Development of human health risk assessment for the site of Cogoleto NPL site according to APAT guidelines for risk assessment

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APAT

Agency for Environmental Protection and Technical Services

Outline

- Overview of the RISC 4.0 model
- Available data for Cogoleto NPL Site
- Practical Exercise

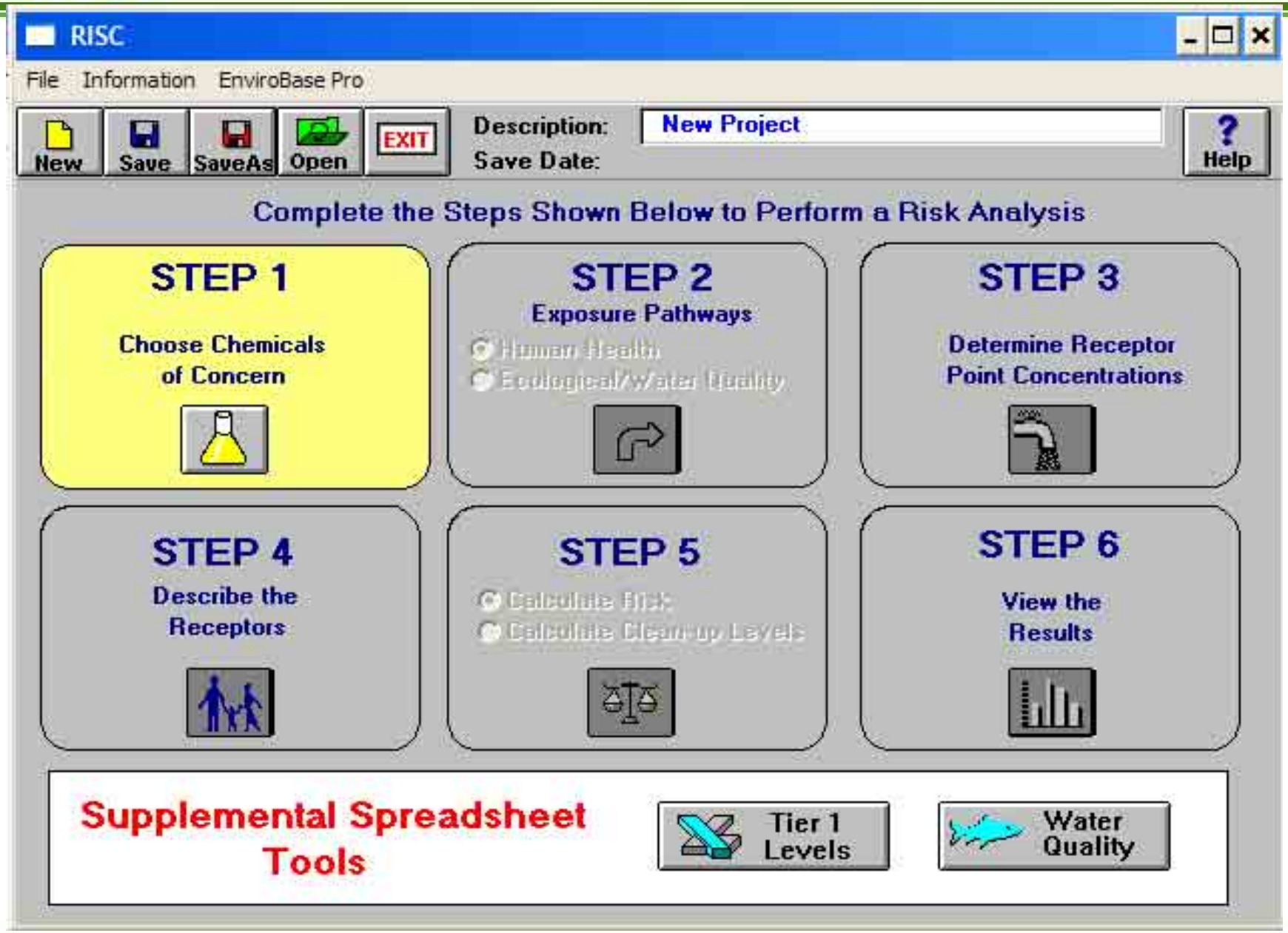
Features of the RISC 4.0 Model (1)

The RISC 4.0 allows the user to:

- Follow the ASTM tiered approach by utilizing a spreadsheet based on the ASTM algorithms for Tier 1, the embedded fate and transport models in RISC for Tier 2, and the Monte Carlo option in RISC for Tier 3;
- Choose chemicals of concern from a standard library of 86 chemicals; users may also add or delete chemicals from the library and alter the physical, chemical, and toxicological properties of each;
- Perform calculations for two different exposure scenarios (with up to fourteen exposure pathways each) simultaneously (e.g. calculations for both residential and industrial scenarios can be performed at the same time);
- Determine cumulative risks from two different exposure scenarios, as might be the case when the user wants to sum the risks for the scenario where a resident is exposed during both childhood and adulthood;

Features of the RISC 4.0 Model (2)

- Estimate exposure point water and air (both indoor and outdoor) concentrations using predictive chemical fate and transport models;
- Allow for additivity of pathways and compounds for either a forward calculation of risk or back calculation of cleanup levels;
- Use an embedded tool to estimate average, 95th UCL, and weight-averaged concentrations for a set of parameter values;
- Print or save tables, charts, and figures. New features in Version 4.0 of RISC allow the user to;
- Estimate human health risk from “irrigation pathways” for groundwater used outdoors but not supplying indoor uses;
- Estimate human health risk from ingestion of vegetables grown in contaminated soil or irrigated with contaminated groundwater;
- Use surface water mixing models to estimate potential impacts to surface water and sediments from contaminated groundwater;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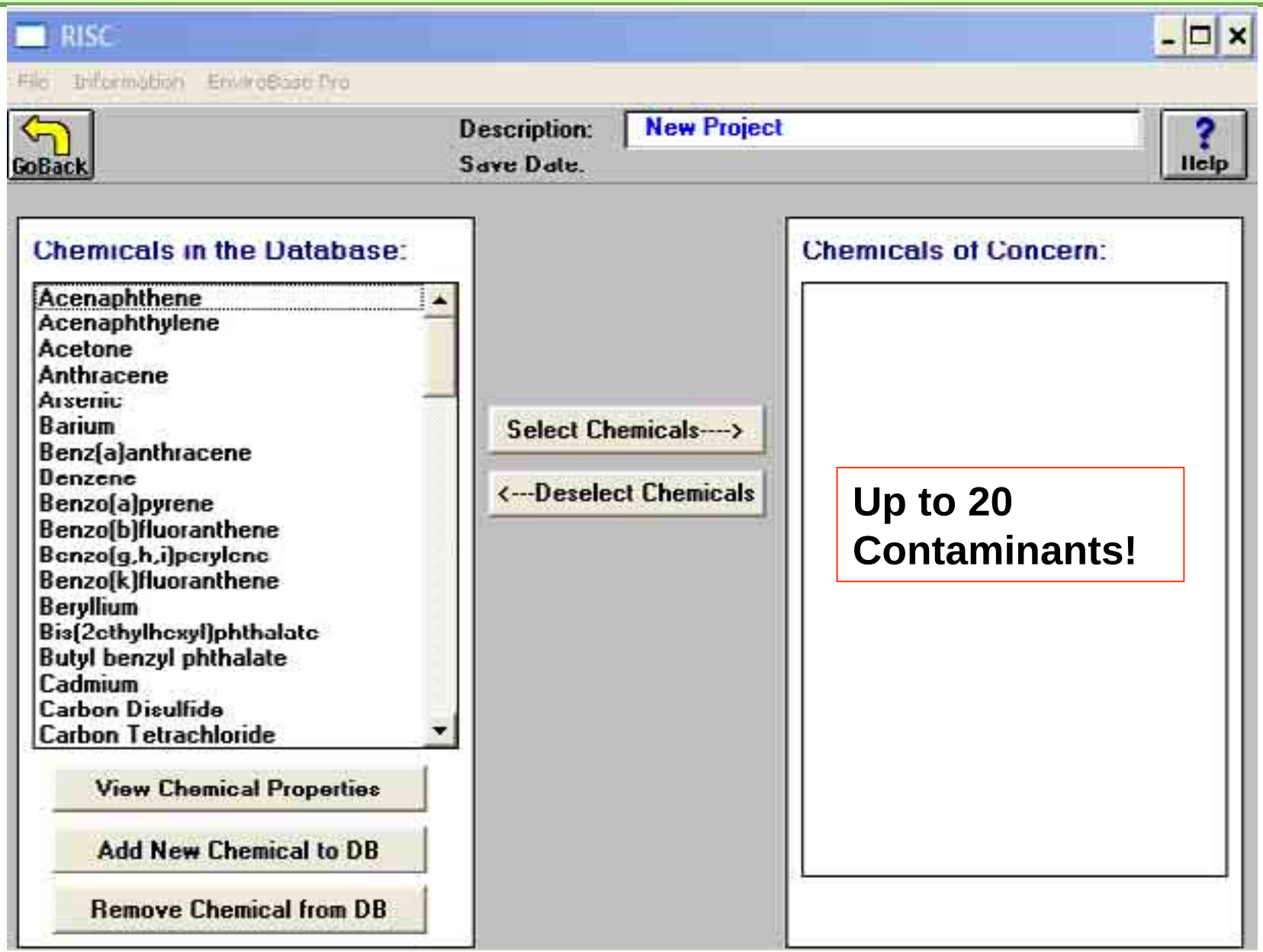
Help
Complete the Steps Shown Below to Perform a Risk Analysis
STEP 1
Choose Chemicals of Concern
STEP 2
Exposure Pathways
Human Health
Ecological/Water Quality
STEP 3
Determine Receptor Point Concentrations
STEP 4
Describe the Receptors
STEP 5
Calculate Risk
Calculate Clean-up Levels
STEP 6
View the Results
Supplemental Spreadsheet Tools
Tier 1 Levels
Water Quality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Help
Chemicals in the Database:
Acenaphthene
Acenaphthylene
Acetone
Anthracene
Arsenic
Barium
Benz(a)anthracene
Benzene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Beryllium
Bis(2ethylhexyl)phthalate
Butyl benzyl phthalate
Cadmium
Carbon Disulfide
Carbon Tetrachloride
View Chemical Properties
Add New Chemical to DB
Remove Chemical from DB
Select Chemicals---->
<---Deselect Chemicals
Chemicals of Concern:
Up to 20 Contaminants!

RISC

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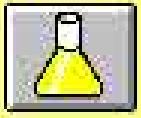
Complete the Steps Shown Below to Perform a Risk Analysis

STEP 1

Choose Chemicals of Concern



STEP 2

Exposure Pathways

- (•) Human Health
- ( ) Ecological/Water Quality

STEP 3

Determine Receptor Point Concentrations

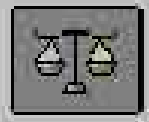
STEP 4

Describe the Receptors

STEP 5

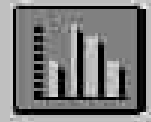
( ) Calculate Risk

( ) Calculate Clean-up Levels



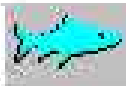
STEP 6

View the Results



Supplemental Spreadsheet Tools

Tier 1 Levels



Water Quality

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Help

Select Contaminated Media and Fate and Transport Models

Surface Soil

Soil Leaching Groundwater Surface Water

Indoor Air Outdoor Air

Select Exposure Pathways

Exposure Routes for Surface Soil

- [ ] Ingestion of soil
- [ ] Dermal contact
- [ ] Vegetable ingestion

Groundwater Used Indoors

- [ ] Ingestion
- [ ] Dermal contact
- [ ] Inhalation in the shower

Groundwater Used For Irrigation

- [ ] Ingestion
- [ ] Inhalation of volatiles
- [ ] Dermal contact w/spray
- [ ] Vegetable ingestion

Indoor Air

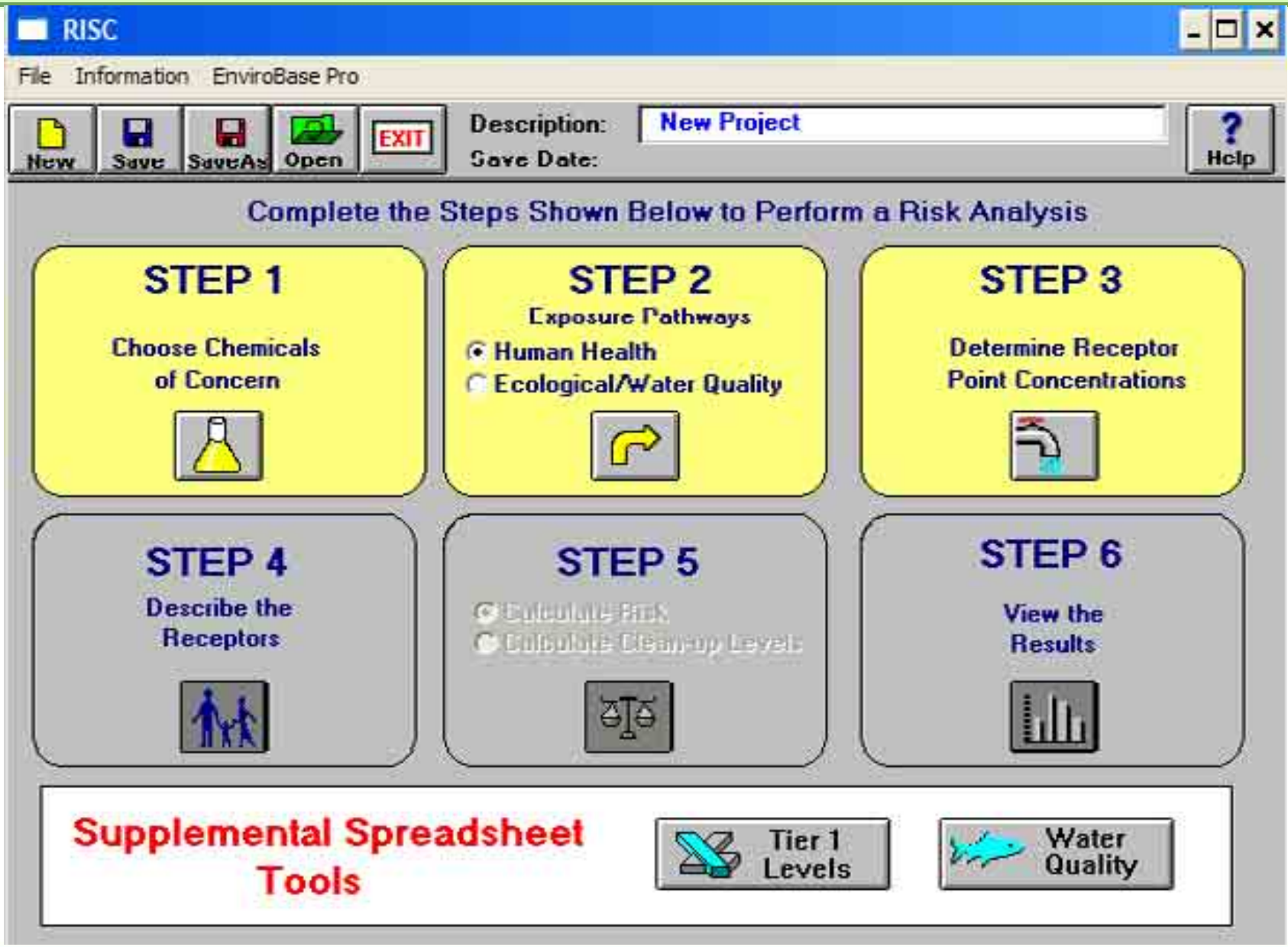
- [ ] Inhalation Indoors

Surface Water

- [ ] Ingestion
- [ ] Dermal contact

Outdoor Air

- [x] Inhalation Outdoors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Help
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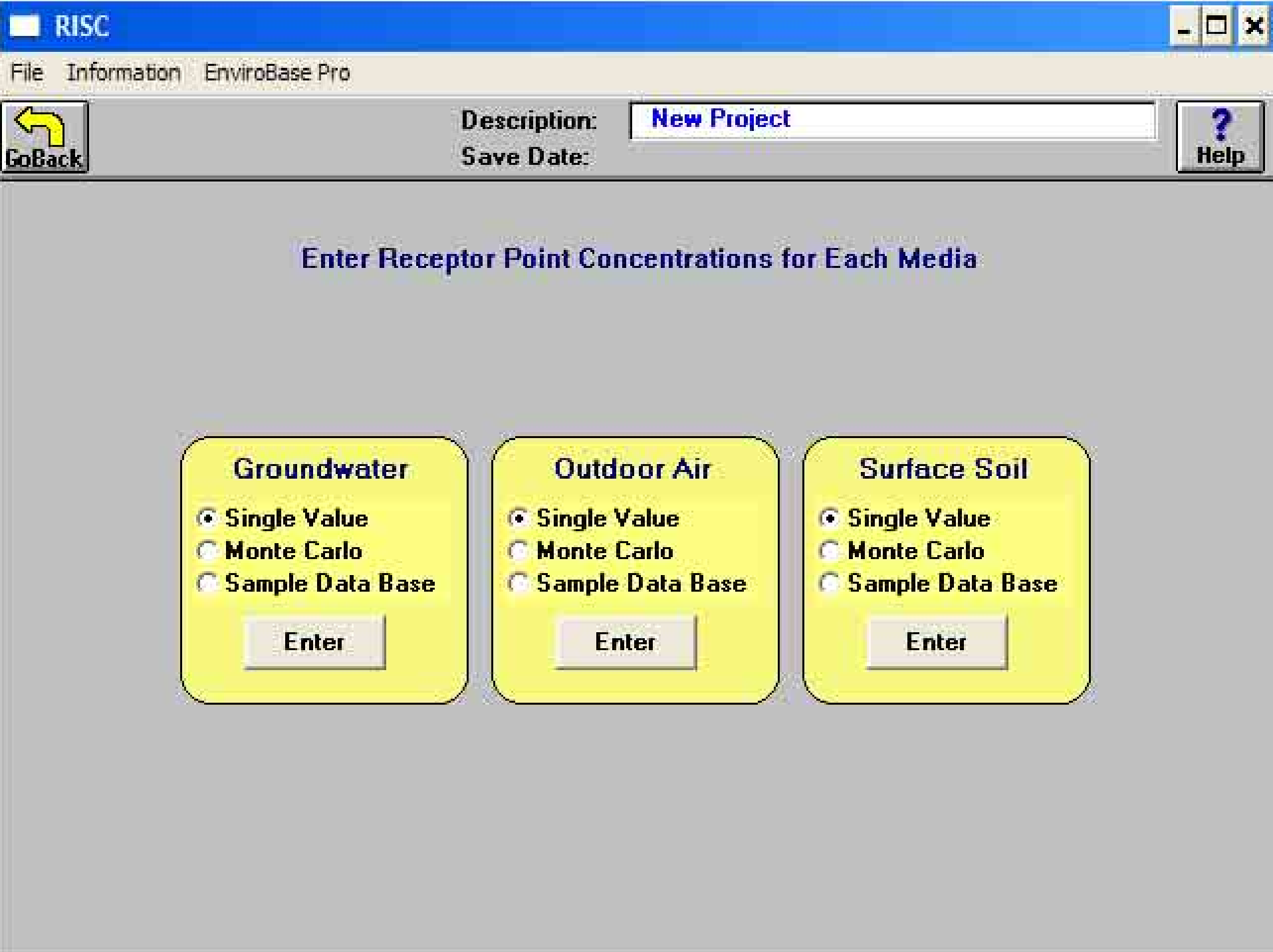
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Help
Enter Receptor Point Concentrations for Each Media
Groundwater
Single Value
Monte Carlo
Sample Data Base
Enter
Outdoor Air
Single Value
Monte Carlo
Sample Data Base
Enter
Surface Soil
Single Value
Monte Carlo
Sample Data Base
Enter

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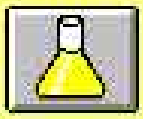
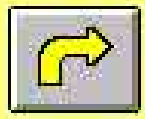
Complete the Steps Shown Below to Perform a Risk Analysis

STEP 1
Choose Chemicals of Concern



STEP 2
Exposure Pathways

- (•) Human Health
- ( ) Ecological/Water Quality



STEP 3
Determine Receptor Point Concentrations

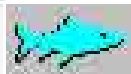
STEP 4
Describe the Receptors

STEP 5
- (•) Calculate Risk
- ( ) Calculate Cleanup Levels

STEP 6
View the Results

Supplemental Spreadsheet Tools


Tier 1 Levels


Water Quality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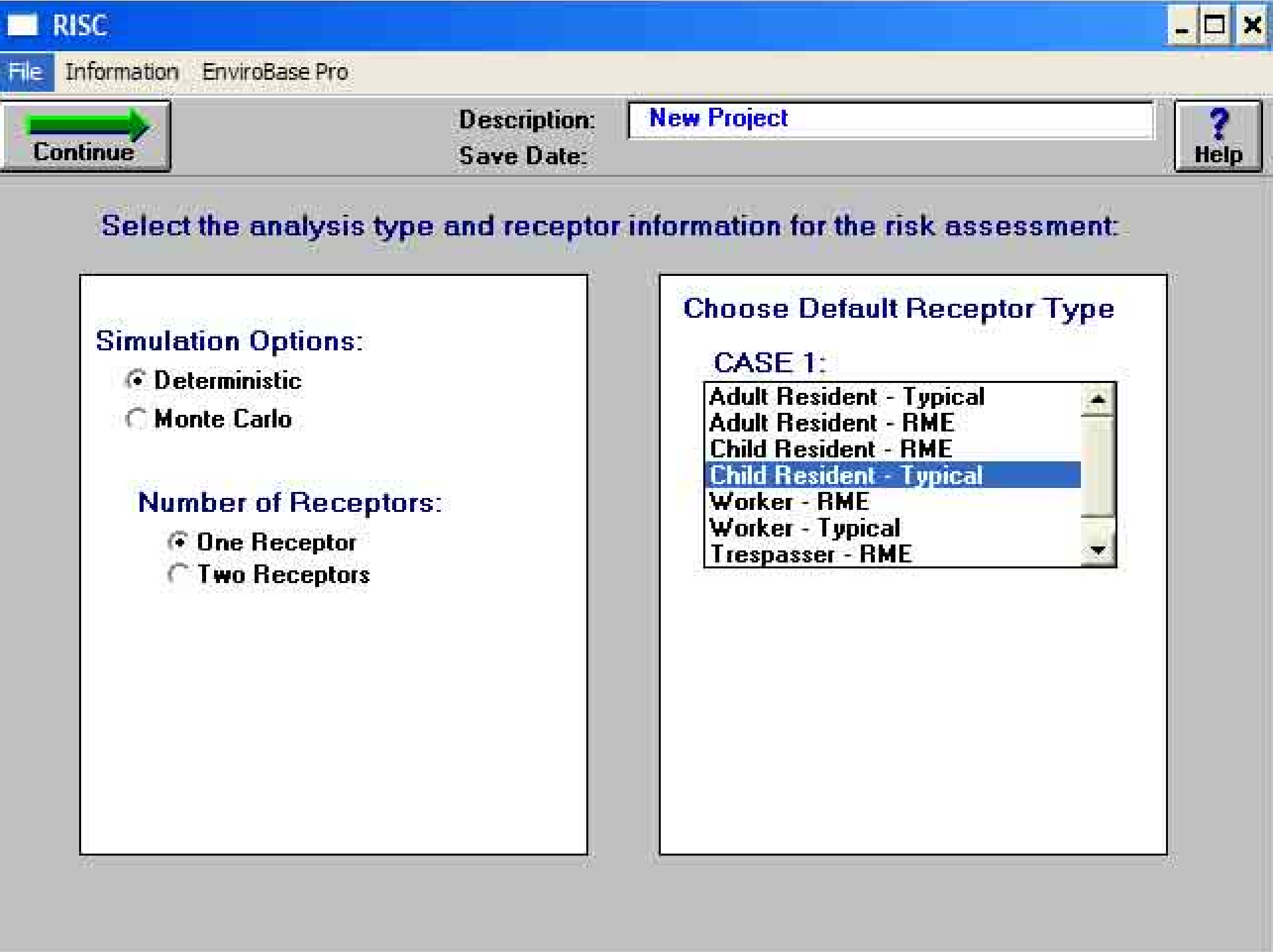
Help
Human Health Risk Assessment
Receptors and Analysis Type
Exposure Data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Help
Select the analysis type and receptor information for the risk assessment:
Simulation Options:
Deterministic
Monte Carlo
Number of Receptors:
One Receptor
Two Receptors
Choose Default Receptor Type
CASE 1:
Adult Resident - Typical
Adult Resident - RME
Child Resident - RME
Child Resident - Typical
Worker - RME
Worker - Typical
Trespasser - RME

RISC

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Enter Receptor Specific Data

Child Resident - Typical	
Lifetime [yr]	70
Body Weight [kg]	15
Exp. Freq. for Soil [events/yr]	130
Exp. Duration for Soil [yr]	6
Ingestion rate for soil [mg/day]	90
Total Skin Surface Area [cm^2]	6800
Fraction Skin Exposed to Soil [-]	0.13
Soil/Skin Adherence Factor [mg/cm^2]	0.2

Enter Bioavailability in Soil for Each Chemical [fraction]

Acenaphthene	1.0
Acetone	1.0
Arsenic	1.0

RISC

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Help

Complete the Steps Shown Below to Perform a Risk Analysis

STEP 1

Choose Chemicals of Concern

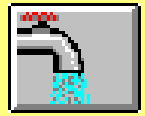
STEP 2

Exposure Pathways

- (•) Human Health
- ( ) Ecological/Water Quality

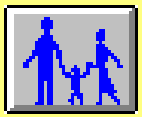
STEP 3

Determine Receptor Point Concentrations



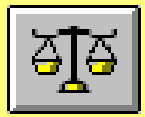
STEP 4

Describe the Receptors



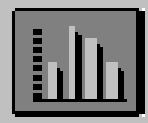
STEP 5

- (•) Calculate Risk
- ( ) Calculate Clean-up Levels

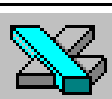


STEP 6

View the Results



Supplemental Spreadsheet Tools



Tier 1 Levels

Water Quality

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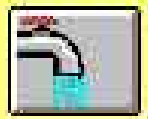
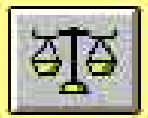


STEP 4

Describe the Receptors

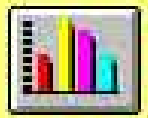
STEP 5

- (•) Calculate Risk
- ( ) Calculate Clean-up Levels



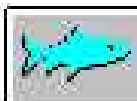
STEP 6

View the Results

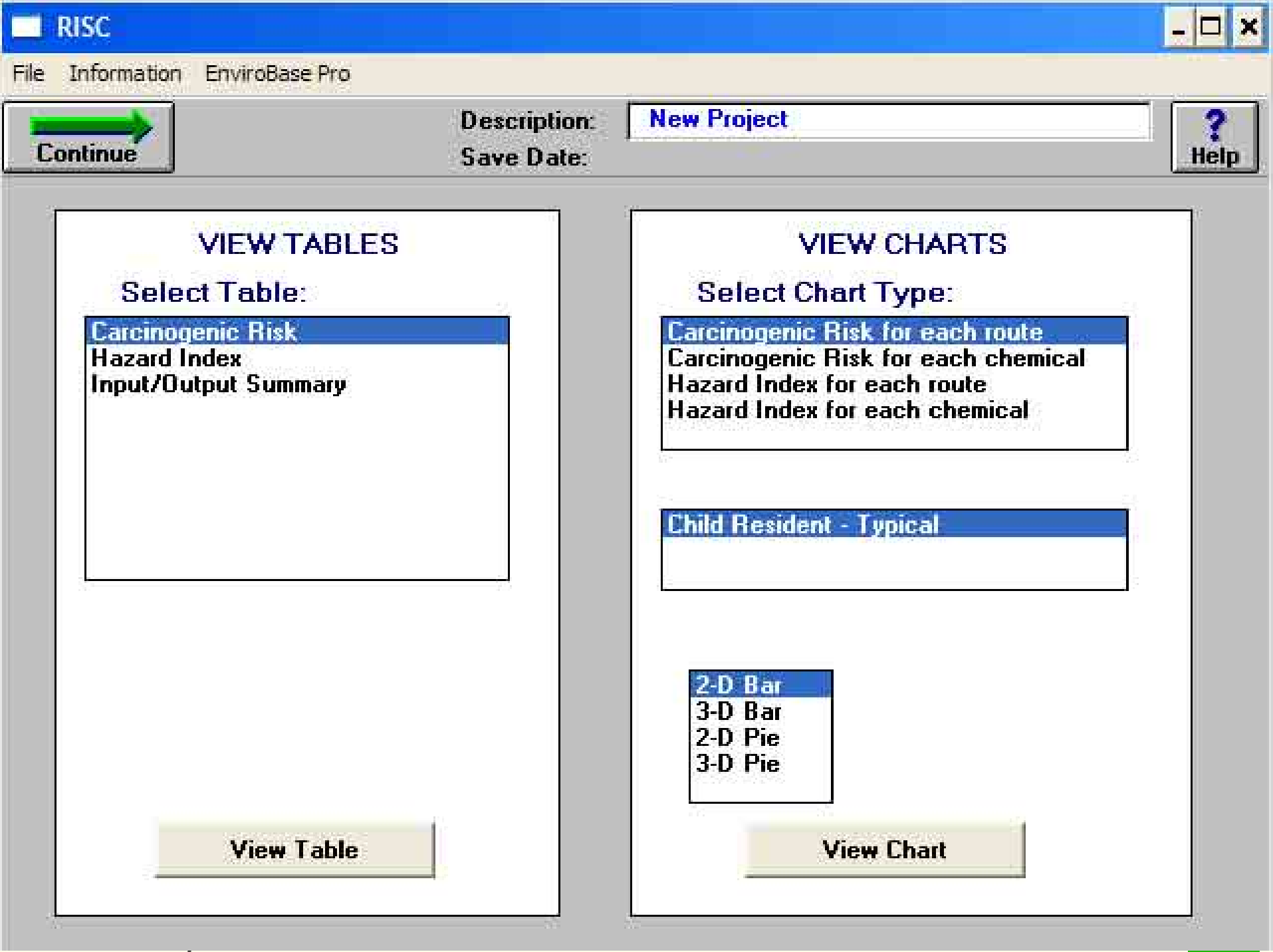


Supplemental Spreadsheet Tools

Tier 1 Levels



Water Quality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Help
VIEW TABLES
Select Table:
Carcinogenic Risk
Hazard Index
Input/Output Summary
View Table
VIEW CHARTS
Select Chart Type:
Carcinogenic Risk for each route
Carcinogenic Risk for each chemical
Hazard Index for each route
Hazard Index for each chemical
Child Resident - Typical
2-D Bar
3-D Bar
2-D Pie
3-D Pie
View Chart

SUMMARY OF CARCINOGENIC RISK
For Surface Soil

CASE 1:
Child Resident - Typical

	Ingestion of Soil	Dermal Contact Soil	TOTAL
Arsenic	2.7E-05	1.6E-06	2.9E-05
TOTAL	2.7E-05	1.6E-06	2.9E-05

SUMMARY OF CARCINOGENIC RISK
For Groundwater

CASE 1:
Child Resident - Typical

	Ingestion of Groundwater	Dermal Contact in Shower	TOTAL
Arsenic	4.1E-01	6.7E-04	4.1E-01
TOTAL	4.1E-01	6.7E-04	4.1E-01

SUMMARY OF CARCINOGENIC RISK
For Outdoor Air

CASE 1:
Child Resident - Typical

	Inhalation of Outdoor Air	TOTAL
Arsenic	1.5E+01	1.5E+01
TOTAL	1.5E+01	1.5E+01

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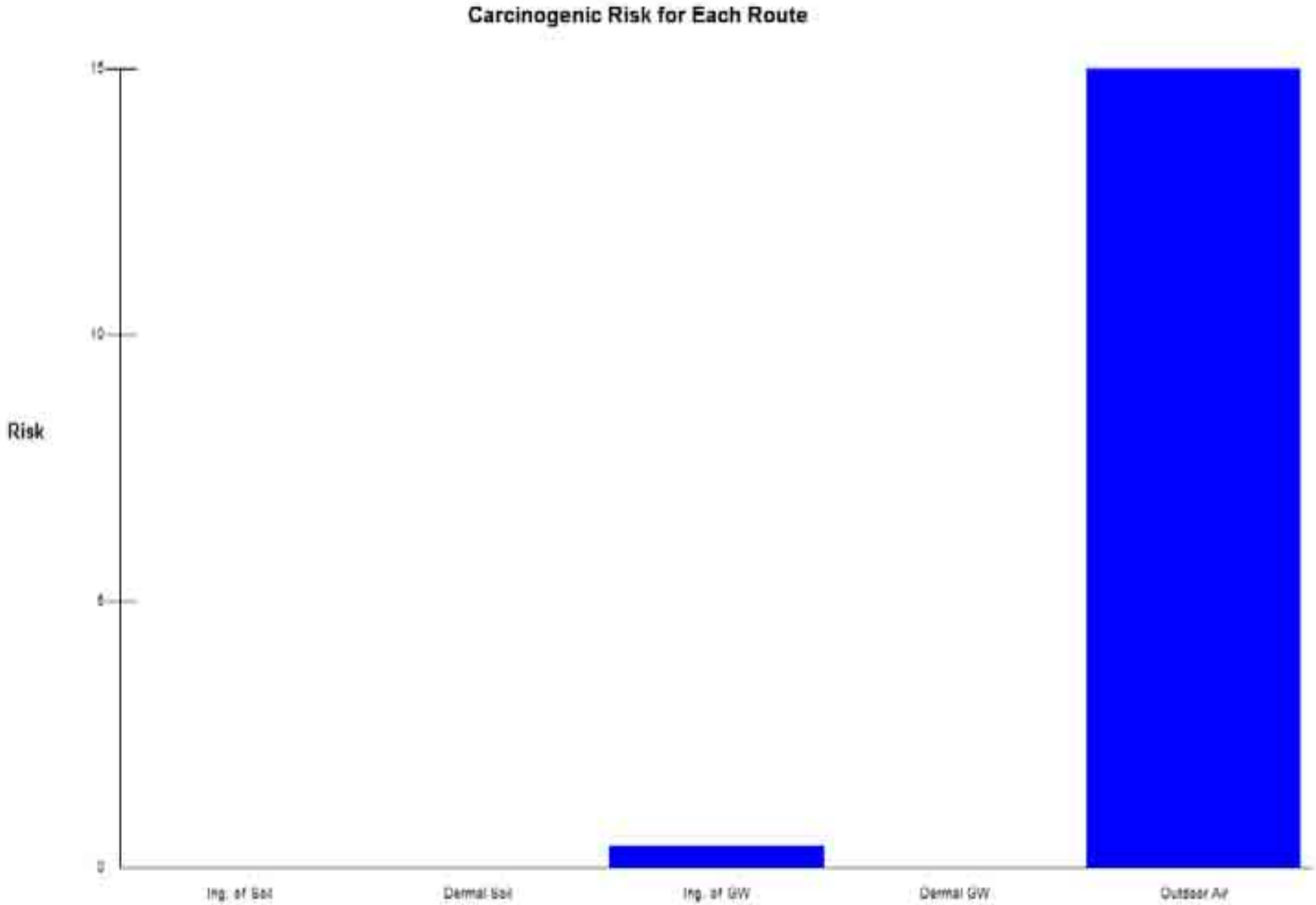

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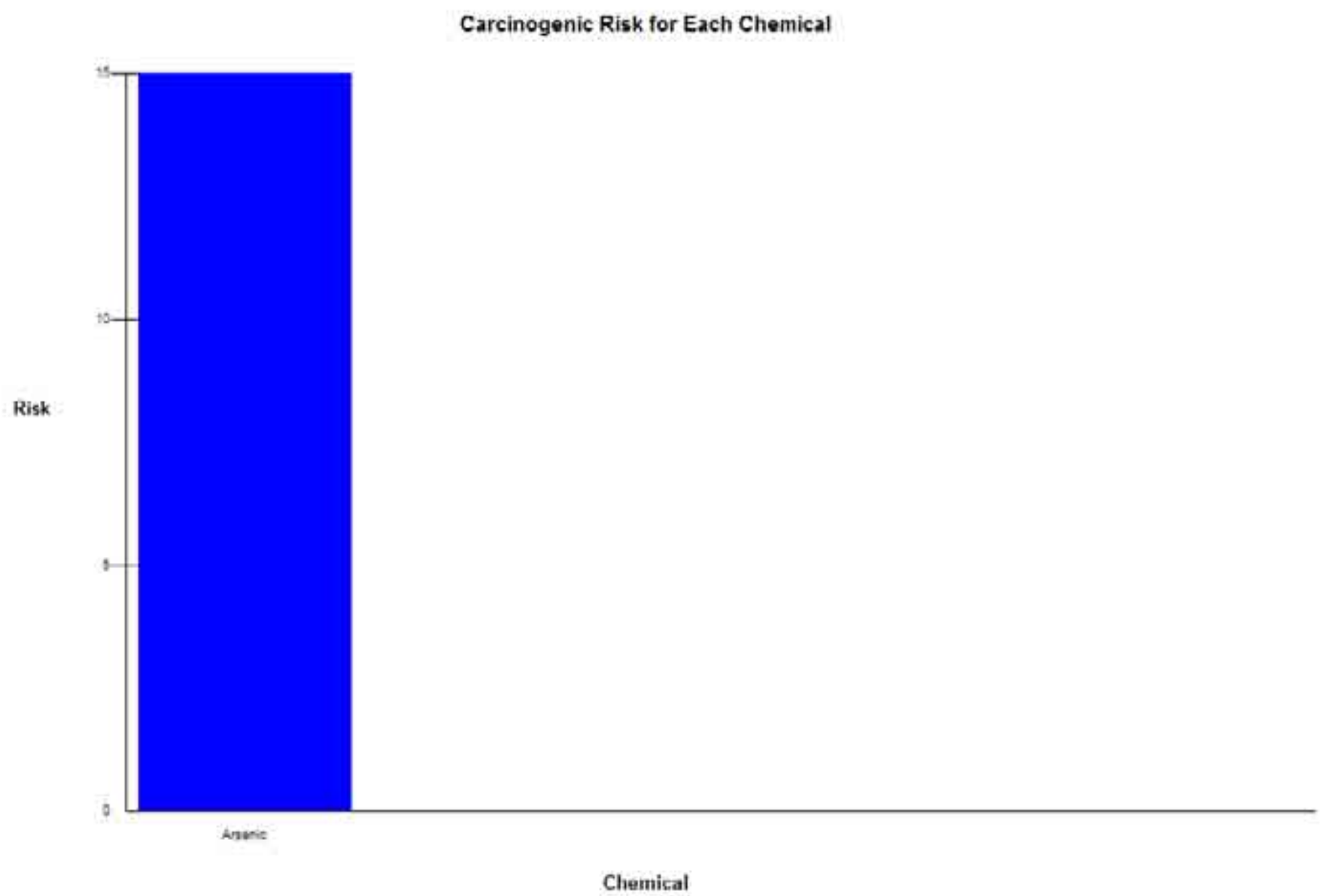

Available data for Cogoleto NPL Site

- Contamination
- Site-specific characteristics
- Exposure
- Chemico-Physical and Toxicological Data

Available data for Cogoleto NPL Site: Contamination

- **Soil**
- **Total Chromium**: up to **15.000 mg/kg** (1000 times the regulatory limit = 15 mg/kg)
- **Chromium VI**: up to **2000 mg/kg** at Pian Masino landfill area
- **Nichel:** concentration range from **500** to **1000** mg/kg, “hot spot” up to **1500 mg/kg**

- **Sediment**

- **Cr VI 1200-1900 mg/kg:** Contamination Range of the sediments upstream

- **Cr VI 1500-5000 mg/kg:** Contamination Range of the sediments downstream

- **Groundwater**

- High levels of Cr and CrVI contamination: **100.000-250.000 µg/l** in the area of the industrial plant

- High levels of contamination at the river mouth (Cr VI from **100-400 µg /l)**

Available data for Cogoleto NPL Site: Site-Specific Characteristics:

- Surface Soil: Sand (sandy loam for a limited extension)
- Sub-soil: Sand-Sandy-Loam
- Groundwater: depth of water table = 13,8 – 15,6 m
- Hydraulic Gradient: 1,5 %
- Fraction Organic Carbon: 0,003

Available data for Cogoleto NPL Site: Exposure

-The human targets of the contamination are industrial workers and trespasser (recreational use of the beach)

Available data for Cogoleto NPL Site: Chemico-Physical and Toxicological Data

See ISS-ISPESL database:

http://www.apat.gov.it/site/_files/Suolo_Territorio/banca_dati_%20agg18ott07.xls