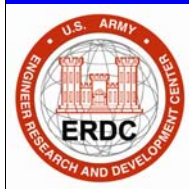


Uses of ARAMS™ for Risk Assessment

September 11, 2007

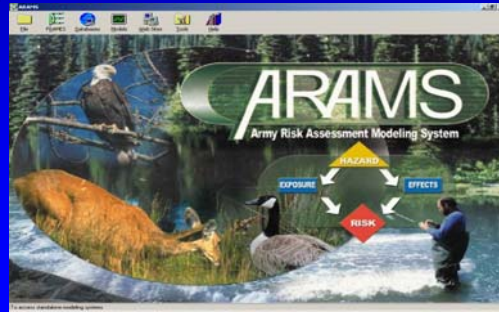
Mr. Jeff Gerald
and
Dr. Mark S. Dortch

U.S. Army Engineer Research and
Development Center

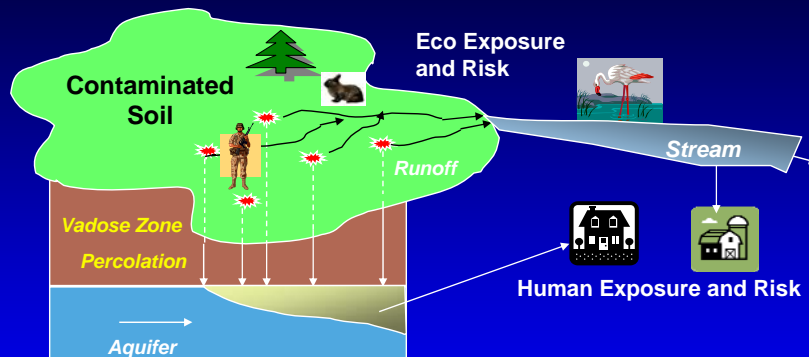


- What is ARAMS™?
 - An adaptive risk assessment modeling system developed by the Army that provides computer-based data delivery, dynamic modeling, and analysis for multi-media, multi-pathway, multi-route exposure and effects of military relevant compounds and other constituents of concern to assess human and ecological health impacts/risks.

ARAMS is a collection of tools, models, and data for use in health risk assessment



Multimedia, Multi-pathway Exposure



Media: air, soil, vadose zone, groundwater, surface water, food

Pathways: inhalation, ingestion, and dermal contact of contaminated media

What is Overall Purpose?



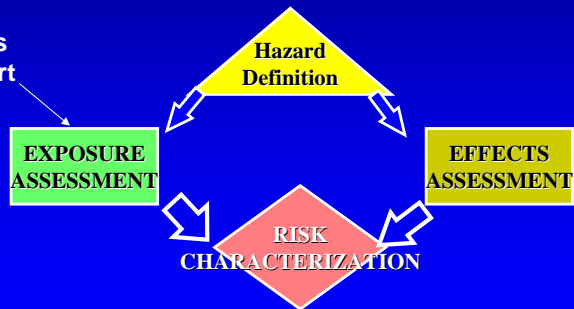
- Assessment of chronic human and ecological health risks associated with long-term exposure to constituent of potential concern (including hazardous and toxic chemicals and radionuclides)
- Originally developed to support cleanup, but has broader application, e.g., aiding in managing future risks

ARAMS is based on Risk Assessment Paradigm of NSF, NAS, USEPA



Integrates exposure and effects to assess human and ecological health impacts/risks

For ARAMS this includes fate/transport



Uses



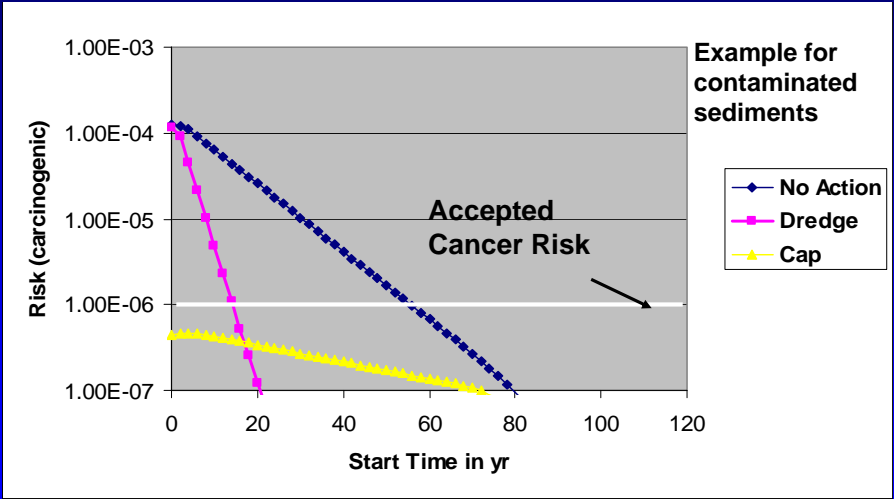
- To assess present risks of emissions, loadings, or in-place contamination
- To determine appropriate contamination clean-up levels for acceptable risk
- To provide risk information to aid in evaluating remediation alternatives
- To aid in managing sites for future potential risks

Unique Features

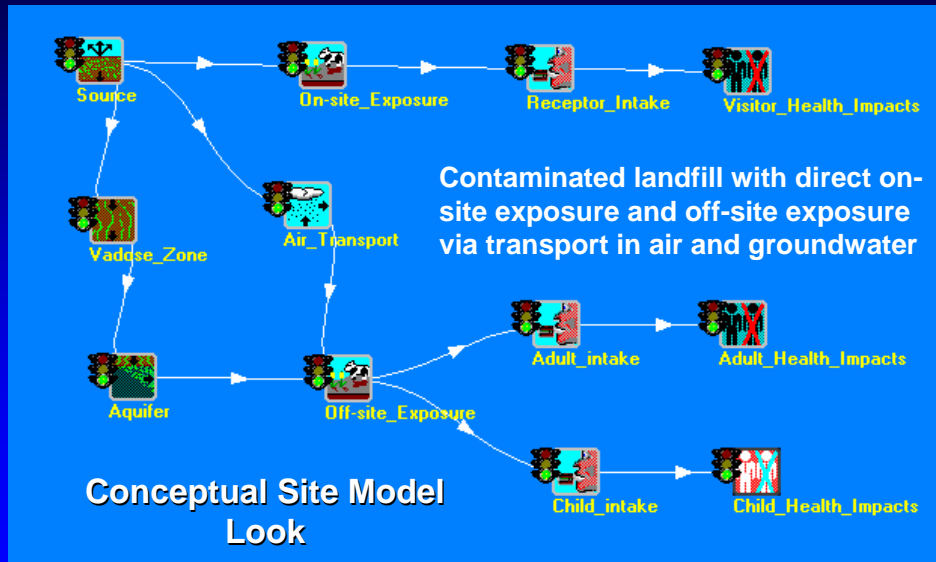


- Linkages to multimedia fate/transport models, thus providing time-varying, future concentrations, exposures, and risks
- Adaptive, object-like framework for assessing a wide array of exposure-risk scenarios

Links to fate/transport models help in Evaluating alternatives and future risks

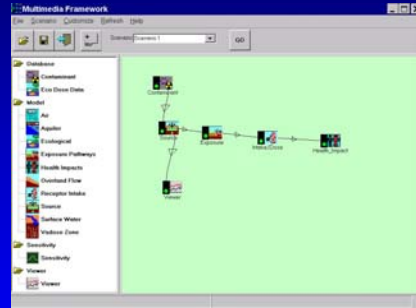


Adaptive, Object-Like Framework



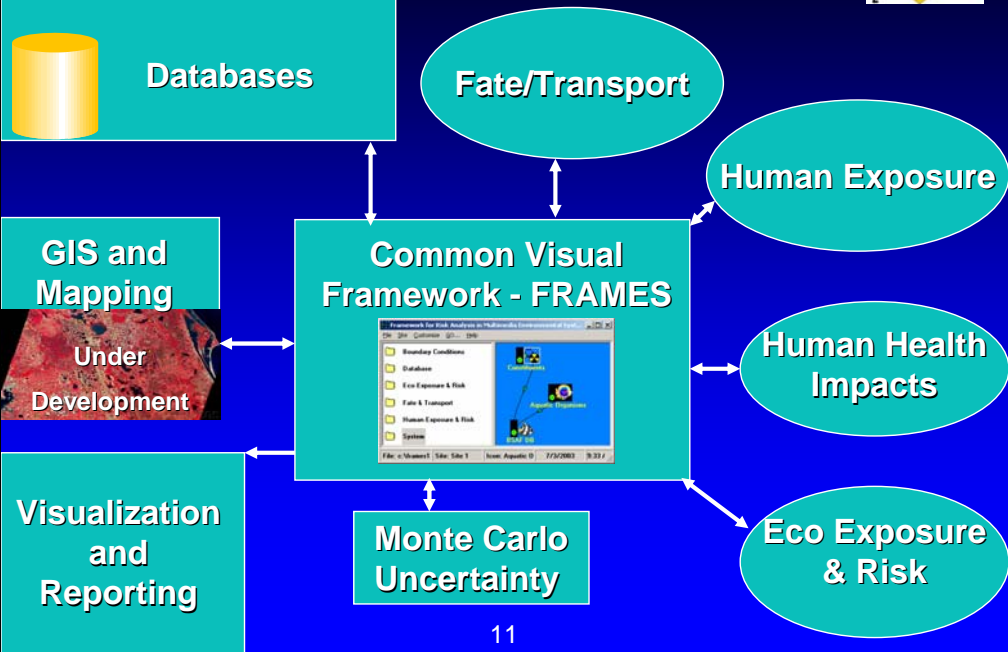
Object-Like Framework (FRAMES)

- Visually and seamlessly links disparate objects, providing flexibility for describing risk scenarios
- Can add objects and modules (e.g., models, databases)

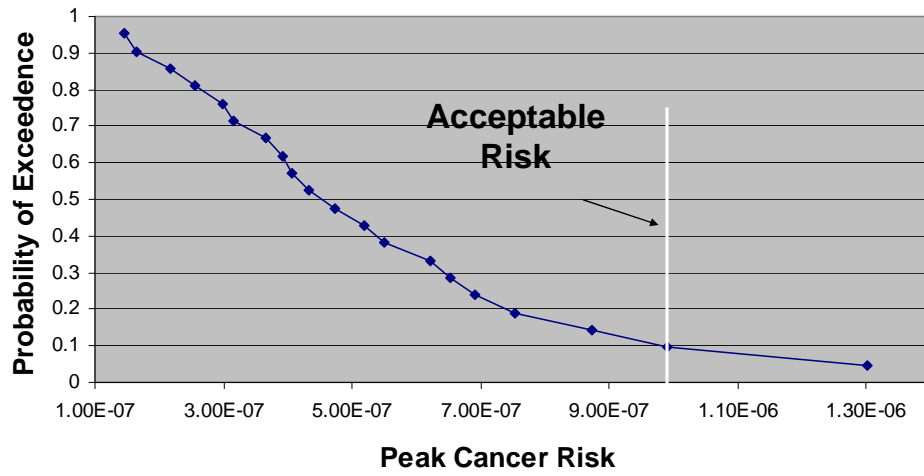


FRAMES development supported
by USACE/ERDC, DOE, EPA, NRC

Major Components



Can Assess Uncertainty of Risks



Uncertainty Analysis



- Can assess uncertainty of inputs to develop probabilistic outputs, e.g., cumulative probability of exceeding various levels of cancer incidence; can also produce confidence (e.g., 95%) bands along time-varying results
- Uses Monte Carlo method with Latin-Hypercube sampling for efficiency
- Can treat multiple parameters (inputs) from multiple modules as uncertain
- Provides options for parameter distributions

13

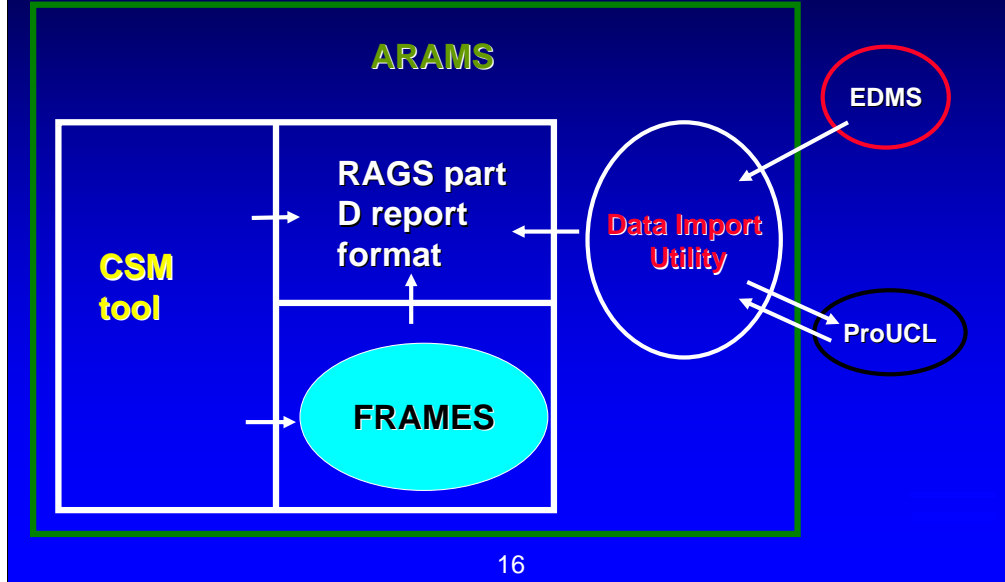
Key Inputs

- Site-specific conditions for soil, weather, hydrogeology, site characterization, etc.
- Chemical-specific properties, e.g., K_{ow} , Henry's constant, M_w , degradation rate, BAF, toxicity values (RfD, SF, etc) for human RA, toxicity reference values (TRVs) for eco RA, etc.
- Media concentrations (can be modeled or entered manually, via spreadsheet template (for soil), or with a generic data import tool – currently in development)

Key ARAMS Outputs

- Risk tables in RAGS Part D format
- A Conceptual Site Model (CSM) that serves as the starting point in FRAMES

ARAMS Interrelations



New slide added per request

A Basic ARAMS Example

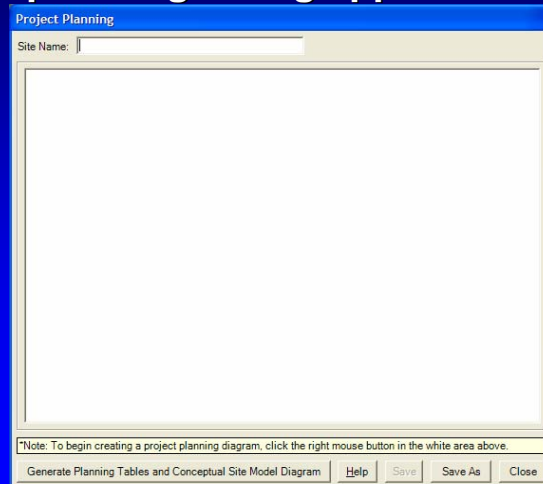
Basic ARAMS Example

- A fictitious site called “XYZ Chemical” incurred a spill from one of the tanks in its tank farm
- The constituent was inorganic Arsenic (CASRN 7440-38-2) and 1850 grams spilled onto the soil
- We are concerned about the impact from incidental soil ingestion to workers
- We’ll create the RAGS planning tables and the conceptual site model (CSM) for this case...

Note that in most of the examples presented that there are some steps that have been omitted

Basic ARAMS Example – con'd

- In ARAMS, we create a new project and the project planning dialog appears



19

Basic ARAMS Example – con'd

- We add a primary source
- We then add an exposure medium to the primary source

The screenshot displays three overlapping windows from the ARAMS software. The largest window, titled "Project Planning", shows a tree view with the following structure:

- Primary Source - Tank farm
 - Exposure Medium - Soil, Surface
 - Receptor - Industrial/Commercial Worker

Below the tree view, a note reads: "Note: To begin creating a project planning diagram, click the right mouse button in the white area above." The bottom of the window contains buttons for "Generate Planning Tables and Conceptual Site Model Diagram", "Help", "Save", "Save As", and "Close".

The "Primary Source Information" dialog box is open, showing a "Description" field with the text "Tank farm". Below the field is a list of examples: "e.g., former landfill, industrial area, waste pile, etc.". At the bottom of the dialog are "Update" and "Cancel" buttons.

The "Exposure Medium Information" dialog box is also open, showing a "Release Mechanism" dropdown menu set to "Release/Spill/Leak" and a "Medium" dropdown menu set to "Soil, Surface". There are two "Other:" text input fields. At the bottom of the dialog are "Update" and "Cancel" buttons.

Basic ARAMS Example – con'd

- We add a receptor to the exposure medium and are then ready to generate the RAGS planning tables and the CSM...

The screenshot shows the 'Receptor Information' dialog box with the following settings:

- Population: Industrial/Commercial Work
- Timeframe: Current
- Age: Adult (selected from a list including Adolescents (teens), Child, Child/Adult, Geriatric, Infant, Not Documented, Other, Pre-Adolescents, and Pregnant)
- Exposure Routes: Ingestion, Dermal, External (Radiation), Other
- Location: On-site, Off-site, Not Documented
- Type of Analysis: Quantitative, Qualitative, Incomplete, None
- Reason for Selection or Exclusion: employees frequently work in the area
- Exposure Point: incidental soil ingestion

Buttons: Update, Cancel

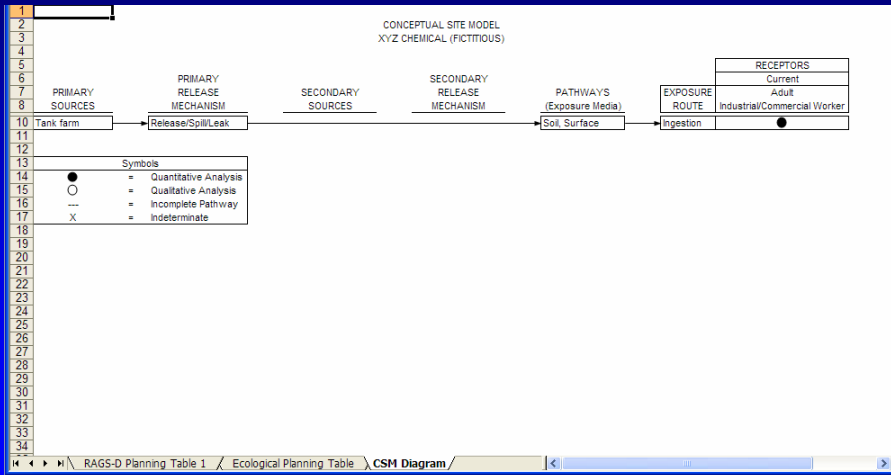
RAGS-D Planning Table 1

RAGS-D PLANNING TABLE 1 SELECTION OF EXPOSURE PATHWAYS XYZ CHEMICAL (FICTITIOUS)									
Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Soil, Surface	Soil, Surface	Incidental soil ingestion	Industrial/Commerci al Worker	Adult	Ingestion	On-site	Quantitative	employees frequently work in the area

*Note: had we included ecological components, then the “Ecological Planning Table” would have been filled out

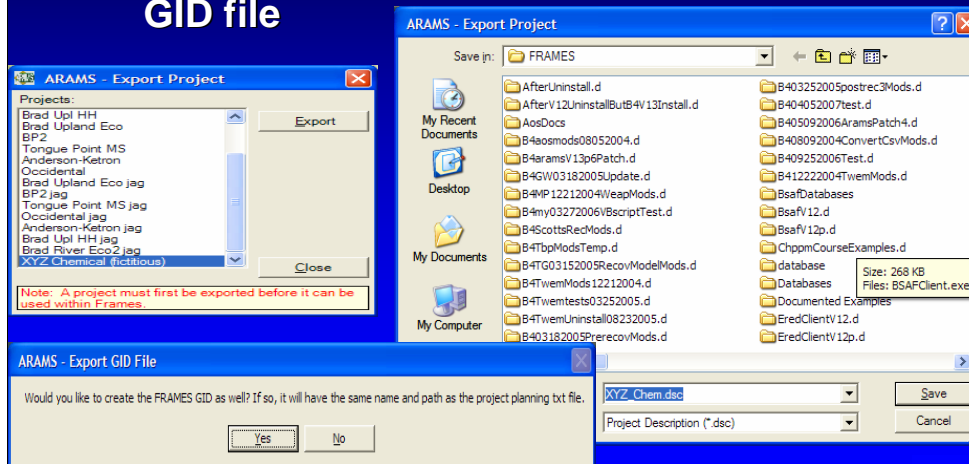
CSM Diagram

- The CSM is on the "CSM Diagram" tab as shown below



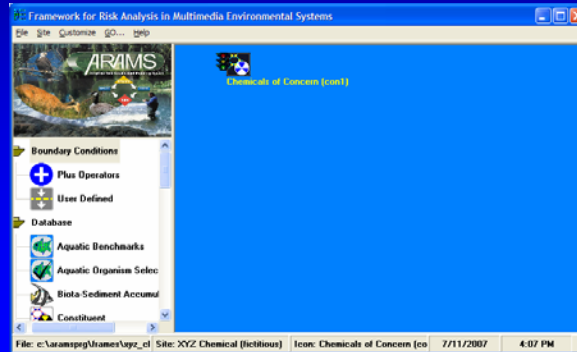
Basic ARAMS Example – con'd

- We then export the project description to FRAMES and create an initial FRAMES GID file



Basic ARAMS Example – con'd

- Note that the created FRAMES GID file only contains the constituent database module. Unfortunately, the ARAMS CSM tool does not fully generate the FRAMES CSM, but under the ARAMS Help menu is a tutorial on how to convert the CSM diagram to objects in FRAMES

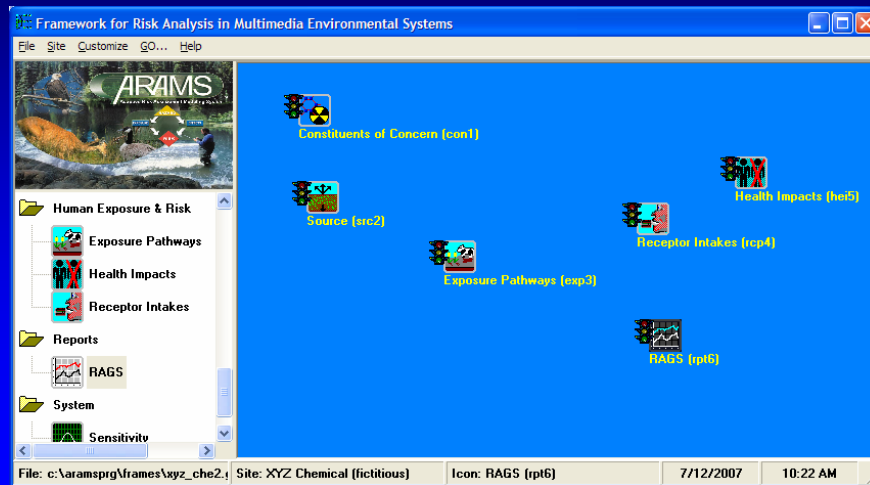


Basic ARAMS Example – con'd

- Using the ARAMS CSM Diagram, we can construct the FRAMES CSM (see the ARAMS Help menu for instructions on this)
- Based on this information, we therefore will want to place Source, Exposure Pathways, Receptor Intakes, and Health Impacts modules on the FRAMES workspace and we will add a RAGS viewer module to generate a RAGS part D report as well

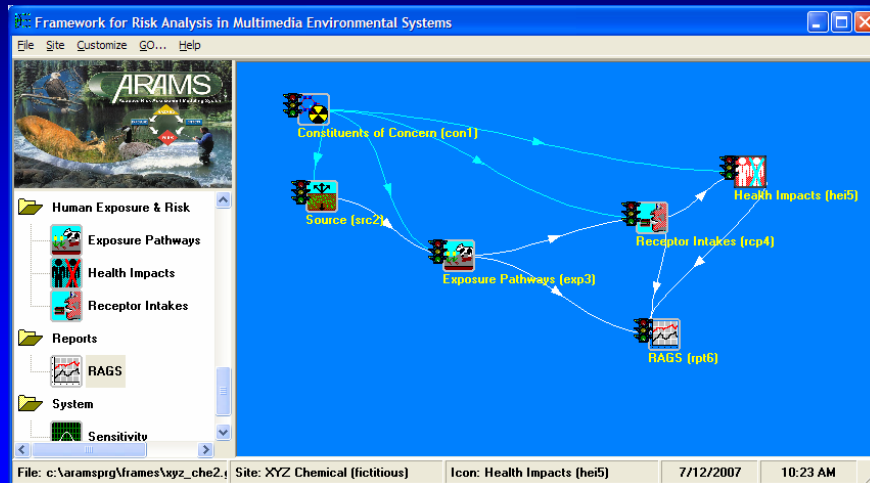
Basic ARAMS Example – con'd

- The FRAMES CSM now looks like that shown below



Basic ARAMS Example – con'd

- We next make the necessary module connections



28

Basic ARAMS Example – con'd

- We are now ready to select the models/database that we will use in the analysis (by right-clicking on an object, selecting “General Info”, and then selecting from the available database/model listings):
 - Constituent Module - “FRAMES Constituent Database Selection”
 - Source module - “MEPAS 5.0 Source in Soil Module”
 - Exposure Pathways - “MEPAS 5.0 Exposure Pathways Module”
 - Receptor Intakes - “MEPAS 5.0 Receptor Intakes Module”
 - Health Impacts - “MEPAS 5.0 Health Impacts Module”
 - RAGS - “RAGS Table Generator”

Basic ARAMS Example – con'd (additional data)

Variable Description	Value	Units
Length	50	m
Width	50	m
Depth	5	cm
Ingestion RfD	0.0003	mg/kg/day
Ingestion CSF	1.5	(mg/kg/day) ¹
Decay/degradation	none	n/a
Soil ingestion rate	0.05	g/day
Soil leach rate constant	0	/yr
Worker work frequency	340	days/yr
Exposure duration	30	yr
Worker average weight	70	kg

Basic ARAMS Example – con'd

- We then perform user input on all of the modules and then run all of the modules (we can also use the FRAMES “Go” button to accomplish this)
- We can then view the output...

Basic ARAMS Example – con'd

- The Health Impacts “Summary Views of Risk, Hazard and Dose” viewer is shown and the cancer risk is 4.08E-06 and the HI is 2.1E-02

Print Save

Dataset: src8:Soil Time Point (yr): 0
Location: 0.0 km Cancer organ: all sites
Age Group: 18 to 62
Constituent: All Chemicals Exposure duration: 30 yr

(Show Totals Only)

Exposure Route and Pathway	HI	Risk
All Chemicals summation for src8:Soil at location (0, 0) km for ages 18 to 62 at time 0	noncarcinogenic	carcinogenic (all sites)
TOTAL	2.11E-02	4.08E-06
ingestion (total)	2.11E-02	4.08E-06
Soil	2.11E-02	4.08E-06

Basic ARAMS Example - concluded

- If we run the RAGS viewer, we get the set of RAGS part D tables shown below using the viewer's RME option

TABLE 9.1B
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE

Summation is based on the sampling of the time-varying curve, after the time-varying Hazard/Risk curves have been combined in time.
Threshold for Carcinogenic Risk = 0.000E+00
Threshold for Non-Carcinogenic Hazard Quotient = 0.000E+00
For applicable time-varying outputs the first value is reported in this table (see footnote a,b,c).
C:\RAMS\PROGRAM\RAMS3072_CHE1

Scenario Timeframe: 0.000 yr
Receptor Population: 1
Receptor Age: 10.0 yr

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient					
				Ingestion	Inhalation	Dermal	External (Resuspension)	Exposure Route Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Route Total	
Soil	Soil	Exposure_Pathways	Arsenic	4.000E-06	--	--	--	4.000E-06	total body	2.19E-02	--	--	2.19E-02	
			Chemical Total	4.000E-06						2.19E-02				
			Radionuclide Total	--						--				
			Exposure Point Total	4.000E-06						2.19E-02				
Exposure Medium Total				4.000E-06						2.19E-02				
Medium Total				4.000E-06						2.19E-02				
Total Risk Across All Media				4.000E-06					Total Hazard Quotient Across All Media					2.19E-02

Notes:
RME = Reasonable Maximum Exposure
FTL = Federal Threshold

Navigation: Table 7.1A / Table 7.1B / Table 8.1 / Table 9.1.A / Table 9.1.B / Table 10.1.A / Table 10.1.B /

Firing Range Example

34

Firing Range Example

- In this example, a hypothetical firing range of 500 m x 500 m has a receiving stream located 3 km down gradient from the range
- The range is to be used for 50 years
- We are only concerned about runoff from the site
- We are interested in determining if and when RDX (CASRN 121-82-4) concentrations in the stream exceed the protective public advisory criteria of 2 parts-per-billion (ppb)

35

Firing Range Example – con'd

Variable Description	Value	Units
Range life	50	yr
Average rainfall	63.5	cm
Receiving stream annual flow rate	0.5	m ³ /sec
Munitions used	81 mm Mortar & 155 mm Howitzer	n/a

Munition	Variable Description	Value	Units
81 mm Mortar	Rounds Fired	3000	/yr
	Low Order	2	%
	Yield*	25	%
155 mm Howitzer	Rounds Fired	3000	/yr
	Low Order	2	%
	Yield*	25	%

* Amount of explosive used up in a low order detonation

Firing Range Example – con'd

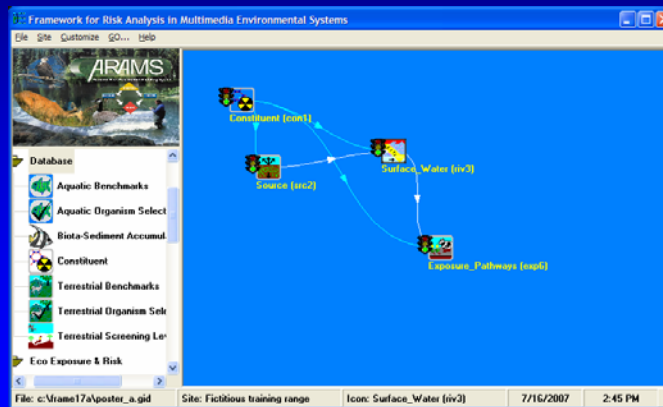
- **Modules, databases and models used:**
 - **Constituent module– “FRAMES Constituent Database Selector”**
 - **Source module – “Munition Residue Characterization and Fate Model” (available beginning with ARAMS 1.4)**
 - **Surface Water module – “MEPAS 5.0 River Module”**
 - **Exposure Pathways module – “MEPAS 5.0 Exposure Pathways Module”**

Firing Range Example – con'd

- We select RDX as the constituent of concern and set any properties of RDX that may be necessary in the constituent database module
- We then supply the model input information required
- Finally, we run the modules...

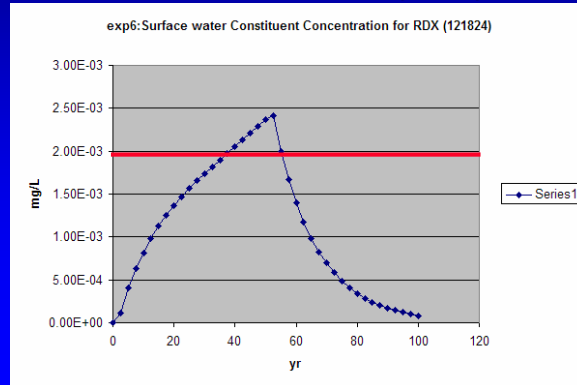
Firing Range Example – con'd

- Our example CSM then looks like that shown below



Firing Range Example – con'd

- We can then view the surface water module's water concentration file (WCF) output
- From the WCF output we notice that the protective public advisory criteria of 2 ppb will be exceeded after approximately 40 years of use



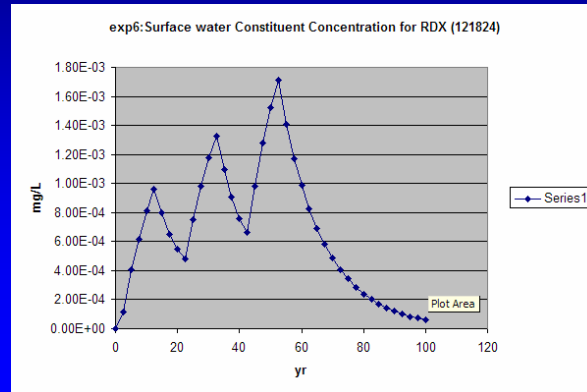
40

Firing Range Example – con'd

- **What can we do to ensure that we do not exceed the advisory criteria for the range usage period?**
- **One possibility is to alternate the range use on 10 year cycles**
- **Let's test this alternative...**

Firing Range Example - concluded

- We make the model input adjustments and re-run the models
- From the output of the alternative case, we can see that this does prevent exceeding the advisory criteria



Terrestrial Eco Example

Terrestrial Eco Example

- This is a steady-state analysis where we wish to evaluate the exposure of a Belted Kingfisher (*Ceryle alcyon*) and Red Fox (*Vulpes vulpes*) to DDT (CASRN 50-29-3) contaminated water, soil, and sediment (where appropriate)

Terrestrial Eco Example –con'd

- The modules, databases and models used:
 - Constituent module – “FRAMES Constituent Database Selector”
 - Terrestrial Organism Selector module– “ARAMS Terrestrial Organism Selector”
 - User Defined module – “SCF – Soil Module”
 - User Defined module – “SCF – Sediment Module”
 - User Defined module – “WCF – Surface Water Module”
 - Terrestrial Benchmarks module – “TTD - TRVs”
 - Eco Receptor Intake module – “Terrestrial Wildlife Exposure Model”
 - Eco Health Effects module – “Wildlife Ecological Assessment Program”

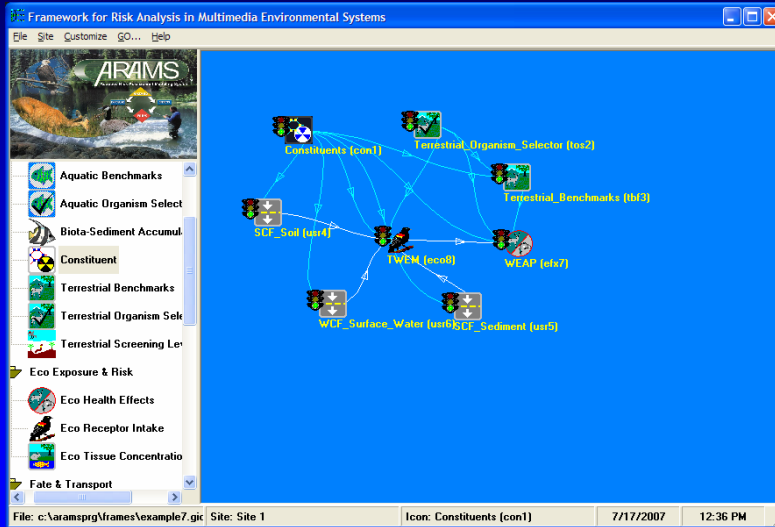
Terrestrial Eco Example – con'd

- We select DDT as the constituent of concern and set any properties of DDT that may be necessary
- We select the terrestrial organisms
- We select TRVs (or provide user-defined ones) to be used in the analysis (we can use multiple TRVs for a given receptor/constituent)
- Next, we supply the model input information required
- Note: **TWEM is the only model that requires the output from the upstream modules be run prior to opening the module for user input**

46

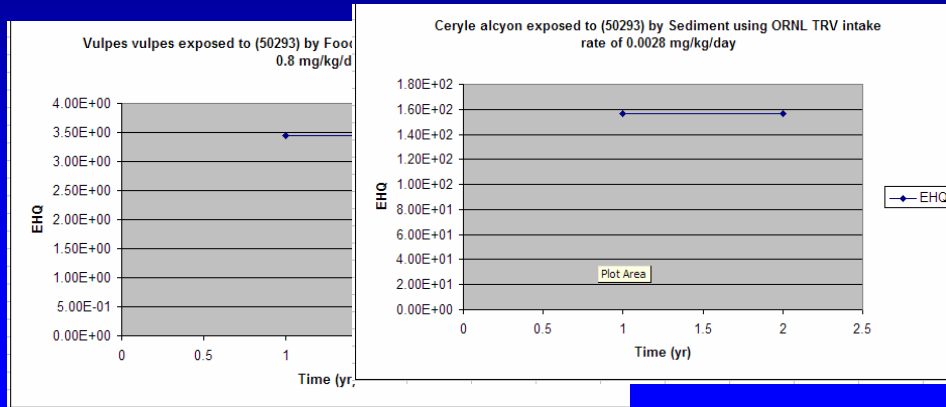
Terrestrial Eco Example – con'd

- After running all models, our example CSM then looks like that shown below



Terrestrial Eco Example – con'd

- We can then view the EHQ output of the WEAP module
- A couple of the graphs where the EHQ is > 1 are shown below



48

Terrestrial Eco Example – concluded

- Some of the EHQs were high, what made them high?
 - We can go check the TRVs that were used (e.g. how conservative were those values?)
 - We could go check the BAFs, Regression, Log(Kow), and life history parameter values used in TWEM
 - If all are reasonable, then perhaps steps need to be taken to mitigate the impacts

The screenshot displays the TTD-DCI 2.0 software interface. The 'Query Keys' section shows a table with columns for Chemical CAS, Chemical Name, Altered Chemical CAS, and Altered Chemical Name. The 'Query Control' section includes a 'Submit Query To Local Database' button and a 'Preserve user default data' checkbox. The 'Query Results' section shows a table with columns for Chemical Name Alias, Jurisdiction, Unique Class, Conservation, and Derivation. The 'Detailed Kinship/Gen' section shows a table with columns for Life History Parameter, Value, Units, Type, Reference, and Comments.

Chemical CAS	Chemical Name	Altered Chemical CAS	Altered Chemical Name	Jurisdiction
10028-15-7	DDT	10028-15-7	DDT	USA

Chemical Name Alias	Jurisdiction	Unique Class	Conservation	Derivation
DDT	CRNL	Aves	Very Conservative	LODEL
DDT	CRNL	Aves	Moderately Conservative	LODEL
DDT	CRNL	Mammals	Very Conservative	NOAEL
DDT	CRNL	Mammals	Moderately Conservative	LODEL

Life History Parameter	Value	Units	Type	Reference	Comments
Food Ingestion Rate (FR)	0.430	kg/kg/d	1 Year 1 Default	White, 1936	wet weight basis reported / converted to a
Sed Proportion of Food (P)	0.050		Unreviewed	Unreviewed	Assumed 0
Water Ingestion Rate (WR)	0.170	L/kg/d	1 Year 1 Default	Cole and Braun, 1983	Calculated
Body Weight (BW)	0.147	kg	1 Year 1 Default	Default	Average adult weight
Home Range (HR)	50,000	acres	1 Year 1 Default	same as ADC use	
AEF-x1		Spatial			

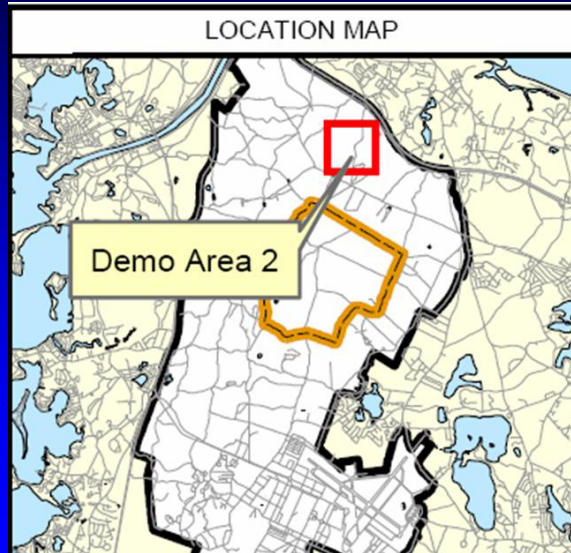
Example with Uncertainty

50

Example with Uncertainty

- This example demonstrates the power and flexibility of the FRAMES S/U module
- A more detailed description is contained in a journal article that has been accepted for publication in the *J. Contam. Soil & Sed.*, entitled “Modeling Fate of RDX at Demolition Area 2 of the Massachusetts Military Reservation” (M.S. Dortch, S. Fant, and J.A. Gerald)

Application to MMR Demo Area 2 for RDX Residue

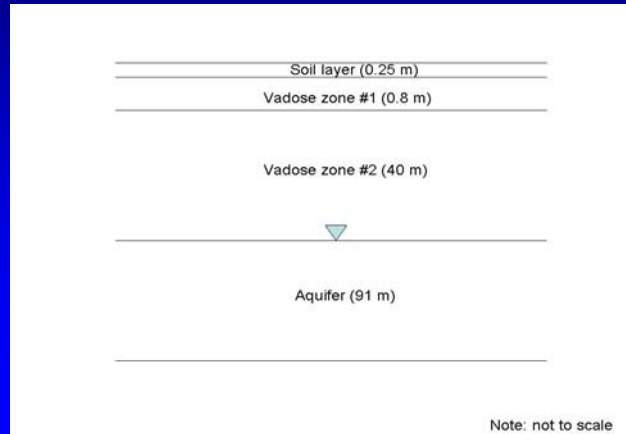


MMR Demo Area 2 Background

- **Used for demolition training from late 70's to late 80's**
- **Used mostly C4 (RDX plus binders and plasticizers)**
- **Measured soil and groundwater concentrations roughly 25 years later**
- **Asked by AEC to model site as proof of concept**
- **Challenge: to predict soil and groundwater concentrations not knowing the residue loading 25 years prior**

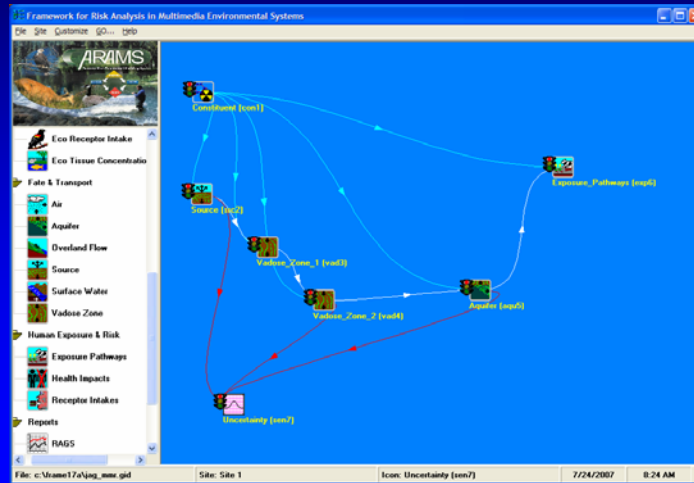
Example with Uncertainty – con'd

- The surface/subsurface profile of the site is shown below



Example with Uncertainty – con'd

- The FRAMES representation used for the site is shown below



Example with Uncertainty – con'd

- The following table shows the variables that were treated as uncertain for this case and their prescribed distributions...

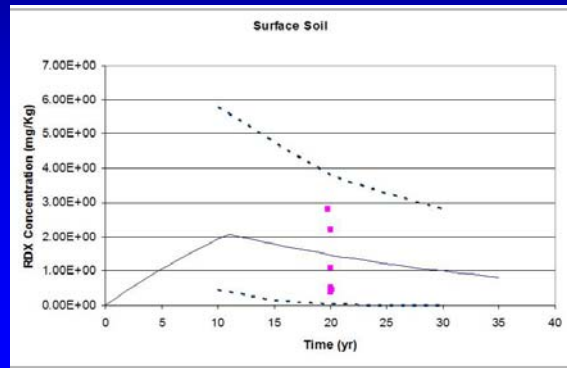
Variable	Units	Distribution	Lower Bound	Mean (baseline)	Upper Bound	Standard Deviation
Source Zone						
Length	m	Normal	80	110	140	10
Width	m	Normal	80	110	140	10
Mass load rate	g/yr	Log Normal	500	1000	5000	750
β dissol. coef.	mg/cm ² /sec	Uniform	7E 10	7E 09	7E 08	NA
Kd	ml/g	Normal	0.22	0.11	0.055	0.028
Infiltration rate	cm/yr	Normal	60	76.2	85	2.5
Lower vadose zone						
Kd	ml/g	Normal	0.007	0.013	0.026	0.003
Sat. Hydraulic Conductivity	cm/day	Normal	450	570	650	33
Half life	years	Normal	10	100	200	32
Aquifer						
Darcy velocity	cm/day	Normal	50	100	150	17
Kd	ml/g	Normal	0.007	0.013	0.026	0.003
Half life	years	Normal	10	100	200	32
Longitudinal dispersivity	cm	Log Normal	21	210	2100	347
Transverse dispersivity	cm	Log Normal	2.1	21	210	35
Vertical dispersivity	cm	Normal	0.01	0.381	1.0	0.165

Example with Uncertainty – con'd

- **In the S/U module we set the number of realizations to 500 and monitored the output of the source zone soil concentration and the groundwater concentration at a monitoring well identified as MW262**
- **Convergence occurred by 400 iterations**

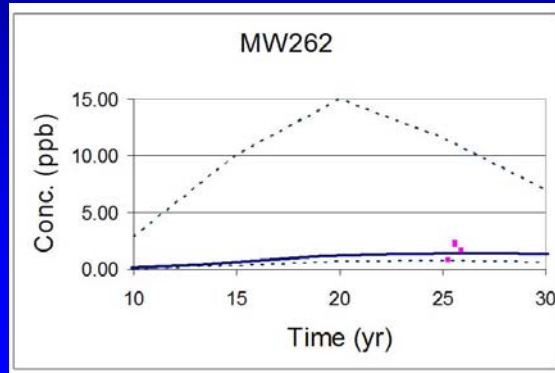
Example with Uncertainty – con'd

- The figure below shows the source zone soil concentration (computed and observed) with upper and lower 95% confidence interval



Example with Uncertainty - concluded

- The figure below shows the groundwater concentration (computed and observed) at monitoring well MW262 with upper and lower 95% confidence interval



60

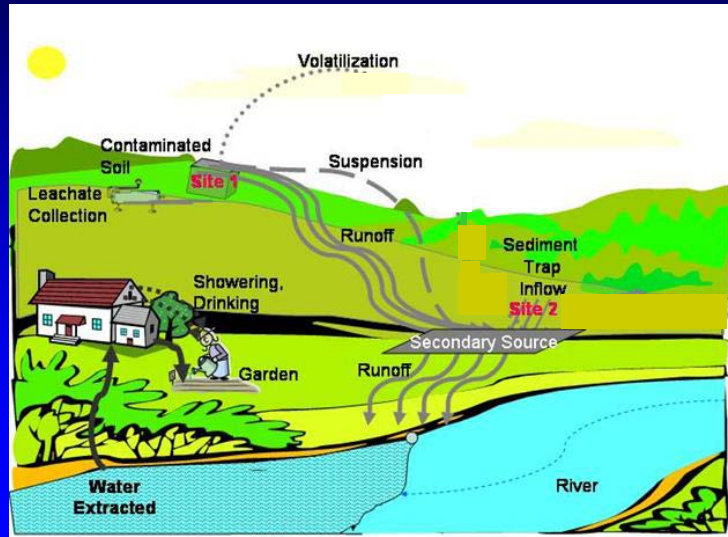
Advanced Example

61

- **In this example the versatility of ARAMS for analyzing multiple fate/transport within a watershed is demonstrated**
 - “Site 1” and “Site 2” are two areas of soil contaminated with PCB. Storm water runoff from both sites feed into another downstream site, “Secondary Source”
 - A leachate collection system exists at site #1, which serves as a sink
 - Volatilization occurs at site #1
 - Runoff and wind suspended particles from site #1 deposit onto the “Secondary Source” site
 - A survey of the area indicated a sediment trap was used in former operations at the site and this also has runoff to the “Secondary Source” site
 - Runoff from the “Secondary Source” site flows into a stream where, at a point downstream, the water is extracted and used for drinking, showering, and watering of a vegetable garden by a local resident

Advanced Example – con'd

- This scenario is depicted as shown below



63

Advanced Example – con'd

- We use the following modules, databases and models:
 - Constituent module – “FRAMES Constituent Database Selection”
 - Source module – “MEPAS 5.0 Source in Soil”
 - User Defined module – “WFF – Surface Water Module”
 - Air module – “MEPAS 5.0 Air Module”
 - Plus Operators module – “WFF – Surface Water Plus Operator”
 - Overland Flow module – “Copy of MEPAS 5.0 Secondary Source in Soil”
 - Surface Water module – “MEPAS 5.0 Surface Water Module”
 - Exposure Pathways module – “MEPAS 5.0 Exposure Pathways Module”
 - Receptor Intakes module – “MEPAS 5.0 Receptor Intakes Module”
 - Health Impacts module – “MEPAS 5.0 Health Impacts Module”

Advanced Example – con'd

- **We select PCB (General Classification) as the constituent of concern and set any properties of it that may be necessary**
- **We provide the required inputs for the modules (fairly numerous for this case)**

Note: The WFF Plus Operator requires no input and creates a single WFF connection to the downstream module for the case where the model used there only accepts a single WFF input connection as indicated in the model's input connection description ("General Info").

Advanced Example – con'd

- Example of the “MEPAS 5.0 Source in Soil” model’s user-interface showing some of its inputs

The screenshot displays the 'Source Term Module Input' window, which is divided into several tabs: 'Options', 'Waste Zone', 'Overland', 'Suspension', and 'Hydrology'. The 'Options' tab is currently selected, showing a list of input parameters with their respective values, units, and flags.

Description	Value	Unit	Flag
mass of clean overburden – STCLEAN	0	cm	0
thickness – STTHICK	3	m	0
length – STLENGTH	100	m	0
width – STWIDTH	100	m	0
density – ST2BULKD	1.6	g/cm ³	0
porosity – STDTPOR	0.4	fraction	0
moisture content – STMOIS1C	0.15	fraction	0
plastic air content – STAIRSPC	0.25	fraction	0
soil air temperature – STAVTEMP	25	C	0
above ground of local wind measure – STWINDHT	10	m	0
annual wind speed – STAVWINDV	5	m/sec	0
leaching loss route – STINF_OP	Turn off pathway		0
overland runoff loss route – STUOVL_OP	Known erosion rate		0
suspension loss route – STSUS_OP	Compute pathway		0
volatilization loss route – STVOL_OP	Compute pathway		0
known source/sink – STSRC_OP	Known constituent flux		0
time interval for simulation – STDELTA_T	1	years	0
time period for simulation – STMAXTIME	130	years	0
residual mass for simulation – STMINWST	0.01	fraction	0

The interface also includes a file path at the bottom: `/b /s/ c:\varamspg\frames\example0 c:\varamspg\frames\ltnsp\1.1 src2`.

Advanced Example – con'd

- Figure showing where the module input connection information can be found (under Module Description of the model, which is available by right clicking on a module and selecting “General Info” from the popup menu)

The screenshot displays the 'Object General Information' dialog box with the following fields:

- Easting coordinate: 0 km
- Northing coordinate: 0 km
- Elevation: 0 km
- User Label: Site_1
- Class: Fate & Transport
- Group: Source
- Object Id: mc2
- Previous Model: MEPAS 5.0 Source in Soil

The 'Model Description' window shows the following information:

National Laboratory, Richland, WA.
Other related sites:
<http://mepas.onl.gov/mepas>
<http://mepas.onl.gov/mepasu1/source.html>

VALID CONNECTIONS
Valid Input Reads:
1 to 1 con required as input

Valid Output Writes:
WFF: Soil
WFF: Waste Water
WFF: Surface Water
WFF: Air

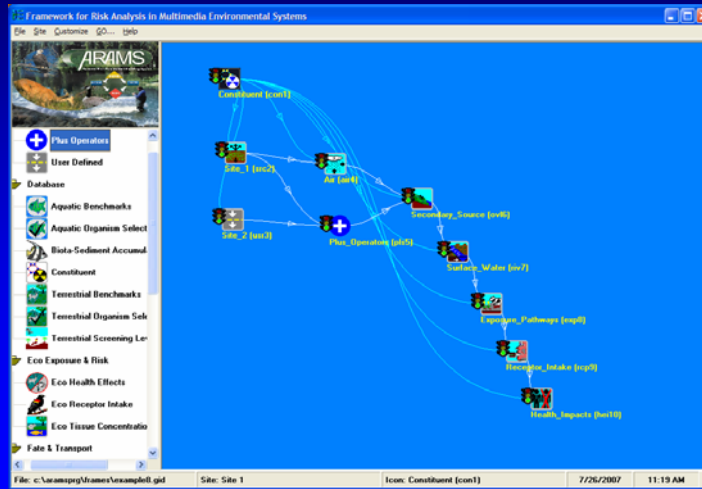
SYSTEM REQUIREMENTS
Operating System: MIN 95 + NT
Processor: Pentium
RAM: Minimum
Disk Space: Minimum 4GB free disk space

POINT OF CONTACT
Company Name: Pacific Northwest National Laboratory
Contact Name: John Buck
Callina Address: P.O. Box 599
City: Richland
State: WA
Zip Code: 99352
Country: USA
Telephone Number:
Fax Number: john.w.buck@pnl.gov
EML Address:
URL Address: <http://mepas.onl.gov/mepas/mxcorea.html>

The context menu includes: Connect-Disconnect, General Info, User Input, Run Model, Rename, Delete, View/Print User Input, and View/Print Module Output.

Advanced Example – con'd

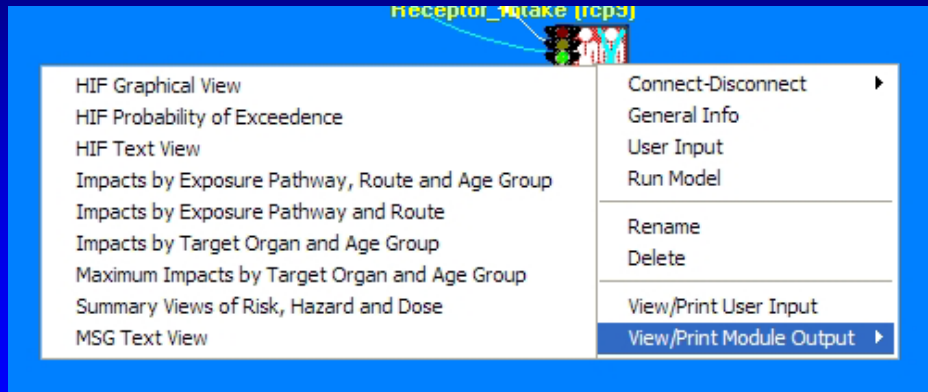
- In FRAMES, the CSM then looks like that shown below after running the models



68

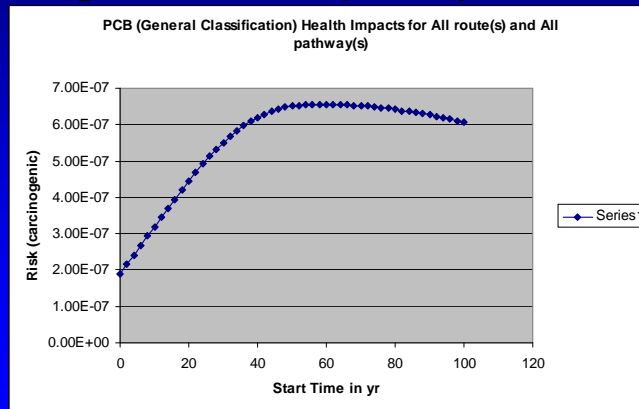
Advanced Example – con'd

- The figure below shows the human health impact viewers available to the user



Advanced Example – con'd

- Below is the plot of the “HIF Graphical View” health impacts viewer showing the time varying carcinogenic risk for all pathways and all routes



Advanced Example – con'd

- The “Summary Views of Risk, Hazard, and Dose” viewer is shown below
- Note that you can easily determine which route/pathway contributes the most risk

Print Save

Dataset: m7 Surface water Time Point (yr): 50
Location: (0, 0) km Cancer organ: all sites
Age Group: 0 to 70
Constituent: PCB (General Classification) Exposure duration: 30 yr

Show Totals Only

Exposure Route and Pathway	HI noncarcinogenic	Risk carcinogenic (all sites)
PCB (General Classification) summation for m7 Surface water at location (0, 0) km for ages 0 to 70 at time 50		
TOTAL	0.0E+00	6.542E-07
ingestion (total)	0.0E+00	1.263E-07
Leafy vegetables	0.0E+00	5.63E-08
Shower	0.0E+00	3.39E-10
Water	0.0E+00	6.77E-08
inhalation (total)	0.0E+00	4.44E-07
Shower	0.0E+00	4.44E-07
dermal (total)	0.0E+00	0.39E-00

User can select time period here

Summary

- ARAMS has multiple uses in risk assessment:
 - Serves as a central framework for conducting a RA
 - Provides tools to help perform a RA quicker and more efficiently (e.g. RAGS planning tables, CSM diagram, RAGS table generator)
 - Provides extensive reporting capabilities
 - Allows tracking and reporting of references
 - Model/Database “Plug and Play” capability (modular/adaptable)
 - Allows the user to use known data or perform modeling and consequently allows for time-varying risk evaluations, i.e. risk management
 - Performs uncertainty in a RA

Status

- **ARAMS 1.4 will include the additional models/modules:**
 - SEEM (Spatially Explicit Exposure Model)
 - MRCFM (Munitions Residue Characterization and Fate Model)
 - GENII* V2 & GENII V2 NESHAPS‡ suite of models
 - Sensitivity added to S/U module
 - A joint frequency data (JFD) utility
- **ARAMS 1.4 planned for release this Fall**

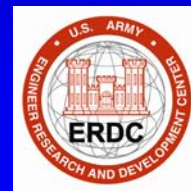
* Generation II

‡ National Emission Standard for Hazardous Air Pollutants

73

Thanks

- To all of the participants
- And to the following:
 - U.S. EPA
 - U.S. Army Engineer Research and Development Center
 - Interstate Technology and Regulatory Council (ITRC)



Upcoming Events

- ITRC ARAMS workshop – fall 2008

Questions?

Contact Info

- **Mr. Jeff Gerald (601)-634-3590**
Jeff.Gerald@erdc.usace.army.mil
- **Dr. Mark S. Dortch (601)-634-3517**
Mark.S.Dortch@erdc.usace.army.mil

Thank You

After viewing the links to additional resources,
please complete our online feedback form.



Thank You

[Links to Additional Resources](#)

[Feedback Form](#)