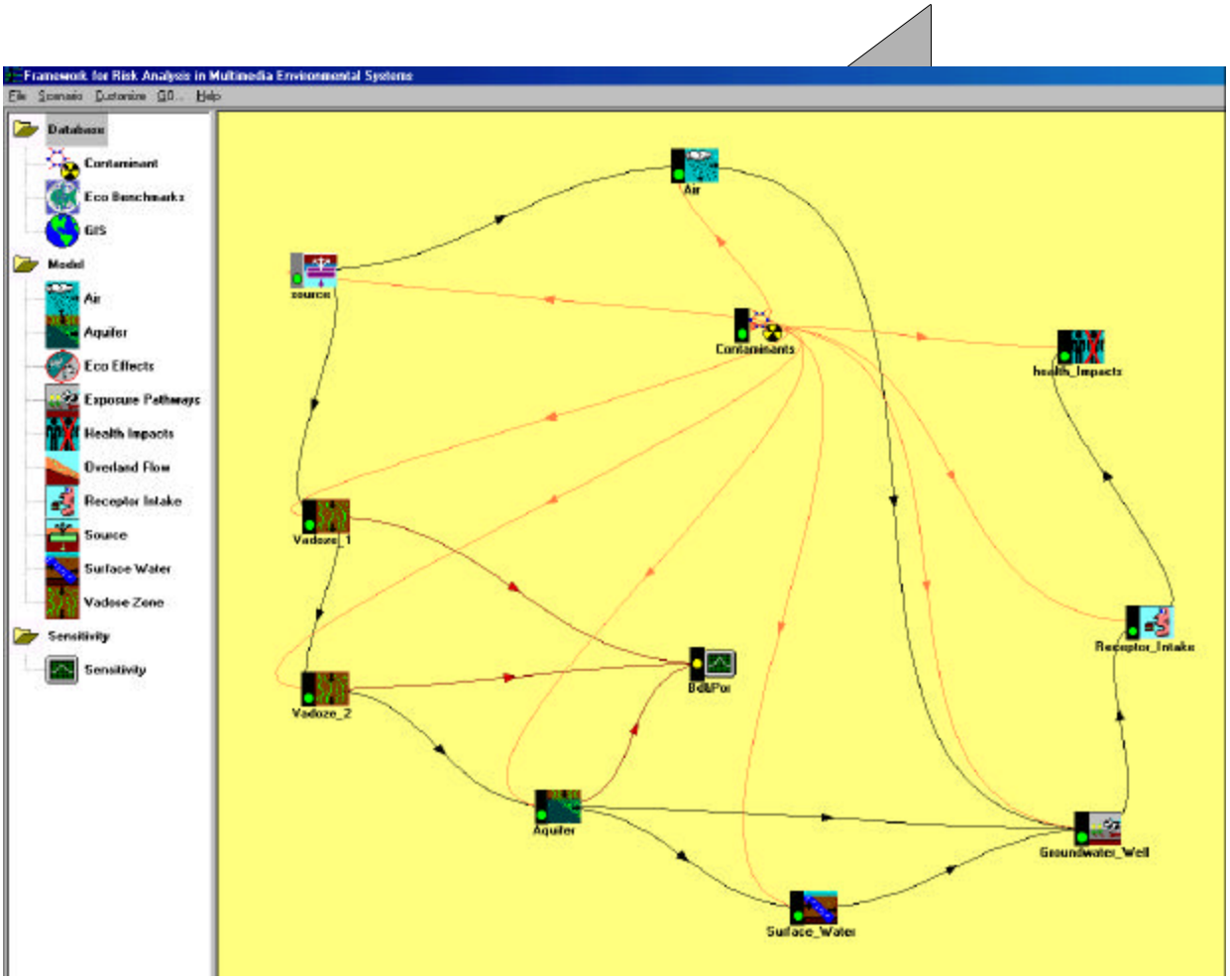


Figure 2.3. System Flow Chart for the FRAMES Model "Case1_gw"

The requirements addressed are listed below.

1 The RAGS Viewer shall be activated at the user's request after running a FRAMES-based model by right-clicking on the Health Impacts module icon to popup a context menu, then moving the cursor over "View/Print Module Output" to popup a sub-menu of applicable viewers, and selecting "RAGS Table Generator for Chemicals."

2 The RAGS Viewer shall save to disk in the EXCEL file a worksheet containing: Table 1—Selection of Exposure Pathways.

3 The RAGS Viewer shall save to disk in the EXCEL file worksheets containing: Tables 2.1 through 2.n—Occurrence, Distribution, and Selection of Chemicals of Potential Concern, one worksheet table for each environmental medium and exposure medium.

4 The RAGS Viewer shall save to disk in the EXCEL file worksheets containing Tables 3.1 through 3.n —Medium-Specific Exposure Point Concentration Summary, one worksheet table for each environmental medium and exposure medium.

5 The RAGS Viewer shall save to disk in the EXCEL file worksheets containing: Tables 4.1 through 4.n—Values Used for Daily Intake Calculations, one worksheet table for each environmental medium and exposure medium.

6 The RAGS Viewer shall save to disk in the EXCEL file worksheets containing Table 5—Non-Cancer Toxicity Data: 5.1—Oral/Dermal, 5.2—Inhalation, 5.3—Special Case Chemicals.

7 The RAGS Viewer shall save to disk in the EXCEL file worksheets containing Table 6—Cancer Toxicity Data: 6.1—Oral/Dermal, 6.2—Inhalation, 6.3—Special Case Chemicals.

8 The RAGS Viewer shall save to disk in the EXCEL file worksheets containing Tables 7.1 through 7.n for RME and also for CT for Calculation of Non-Cancer Hazards, one worksheet table for each environmental medium and exposure medium.

9 The RAGS Viewer shall save to disk in the EXCEL file worksheets containing Tables 8.1 through 8.n for RME and also for CT for Calculation of Cancer Risks, one worksheet table for each environmental medium and exposure medium.

10 The RAGS Viewer shall save to disk in the EXCEL file worksheets containing Tables 9.1 RME and 9.1 CT for RME and also for CT, respectively, for Summary of Receptor Risks and Hazards for COPCs.

11 The RAGS Viewer shall save to disk in the EXCEL file worksheets containing Tables 10.1 RME and 10.1 CT for RME and also for CT, respectively, for Risk Assessment Summary.

2.2.2.2 Input Data

This test case requires that you use the .GID file "Case1_gw.gid" and the RAGS files: "RAGSgen.exe," "RAGS_templates.XLS," "RAGSgen.des," and "XlsChart.exe." All of these files should be located on the computer. All other input will be described in the procedure section below.

2.2.2.3 Expected Results

It is expected that the RAGS Viewer will execute without error and will meet all of the requirements listed in Section 2.2.2.1.

2.2.2.4 Procedure

Place the RAGS Viewer files, RAGSgen.exe, RAGS_templates.XLS, RAGSgen.des, and XlsChart.exe in your FRAMES folder if they are not already there. Then, either place the model file "Case1_gw.gid" in this folder or create the model by selecting icons from the left side of the screen, as shown in Figure 2.3, and linking or connecting them as shown in the Figure.

Right-click on the Contaminants icon, then "User Input," and enter the chemical names for: Antimony, Strontium-90, and Trichloroethylene. Save and Exit. Right-click on the Source term icon, then "User Input," and enter the parameter values as shown in Figure 2.4.

Save and Exit.

Next, right-click on the Air icon, then "User Input," and enter for the Climatology tab, a Morning mixing height of 400. m, afternoon mixing height of 1400. m, Annual precipitation of 6.3 in, Precipitation days as 68, and Thunderstorms per year as 10. For Joint Frequency Distribution , enter 15.2 m for Anemometer height, and 45.5 cm Average roughness length. Wind joint frequency calms can be set or left as 0.0000. Wind speed midpoints for Group 1 through 6 should be set at 0.671, 2.46, 4.48, 6.94, 9.62, and 12.53 respectively. Under the Topographical Data tab, all regional surface roughness lengths can be set as 10.0. Save and Exit.

Right-click on the Vadose 1 icon, then "User Input," and enter the values shown in Figure 2.5.

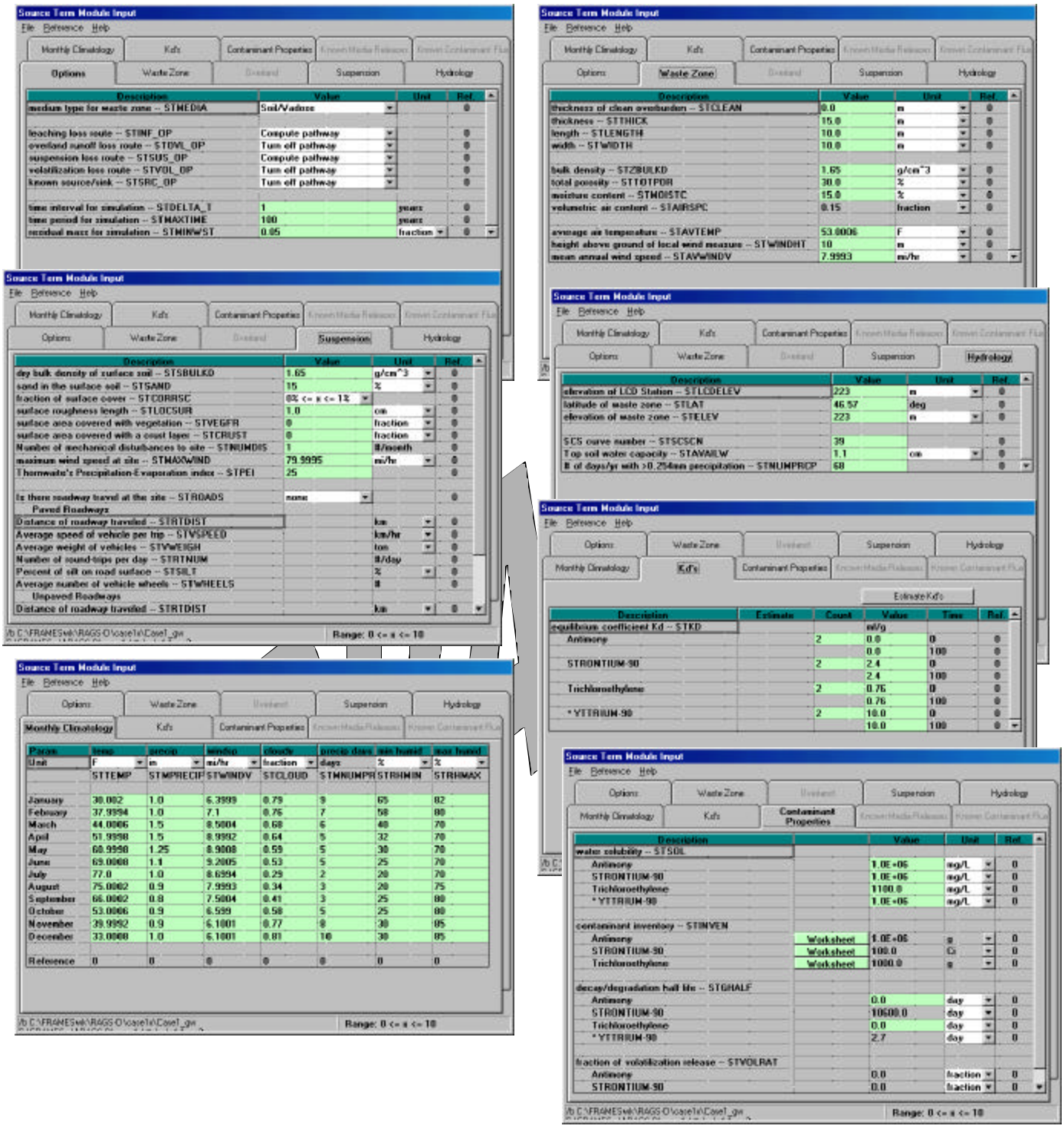


Figure 2.4. Parameter settings for the Source Term in Case1_gw test case for RAGS

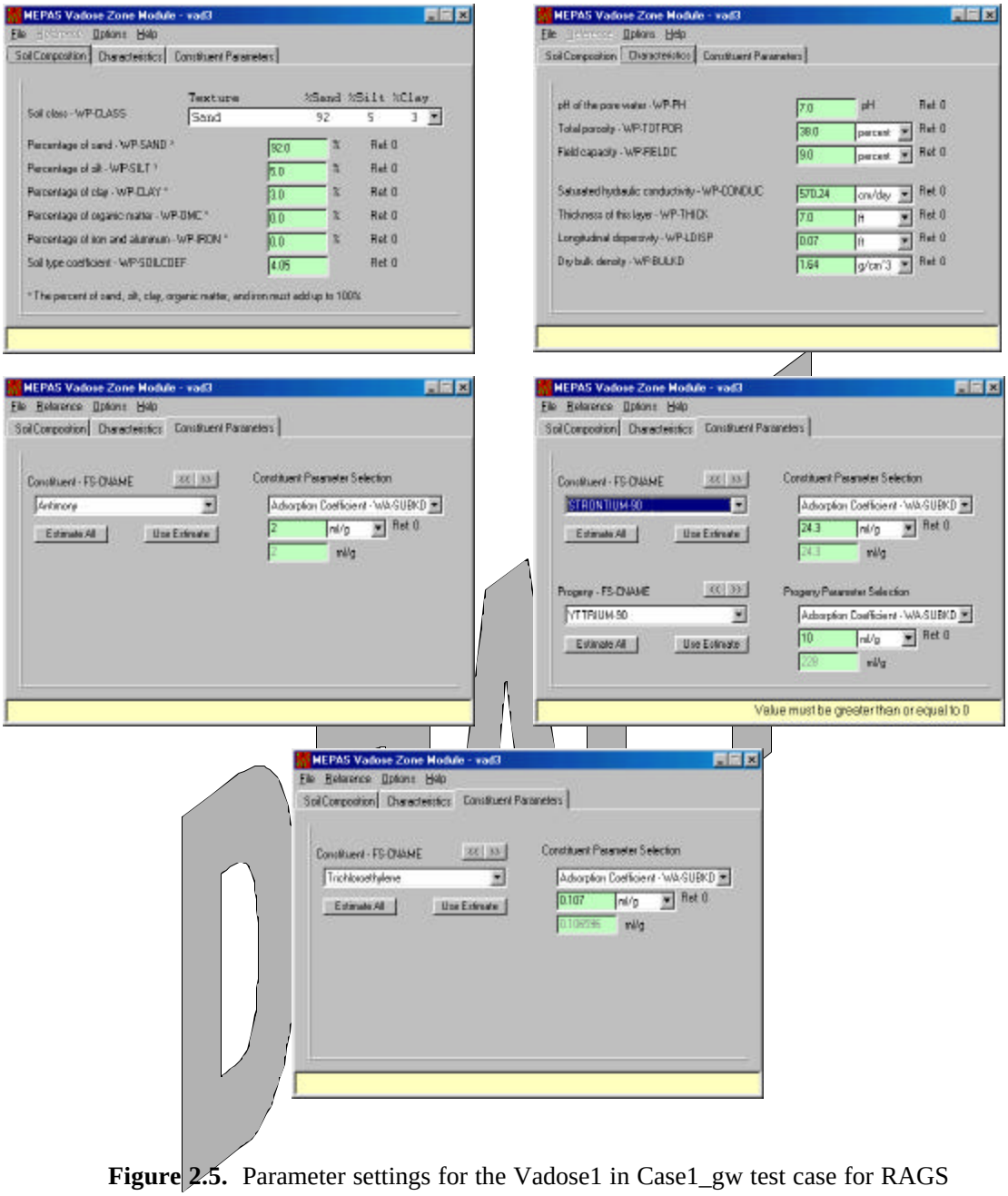


Figure 2.5. Parameter settings for the Vadose1 in Case1_gw test case for RAGS

Save and Exit.

Right-click on the Vadose 2 icon, then “User Input,” and enter the settings shown in Figure 2.6.

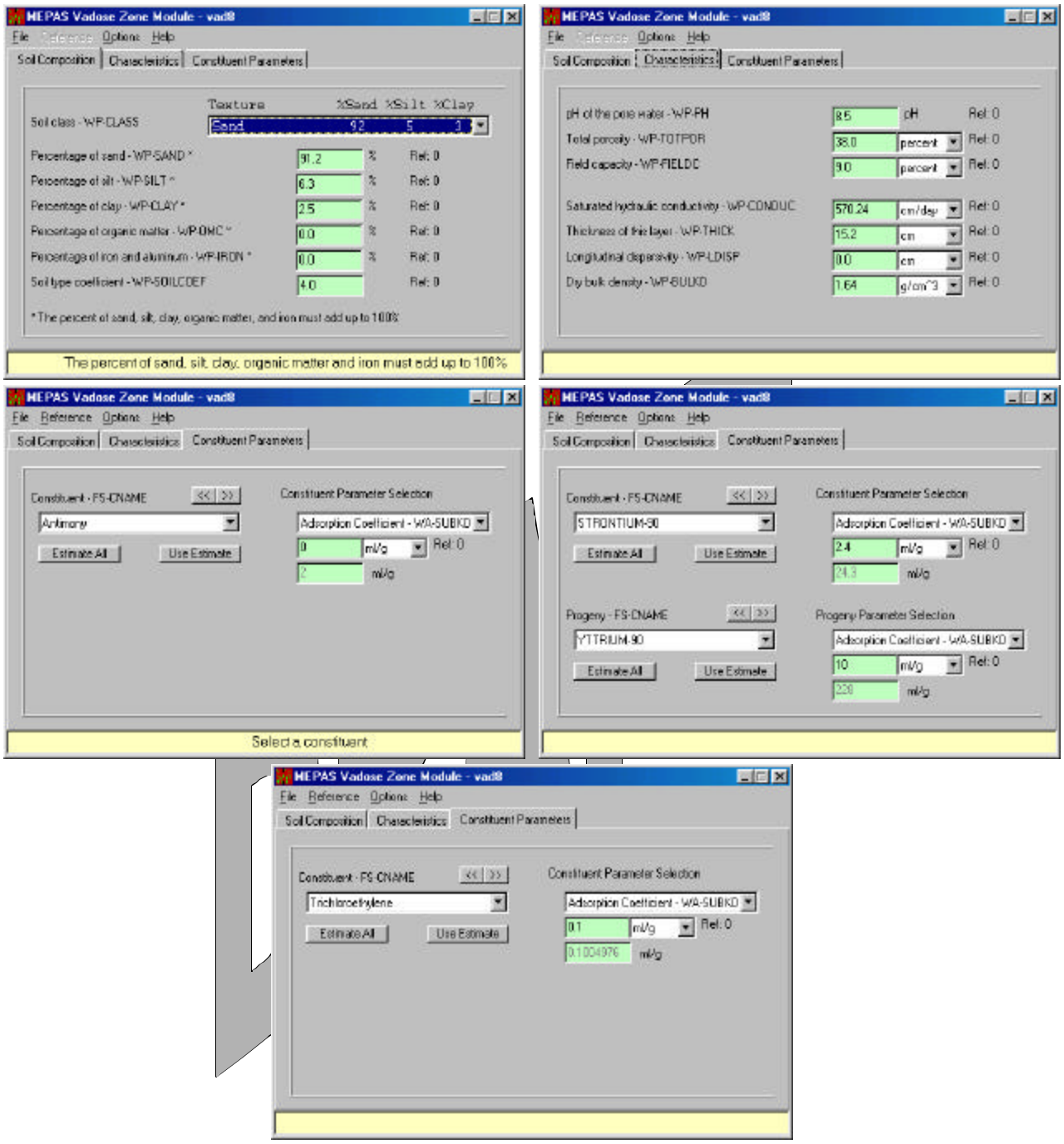


Figure 2.6. Parameter Settings for the Vadose2 in Case1_gw test Case for RAGS

Save and Exit.

Right-click on the Aquifer icon, then “User Input,” and enter the settings shown in Figure 2.7.

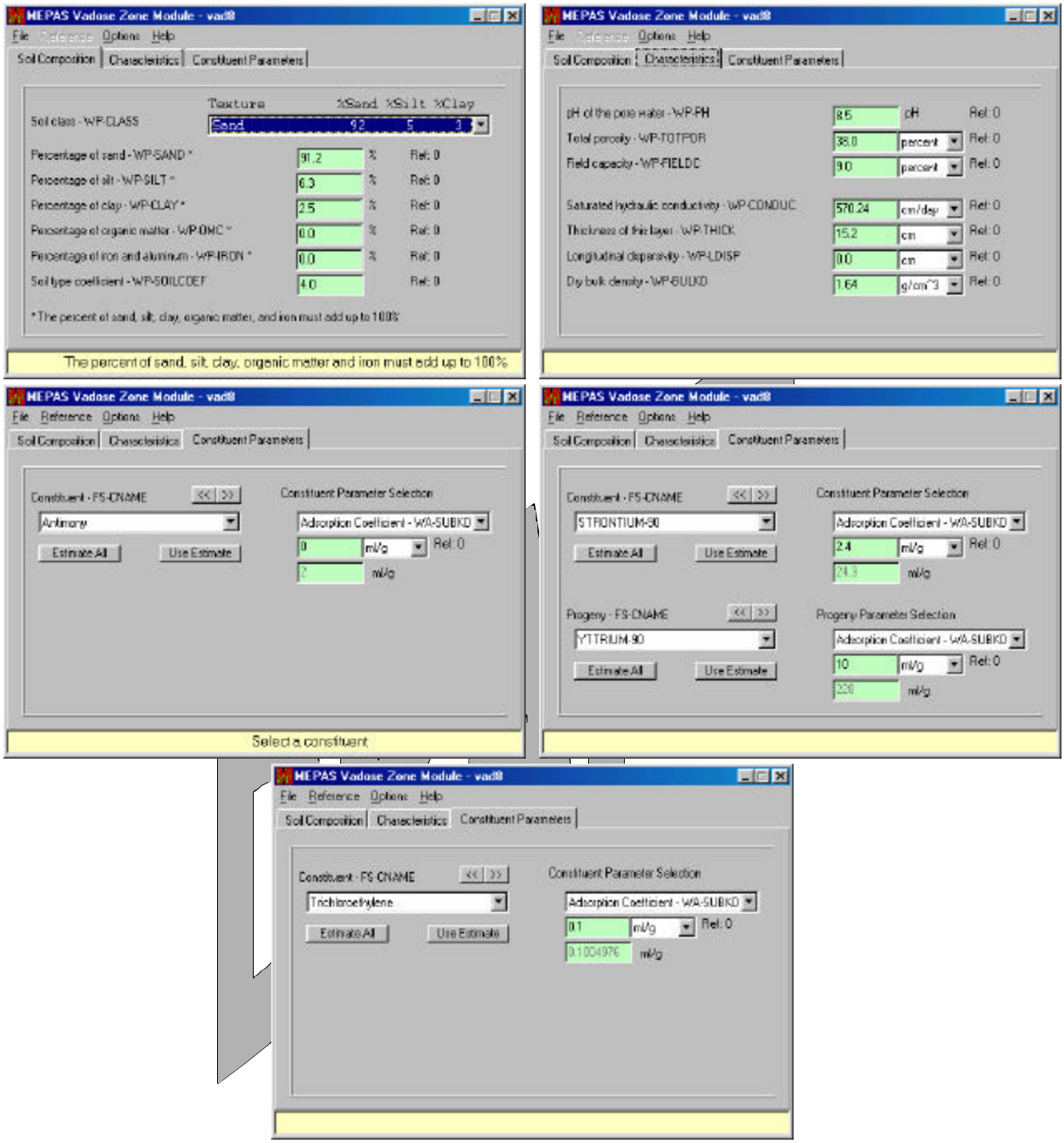


Figure 2.7. Parameter settings for the Aquifer in Case1_gw test case for RAGS

Save and Exit.

Right-click on the Surface Water (River module) icon, then "User Input," and enter Flow velocity at 10.0 mi/yr, Depth... at 10.0 ft, and Width at 100.0 ft. Then specify Distance from source... as 100.0 ft, and Average annual discharge... as 10022.4 cm^3/s. Save and Exit.

Right-click on the Chronic Exposure icon (Groundwater_Well), then "User Input." Under the Ground Water tab, enter an Exposure Duration of 20 yr, and click an X in the boxes to the left of Plant Production Ingestion—Leafy vegetables and Other vegetables; do the same for Other Ingestion—Drinking water, and Shower water. Also, click the box to show an X for Dermal—Shower, and a darkened center for the small circle to the left of Indoor—Air.

Under the Surface Water tab, again specify 20.0 yr for Exposure duration. Click an X in the boxes to the left of: Plant Production Ingestion—Leafy vegetables, and Other vegetables; do the same for Other Ingestion—Drinking water, Shower water, and Swimming water. Also, click the boxes to show an X for Dermal—Swimming, and External—Shoreline, and a darkened center for the small circle to the left of Indoor—Air.

Under the Atmospheric tab, again specify 20.0 yr as the Exposure duration. Click an X in the boxes to the left of: Plant Production Ingestion—Leafy vegetables, and Other vegetables; do the same for Other Pathways—Soil—Ingestion, Soil—Inhalation, Soil—Dermal, Soil—External, Air—External, and Air Inhalation.

Under the Exposure Controls tab, enter 0.0 yr for Time to start..., 1000.0 yr for Maximum time..., and 20 for Number of time points....

Under the Leach Rate tab, enter 1.0 for 1/yr for each of the chemicals by stepping down through with the down arrow to the right of the chemical name. Save and Exit.

Right-click on the Receptor Intake icon, and then "User Input," and enter Body weight as 70.0 kg, Exposure duration as 30.0 yr, Ground water ingestion... as 2.0 L/d, Surface water ingestion... as 2.0 L/d, Age...at start as 0.0 yr, and Age...at end as 70.0 yr. Save and Exit.

Right-click on the Health Impacts icon and then "User Input," and be sure that all boxes are checked with an X under the Chemical tab, and also under the Radionuclide tab. Thickness of contaminated soil can be set at 0.04 m, and Density... set at 1.5 g/cm^3. Save and Exit.

At this point, all icons shown in Figure 2.3 should display a yellow light. On the command bar at the top of the screen, click on "GO." After execution of the model, all icons should show green lights.

To produce the RAGS Tables as the "CASE1_GW.rags.xls" file, right-click on the Human Health Impacts icon to pop-up a context menu. Then, move the cursor over "View/Print Module Output" to pop-up a sub-menu of applicable viewers and select "RAGS Table Generator for Chemicals." Table displays will flash quickly in sequence on the screen as the RAGS Viewer software builds the output EXCEL file.

When finished, it will have your display positioned inside of this output file, “CASE1_GW.rags.xls,” having already saved a file copy to your working folder.

2.2.1.5 Results

1 The RAGS Viewer was activated at the user’s request after running a FRAMES-based model by right-clicking on the Health Impacts module icon to popup a context menu, then moving the cursor over “View/Print Module Output” to popup a sub-menu of applicable viewers, and selecting "RAGS Table Generator for Chemicals.”

2 The RAGS-D Viewer saved to disk in the EXCEL file worksheets for 151 Tables as listed in the following Table, and including Table 1—Selection of Exposure Pathways. .

3 The RAGS Viewer saved to disk in the EXCEL file worksheets containing Tables 2.1 through 2.n—Occurrence, Distribution, and Selection of Chemicals of Potential Concern, one worksheet table for each environmental medium and exposure medium.

4 The RAGS Viewer saved to disk in the EXCEL file worksheets containing Tables 3.1 through 3.n—Medium-Specific Exposure Point Concentration Summary, one worksheet table for each environmental medium and exposure medium.

5 The RAGS Viewer saved to disk in the EXCEL file worksheets containing Tables 4.1 through 4.n—Values Used for Daily Intake Calculations, one worksheet table for each environmental medium and exposure medium.

6 The RAGS Viewer saved to disk in the EXCEL file worksheets containing Table 5—Non-Cancer Toxicity Data: 5.1—Oral/Dermal, 5.2—Inhalation, 5.3—Special Case Chemicals.

7 The RAGS Viewer saved to disk in the EXCEL file worksheets containing Table 6—Cancer Toxicity Data: 6.1—Oral/Dermal, 6.2—Inhalation, 6.3—Special Case Chemicals.

8 The RAGS Viewer saved to disk in the EXCEL file worksheets containing Tables 7.1 through 7.n for RME and also for CT for Calculation of Non-Cancer Hazards, one worksheet table for each environmental medium and exposure medium.

9 The RAGS Viewer saved to disk in the EXCEL file worksheets containing Tables 8.1 through 8.n for RME and also for CT for Calculation of Cancer Risks, one worksheet table for each environmental medium and exposure medium.

10 The RAGS Viewer saved to disk in the EXCEL file worksheets containing Tables 9.1 RME and 9.1 CT for RME and also for CT, respectively, for Summary of Receptor Risks and Hazards for COPCs.

11 The RAGS Viewer saved to disk in the EXCEL file worksheets containing: Tables 10.1 RME and 10.1 CT for RME and also for CT, respectively, for Risk Assessment Summary.

RAGS - D Tables Produced for Case1_gw.gid

BOLD indicates Table contains data; Not Bold indicates Table contains no data

TABLE 6.1 CANCER TOXICITY DATA -- ORAL/DERMAL
TABLE 6.2 CANCER TOXICITY DATA -- INHALATION
TABLE 6.3 CANCER TOXICITY DATA -- SPECIAL CASE CHEMICALS

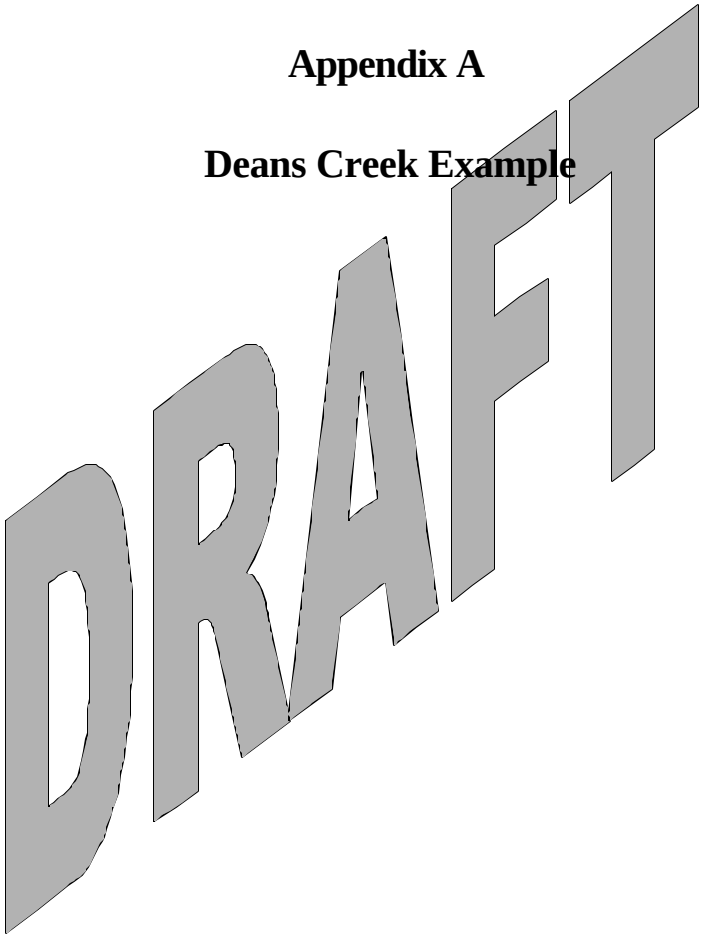
TABLE 7.1 RME CALCULATION OF NON-CANCER HAZARDS Aquifer-Water
TABLE 7.2 RME CALCULATION OF NON-CANCER HAZARDS Aquifer-Shower (dermal)
TABLE 7.3 RME CALCULATION OF NON-CANCER HAZARDS Aquifer-Shower (ingestion)
TABLE 7.4 RME CALCULATION OF NON-CANCER HAZARDS Aquifer-Leafy Vegetables
TABLE 7.5 RME CALCULATION OF NON-CANCER HAZARDS Aquifer-Other Vegetables
TABLE 7.6 RME CALCULATION OF NON-CANCER HAZARDS Air- Leafy Vegetables
TABLE 7.7 RME CALCULATION OF NON-CANCER HAZARDS Air- Other Vegetables
TABLE 7.8 RME CALCULATION OF NON-CANCER HAZARDS Air - Soil (ingestion)
TABLE 7.9 RME CALCULATION OF NON-CANCER HAZARDS Air - Soil (dermal)
TABLE 7.10 RME CALCULATION OF NON-CANCER HAZARDS Air - Air (inhalation)
TABLE 7.11 RME CALCULATION OF NON-CANCER HAZARDS Air - Soil (inhalation)
TABLE 7.12 RME CALCULATION OF NON-CANCER HAZARDS Air - Soil (external)
TABLE 7.13 RME CALCULATION OF NON-CANCER HAZARDS Air - Air (external)
TABLE 7.14 RME CALCULATION OF NON-CANCER HAZARDS Surface water - Water
TABLE 7.15 RME CALCULATION OF NON-CANCER HAZARDS Surface water - Shower
TABLE 7.16 RME CALCULATION OF NON-CANCER HAZARDS Surface water - Leafy Vegetables
TABLE 7.17 RME CALCULATION OF NON-CANCER HAZARDS Surface water - Other Vegetables
TABLE 7.18 RME CALCULATION OF NON-CANCER HAZARDS Surface water - Swimming (ingestion)
TABLE 7.19 RME CALCULATION OF NON-CANCER HAZARDS Surface water - Swimming (dermal)
TABLE 7.20 RME CALCULATION OF NON-CANCER HAZARDS Surface water - Shoreline

TABLE 7.1 CT CALCULATION OF NON-CANCER HAZARDS Aquifer-Water
TABLE 7.2 CT CALCULATION OF NON-CANCER HAZARDS Aquifer-Shower (dermal)
TABLE 7.3 CT CALCULATION OF NON-CANCER HAZARDS Aquifer-Shower (ingestion)
TABLE 7.4 CT CALCULATION OF NON-CANCER HAZARDS Aquifer-Leafy Vegetables
TABLE 7.5 CT CALCULATION OF NON-CANCER HAZARDS Aquifer-Other Vegetables
TABLE 7.6 CT CALCULATION OF NON-CANCER HAZARDS Air- Leafy Vegetables
TABLE 7.7 CT CALCULATION OF NON-CANCER HAZARDS Air- Other Vegetables
TABLE 7.8 CT CALCULATION OF NON-CANCER HAZARDS Air - Soil (ingestion)
TABLE 7.9 CT CALCULATION OF NON-CANCER HAZARDS Air - Soil (dermal)
TABLE 7.1 CT CALCULATION OF NON-CANCER HAZARDS Air - Air (inhalation)
TABLE 7.11 CT CALCULATION OF NON-CANCER HAZARDS Air - Soil (inhalation)
TABLE 7.12 CT CALCULATION OF NON-CANCER HAZARDS Air - Soil (external)
TABLE 7.13 CT CALCULATION OF NON-CANCER HAZARDS Air - Air (external)
TABLE 7.14 CT CALCULATION OF NON-CANCER HAZARDS Surface water - Water
TABLE 7.15 CT CALCULATION OF NON-CANCER HAZARDS Surface water - Shower
TABLE 7.16 CT CALCULATION OF NON-CANCER HAZARDS Surface water - Leafy Vegetables
TABLE 7.17 CT CALCULATION OF NON-CANCER HAZARDS Surface water - Other Vegetables
TABLE 7.18 CT CALCULATION OF NON-CANCER HAZARDS Surface water - Swimming (ingestion)
TABLE 7.19 CT CALCULATION OF NON-CANCER HAZARDS Surface water - Swimming (dermal)
TABLE 7.20 CT CALCULATION OF NON-CANCER HAZARDS Surface water - Shoreline

TABLE 8.1 RME CALCULATION OF CANCER RISKS Aquifer-Water
TABLE 8.2 RME CALCULATION OF CANCER RISKS Aquifer-Shower (dermal)
TABLE 8.3 RME CALCULATION OF CANCER RISKS Aquifer-Shower (ingestion)
TABLE 8.4 RME CALCULATION OF CANCER RISKS Aquifer-Leafy Vegetables
TABLE 8.5 RME CALCULATION OF CANCER RISKS Aquifer-Other Vegetables
TABLE 8.6 RME CALCULATION OF CANCER RISKS Air- Leafy Vegetables
TABLE 8.7 RME CALCULATION OF CANCER RISKS Air- Other Vegetables
TABLE 8.8 RME CALCULATION OF CANCER RISKS Air - Soil (ingestion)
TABLE 8.9 RME CALCULATION OF CANCER RISKS Air - Soil (dermal)
TABLE 8.10 RME CALCULATION OF CANCER RISKS Air - Air (inhalation)
TABLE 8.11 RME CALCULATION OF CANCER RISKS Air - Soil (inhalation)
TABLE 8.12 RME CALCULATION OF CANCER RISKS Air - Soil (external)
TABLE 8.13 RME CALCULATION OF CANCER RISKS Air - Air (external)
TABLE 8.14 RME CALCULATION OF CANCER RISKS Surface water - Water
TABLE 8.15 RME CALCULATION OF CANCER RISKS Surface water - Shower
TABLE 8.16 RME CALCULATION OF CANCER RISKS Surface water - Leafy Vegetables
TABLE 8.17 RME CALCULATION OF CANCER RISKS Surface water - Other Vegetables
TABLE 8.18 RME CALCULATION OF CANCER RISKS Surface water - Swimming (ingestion)
TABLE 8.19 RME CALCULATION OF CANCER RISKS Surface water - Swimming (dermal)
TABLE 8.20 RME CALCULATION OF CANCER RISKS Surface water - Shoreline

Appendix A

Deans Creek Example



Input Data

Open the Multimedia Framework (fui.exe). Select New from the File menu. Enter a file name and select Open. Enter a site name and select Ok.

Double click on the Contaminant icon. Left click and hold the mouse button to drag the icon on the main screen to the desired location. Repeat this operation to place the following icons into the workspace:

1 "Contaminants"
1 "Aquifers"
1 "Exposure Pathways"
1 "Receptor Intakes"
1 "Human Health Impacts"

Connect the Contaminant icon and Aquifer icon together by holding down SHIFT, clicking on the Contaminant Icon, dragging the cursor to the Aquifer icon, and releasing the mouse button (Note: To remove this line, repeat the steps used to connect it. To remove an icon from the screen, right click and select "Delete," and the icon will be removed).

In the same fashion, connect the following pairs of icons:

Contaminants	**û**	*Aquifer (already done)*
Contaminants	**û**	*Exposure Pathways*
Contaminants	**û**	*Receptor Intake*
Contaminants	**û**	*Human Health Impacts*
Aquifer	**û**	*Exposure Pathways*
Exposure Pathways	**û**	*Receptor Intake*
Receptor Intake	**û**	*Human Health Impacts*

FRAMES should now be arranged on the screen like Figure 1.

Figure A.1. Multimedia Framework Screen

Contaminant Database Module

Right click the Contaminant icon and choose General Info. When the General Info screen opens, enter "Contaminants" in the Label text box and select "FRAMES Default Chemical Database Selection" in the "Select from applicable models" text box. Click OK at the bottom of the screen to return to the work area. The signal light attached to the contaminant icon will change from black into red. Right click on the contaminant icon in the main screen and select User Input. The Contaminant Selection screen will open. Select "All Contaminants" from the "Possible Contaminants" dropdown box. The contaminants used in this case are: "1,1 dicloroethylene," "1,1,1,2-Tetrachloroethane," "Aluminum," "Arsenic," "Barium," "Beryllium," "Calcium Ion," and "Vinyl chloride." Scroll to select the contaminants from the contaminant list or use the Find option to search for them (see figure 2). Click "OK" to return to the work screen. Then click File, "Exit-Save Changes" and the Contaminant's icon status light will change from red to green.

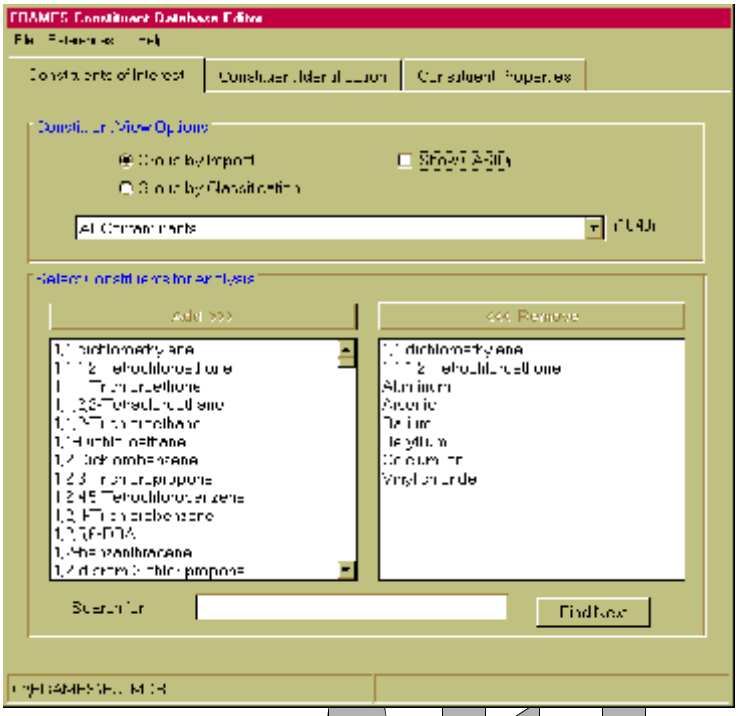


Figure A.2. Contaminant Selection Screen

Following is a listing of all data input required by the remaining modules used in this case. *Names of module icons* are in bold Italics. *Menu items* (displayed by right clicking on the icon) are shown below and indented to the right the icon names. *Explanations* of data required by each menu item are indented further to the right.

Aquifer

General Info

A window titled "Object General Information" will appear. In the Label text box put in "Aquifer_1_to _tap_water." In "Select from Applicable Models," choose "FRAMES known Aquifer Module" and click "Ok." The traffic light next to the Source Term icon should turn red.

User Input

A window titled "FRAMES Known Aquifer Concentration/Flux Module" will appear. Below "*Parent*" ensure that all the contaminants entered from before are present: *"1,1 dicloroethylene, "1,1,1,2-Tetrachloroethane," "Aluminum," "Arsenic," "Barium," "Beryllium," "Calcium Ion,"* and *"Vinyl chloride."*

Scroll down and click on *"1,1 dicloroethylene"* and enter the following data from the spreadsheet into the table at the bottom of the window.

Time	Concentration
yr	mg/l
0	7.60E-02
70	7.60E-02

Click on *"1,1,1,2-Tetrachloroethane,"* and repeat the process using this set of data:

Time	Concentration
yr	mg/l
0	5.60E-01
70	5.60E-01

Click on *"Aluminum,"* and repeat the process using this set of data:

Time	Concentration
yr	mg/l
0	3.20E+00
70	3.20E+00

Click on *"Arsenic,"* and repeat the process using this set of data:

Time	Concentration
yr	mg/l
0	4.20E-08
70	4.20E-08

Click on *"Barium,"* and repeat the process using this set of data:

Time	Concentration
yr	mg/l
0	1.73E-01
70	1.73E-01

Click on *"Beryllium,"* and repeat the process using this set of data:

Time	Concentration
yr	mg/l
0	2.10E-09
70	2.10E-09

Click on *"Calcium Ion,"* and repeat the process using this set of data:

Time	Concentration
yr	mg/l
0	3.07E-05
70	3.07E-05

Click on *"Vinyl chloride."* and repeat the process using this set of data:

Time	Concentration
yr	mg/l
0	5.00E-03
70	5.00E-03

Click "File û Save and Exit." The traffic light next to the Aquifer icon should turn yellow.

Run Model

A DOS batch file will execute in a command prompt window, completing the operation. The traffic light next to the Aquifer icon should turn green.

View/Print Module Output

A second menu will appear, select the "WCF Text View." The view should output a screen like Figure A.3.

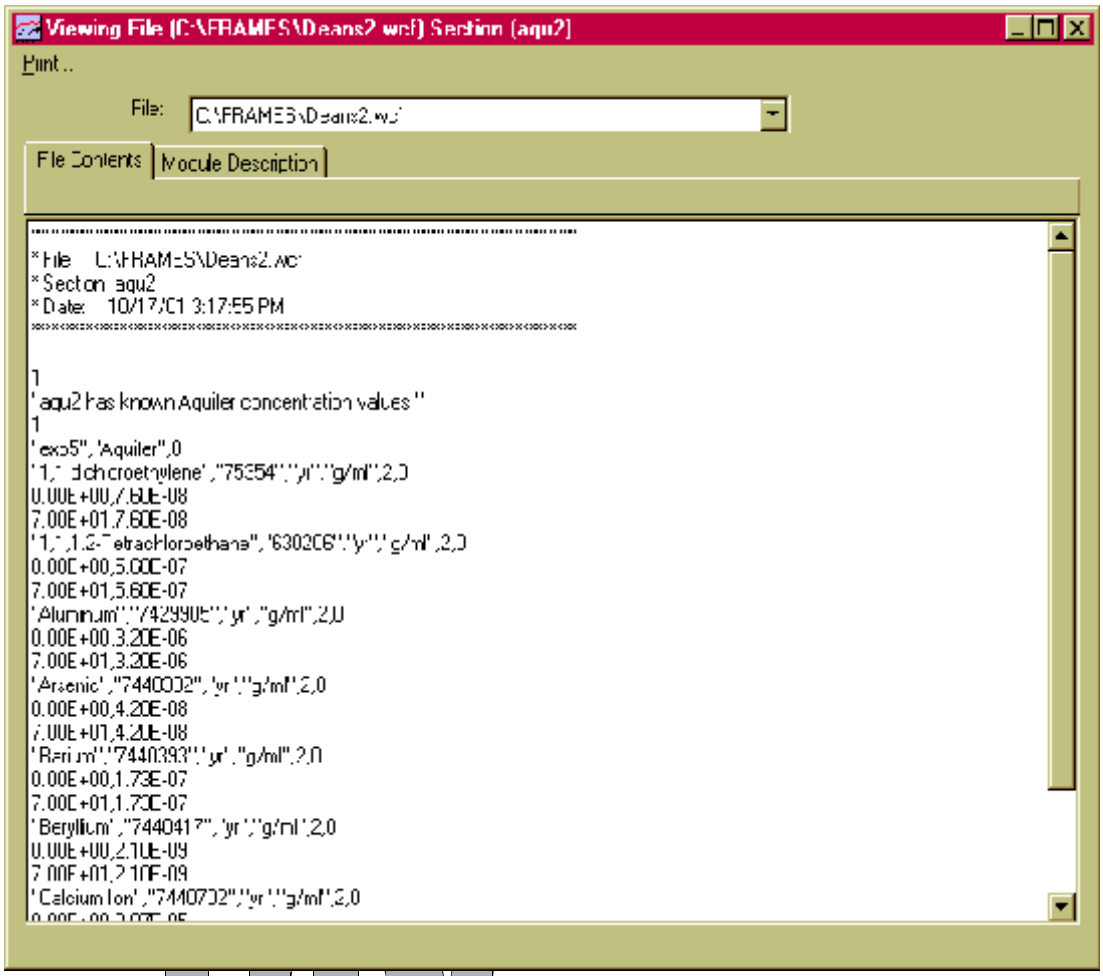


Figure A.3. View screen for Aquifer_1_to_tap_water

Exposure Pathways

General Info

A window titled "Object General Information" will appear. In the Label text box put in "Exposure." In "Select from Applicable Models," choose "MEPAS 4.1 Chronic Exposure Module" and click "Ok." The traffic light next to the Exposure icon should turn red.

User Input

A window titled "MEPAS Chronic Exposure Module" will appear. Click the "Exposure Controls" and ensure that the following are true:

- Time to start exposure computation -EC-TEXPOS = 0 yr
- Maximum time for reporting - EC - MAXTIM = 70 yr
- Number of time points for evaluation - EC - NTIMES = 1

Click "Ground Water" and ensure that the following are true:

- Exposure duration – EG - DGWED = 24yr

Under Exposure duration click “Pathways” and ensure that the following are true:

- Under the heading “Other Ingestion” make sure “Shower water” is selected.
- Under the heading “Dermal” make sure “Shower” is selected.
- Under the heading “Inhalation” make sure “Air - Volatiles water” and “Shower - Air” is selected.

Click “File ➪ Save and Exit.” The traffic light next to the Exposure icon should turn yellow.

Run Model

A DOS batch file will execute in a command prompt window, completing the operation. The traffic light next to the Exposure icon should turn green.

View/Print Module Output

A second menu will appear, select the “EPF Text View.” The view should output a screen like Figure A.4a.

Receptor Intake

General Info.

A window titled “Object General Information” will appear. In the Label text box put in “Receptors.” In “Select from Applicable Models,” choose “MEPAS 4.1 Intake Module” and click “Ok.” The traffic light next to the Receptor Intake icon should turn red.

User Input

A window titled “MEPAS Intake Module" will appear, ensure that the following are true:

- Body weight of individual – IC-BODYWT = 70 kg
- Exposure duration – IC-EXPDUR = 24 yr
- Water dermal absorption model – IC-DERM, = “EPA Model” in drop down box
- Ground water ingestion rate – IG-UDWGW = 2 L/d
- Age of receptor at start of exposure – IC-TAGE1 = 0 yr
- Age of receptor at end of exposure – IC -TAGE2 = 70 yr
- Method for inhalation impact analysis – HE-INHAL, = “Daily Intake” in drop down box

Click “File ➪ Save and Exit.” The traffic light next to the Receptor Intake icon should turn yellow.

Run Model

A DOS batch file will execute in a command prompt window, completing the operation. The traffic light next to the Receptor Intake icon should turn green.

View/Print Module Output

A second menu will appear, select the "RIF Text View." The view should output a screen like Figure A.4b.

Health Impacts

General Info

A window titled "Object General Information" will appear. In the Label text box put in "Human_Health_Impacts." In "Select from Applicable Models," choose "MEPAS 4.1 Human Health Impact Module" and click "Ok." The traffic light next to the Health Impacts icon should turn red.

User Input

A window titled "MEPAS Human Health Impact Module" should appear. Click the "Chemical" tab and ensure that the following conditions are true:

- "Calculate lifetime cancer incidence - CHEMRISK" is checked
- "Calculate hazard index - CHEMHI" is checked
- "Hazard quotient threshold limit - RFDLIM" = 0
- "Method for inhalation impact analysis - HE - INHAL" = "Daily Intake" in a drop down box

Click the "Radionuclide" tab and ensure that the following conditions are true:

- "Calculate lifetime cancer incidence –HE-INC" is checked.
  Conversion factor – HE-CONINC = 0.06 risk/Sv
- "Calculate cancer fatalities – HE-FAT" is checked.
  Conversion factor – HE-CONFAT = 0.05 risk/Sv
- "Calculate lifetime cancer and severe hereditary effects – HE-FSH" is checked.
  Conversion factor –HE-CONFSH = 0.073 risk/Sv
- "Calculate radiation dose commitment (CEDE) –HE-CEDE" is checked.
- "Thickness of contaminated soil/sediment layer – TSOIL = 0.04 m
- "Density of contaminated soil/sediment layer – DSOIL = 1.5 g/cm^3

Click "File û Save and Exit." The traffic light next to the Health Impacts icon should turn yellow.

Run Model

A DOS batch file will execute in a command prompt window, completing the operation. The traffic light next to the Health Impacts icon should turn green.

View/Print Module Output

A second menu will appear, select the "HIF Text View." The view should output a screen like Figure A.4c.

Expected Results

Viewer outputs should look like the three viewers of Figure 4.

Figure A.4a. Viewer for Exposure Pathways

Figure A.4b. Viewer for Receptor Intake

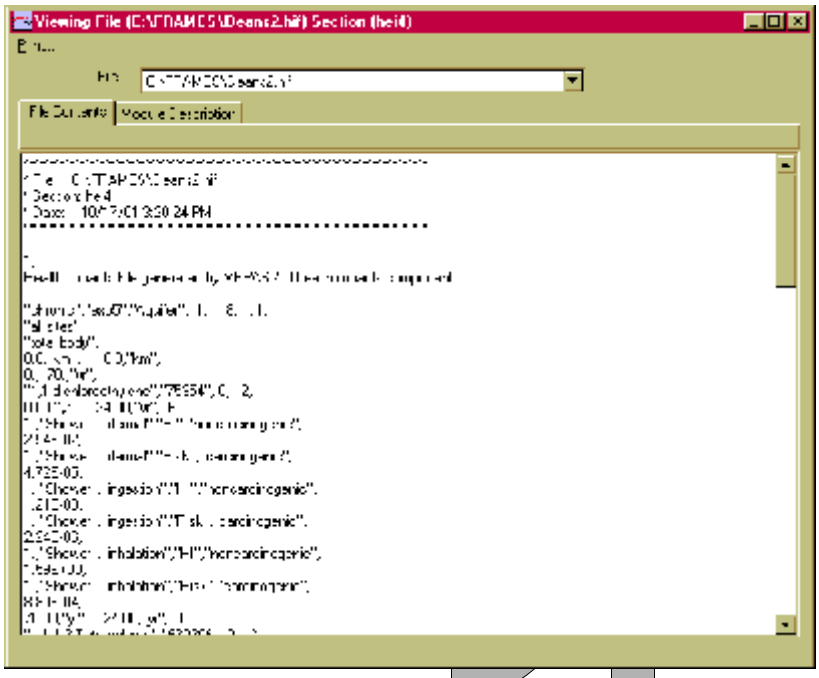


Figure A.4c. Viewer for Health Impacts

Testing Results

Testing Results were identical to the Expected Results.