

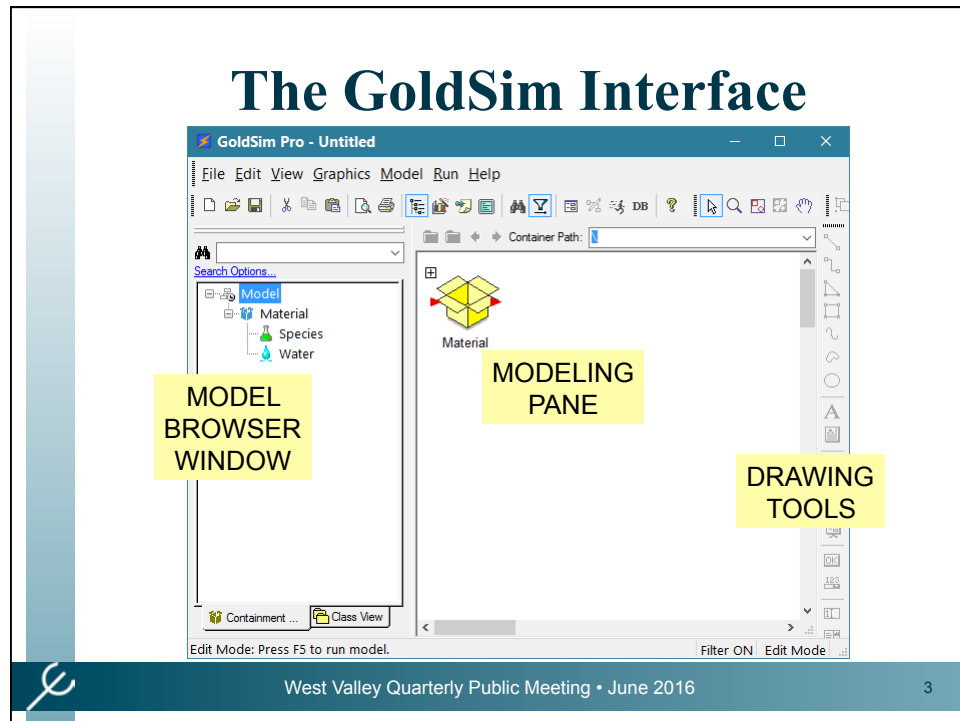
Performance Assessment Modeling with GoldSim










Presentation Outline

- Introduction to GoldSim
- Handling Uncertainty
- A GoldSim PA Example





GoldSim Basic Model Elements

	Data: input of a fixed value
	Stochastic: input of a distribution for a value
	Expression: a mathematical expression
	Selector: for building complex conditionals
	Event: timed or triggered event and consequences
	Extremum: for tracking maximum values
	Lookup Table: input of a table of values

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GoldSim PA Model Elements



Species

Species: input of chemical and rad species



Water

Fluid: definition of a fluid (in this case, water)



Solid

Solid: definition of a porous solid



Source

Source: contaminant source



Cell

Cell: compartment containing materials



Aquifer

Aquifer: definition for simple groundwater transport

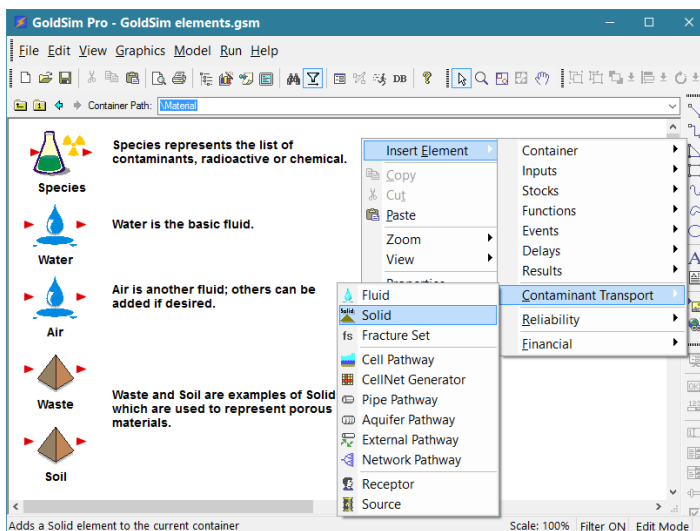


Receptor

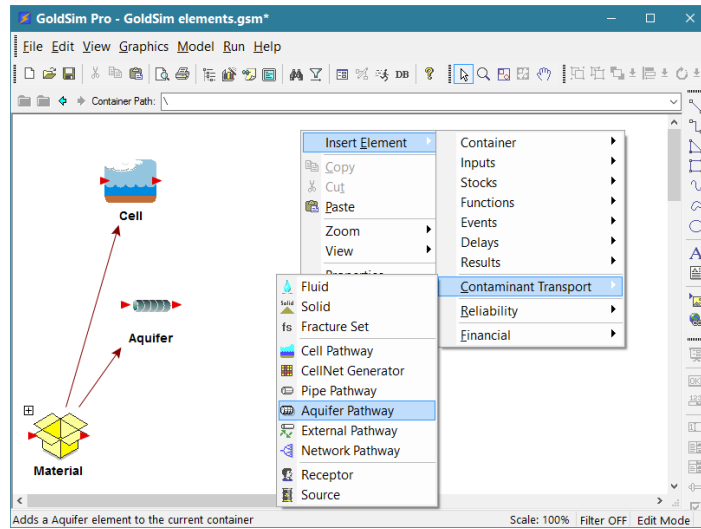
Receptor: definition of an exposed receptor



Model Elements: Materials



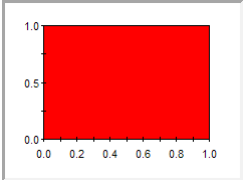
Model Elements: Pathways



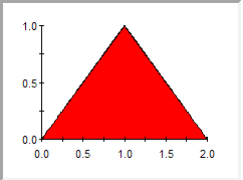
A list of decay products is defined in the dialog box.

Many Types of Distributions are Available to Represent Uncertainty

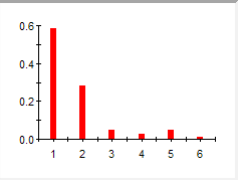
uniform



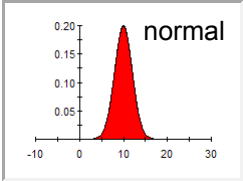
triangular



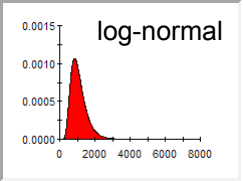
discrete



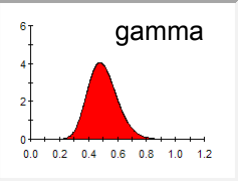
normal




log-normal




gamma



What is chosen must have some basis in reality.

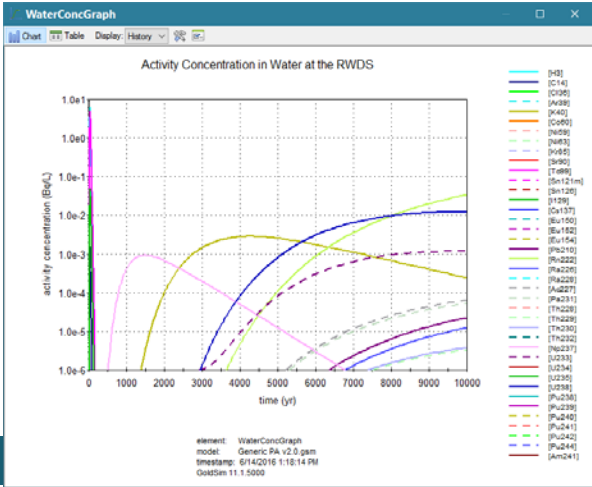

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Typical Results



Any state or condition of the model can be tracked and graphed through time (e.g. concentrations, flow rates, doses).

This could be concentration or dose.




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A Screenshot Tour of Neptune's Generic PA Model



GoldSim Player - Generic PA Model (Generic PA v2.0.gsp)

File View Model Help

Search Options...

Model

- Acknowledgements
- Dashboards
- Disposal
- Documentation
- DoseAssessment
- Inventory
- Materials
- AirDiffusivities
- DecayChains
- KhAirWater
- RockProperties
- SoilKds
- SoilProperties
- Solubilities
- WasteProperties
- WaterProperties
- Air
- DecayRate
- ElementalDensity
- HalfLife
- Rock
- RockKds
- Soil
- Species
- Waste
- Water
- Processes
- Results
- SimulationSettings

Container Path

A Generic Radiological Performance Assessment Model for a Radioactive Waste Disposal Site (RWDS)

The RWDS is a fictitious site conjured simply as a modeling demonstration. Resemblance to any real radioactive waste site is unintentional.

version 2.0
April 2016

Materials

Processes

Inventory

Disposal

DoseAssessment

Results

Home Dashboard

Dashboards

SimulationSettings

Documentation

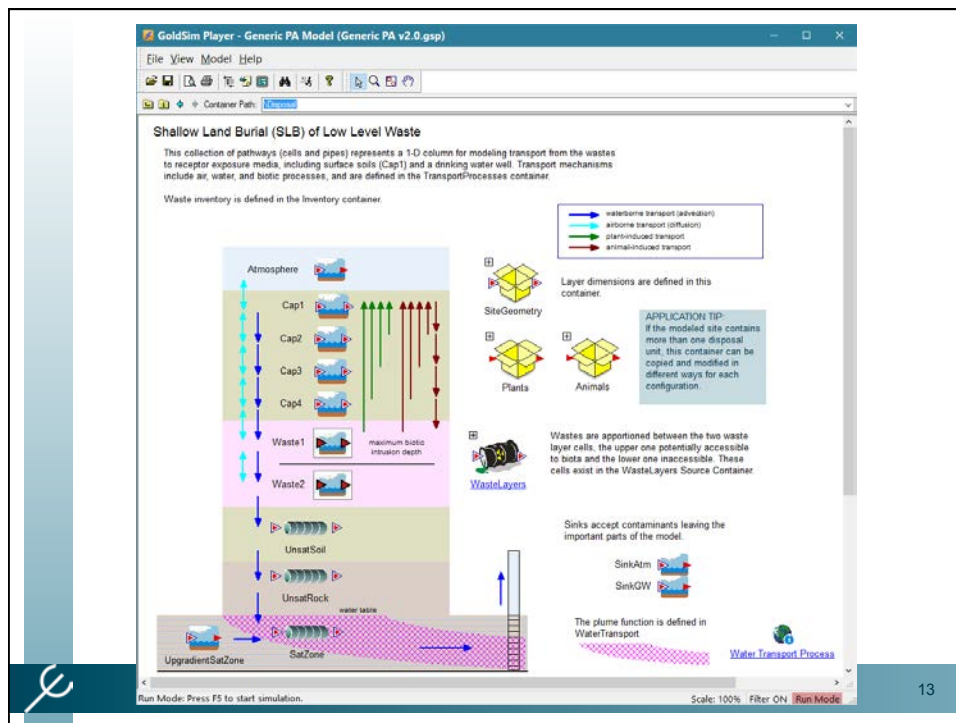
To learn about this model, click on the note button (or choose View | Note | Show Note from the menu, or use Alt+V N)

Built using GoldSim version: 11.1.8

NEPTUNE AND COMPANY

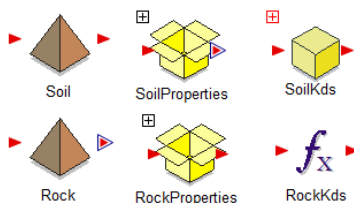
John Tause, PhD, PE | www.neptunecorp.com/goldsim | Acknowledgements

Run Mode: Press F5 to start simulation. | Scale: 100% Filter ON Run Mode



Modeling elements are logically organized on the page, with clear naming and accompanying text.

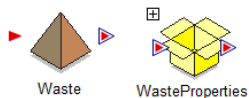
Porous media Soil and Rock



Properties of the unsaturated porous medium, including porosity, bulk density, etc., are defined in SoilProperties. Soil/Water partition coefficients are in Kds. Porosity and tortuosity are defined for the air and water phases for purposes of phase-specific advective and diffusive transport.

Similar properties are defined for Rock. If different Kds are to be used for Rock, then a separate (localized) container should be used for their definition.

Waste - a specialized solid medium



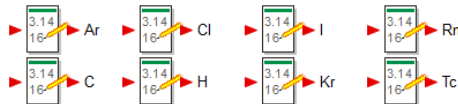
The Waste medium occupies the waste cells. For now, it has the same properties as Soil, but this can be changed in WasteProperties.

This example shows how soil/water partition coefficients (K_d s) are defined.

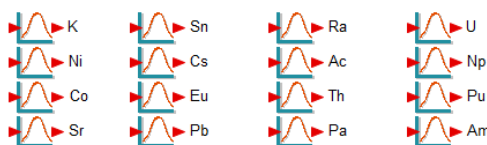
Soil/water partition coefficients

A soil/water partition coefficient (K_d) is defined for each chemical element in the model (not each radionuclide Species). Units are from the original references, but GoldSim takes care of the conversions.

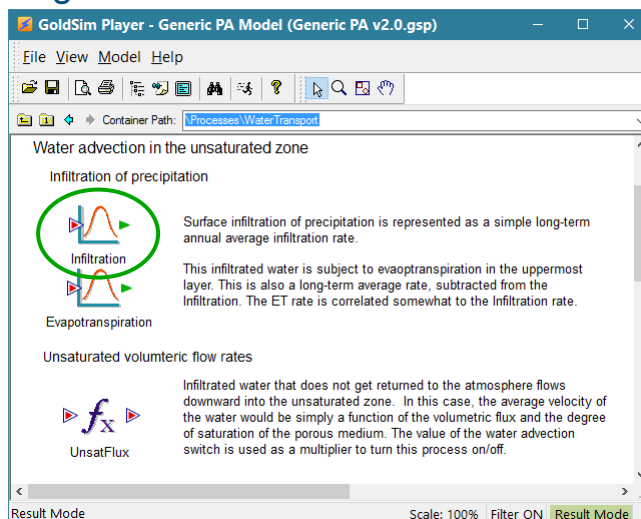
The following K_d values are assumed to be zero (no retardation):



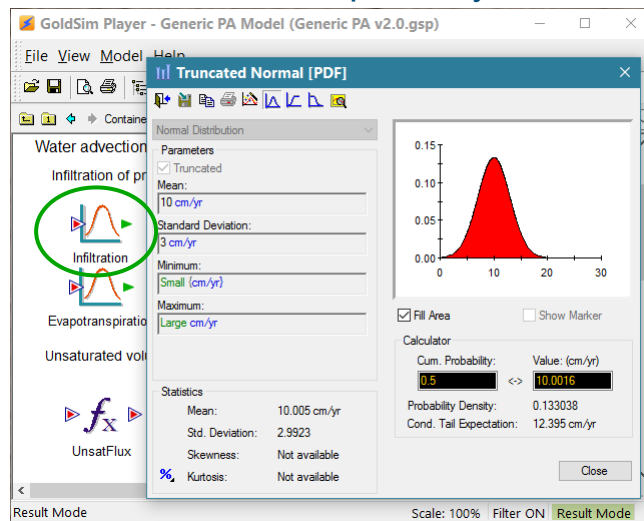
The following K_d values are from Sheppard and Thibault (1990) for sand, with log-normal distributions applied as suggested in the paper:



Here's an example of how the rate of water flow into the ground is calculated.



Infiltration is defined with some uncertainty, since we do not know the value perfectly.



Detail of the definition of UnsatFlux. Note that names that make sense are used.

Element ID: Appearance...

Description:

Display Units: Type... Scalar

Equation

```
WaterAdvection_Switch * max( Small cm/yr, ( Infiltration - Evapotranspiration ) )
```



Infiltrated water that does not get returned to the atmosphere flows downward into the unsaturated zone. In this case, the average velocity of the water would be simply a function of the volumetric flux and the degree of saturation of the porous medium. The value of the water advection switch is used as a multiplier to turn this process on/off.

GoldSim Player - Generic PA Model (Generic PA v2.0.gsp)

Home Dashboard for the Generic PA Model

Controls for running the model

- Simulation Switches**: Switches are available to run the model in different ways and to test the influence of different processes.
- Simulation Settings**: The collection of standard GoldSim Simulation Settings is accessible through this button.

Access to results

- Total and Max Doses**: Dose results are accessed through this button, which takes you to the dose result dashboard.
- Radon Performance**: Radon performance, as a ground surface flux (per unit area) and as a concentration in air above the disposal unit, are accessed here.
- Contaminant Flux**: This button goes to the contaminant flux results dashboard.
- Dynamic Results**: Some dynamic results can be viewed through GoldSim dashboard output controls here.

Run Model: You may run the model at any time.

Browse Model: You may browse the model at any time.

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GoldSim Player - Generic PA Model (Generic PA v2.0.gsp)

Dose Time History Results • Total and Peak Effective Dose Equivalents (EDE)

Total dose (excluding dose from Rn and progeny in air)

Average time to loss of Institutional Control: 100 yr Simulation duration: 10000 yr

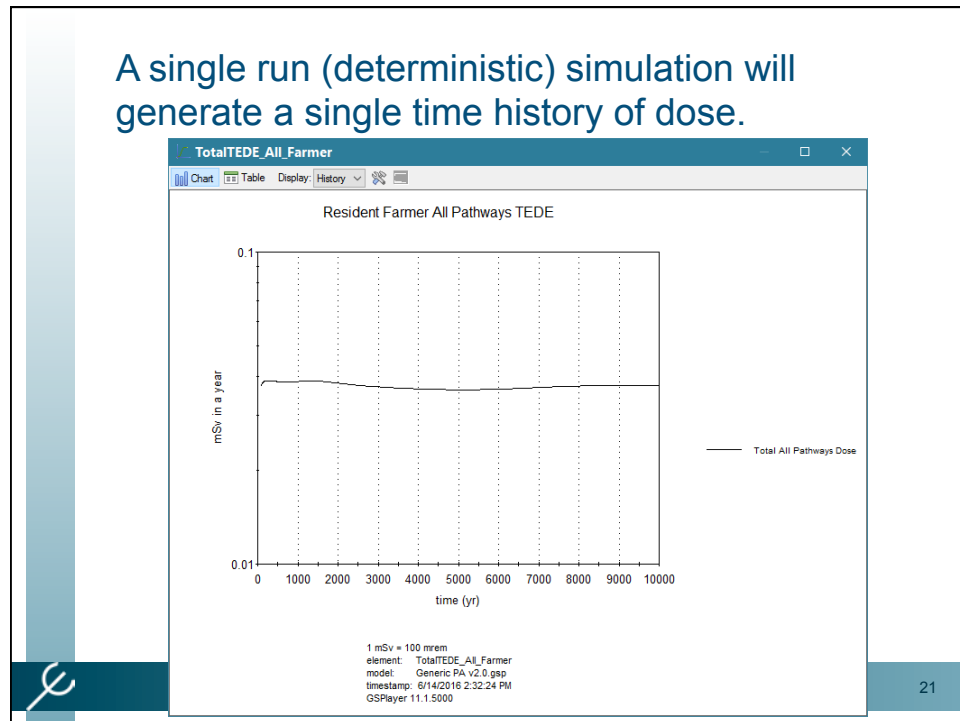
Performance objectives DOE G 435.1-1§IV.P.(1)(a,b)	Air pathway 0.1 mSv/yr	All pathways 0.25 mSv/yr*
Resident farmer	Dose Time Histories	
	Peak History CCDF	
	Mean peak dose	0.0387 mSv/yr
	95th %ile peak dose	0.0387 mSv/yr
Probability of exceedence	0	
Transient occupant	Dose Time Histories	
	Peak History CCDF	
	Mean peak dose	0.0135 mSv/yr
	95th %ile peak dose	0.0135 mSv/yr
Probability of exceedence	0	

* NUREG-1573 suggests that the mean all-pathways peak dose be below 0.25 mSv/yr and that the 95th percentile of the peak dose be below 1 mSv/yr (as in the CCDFs).

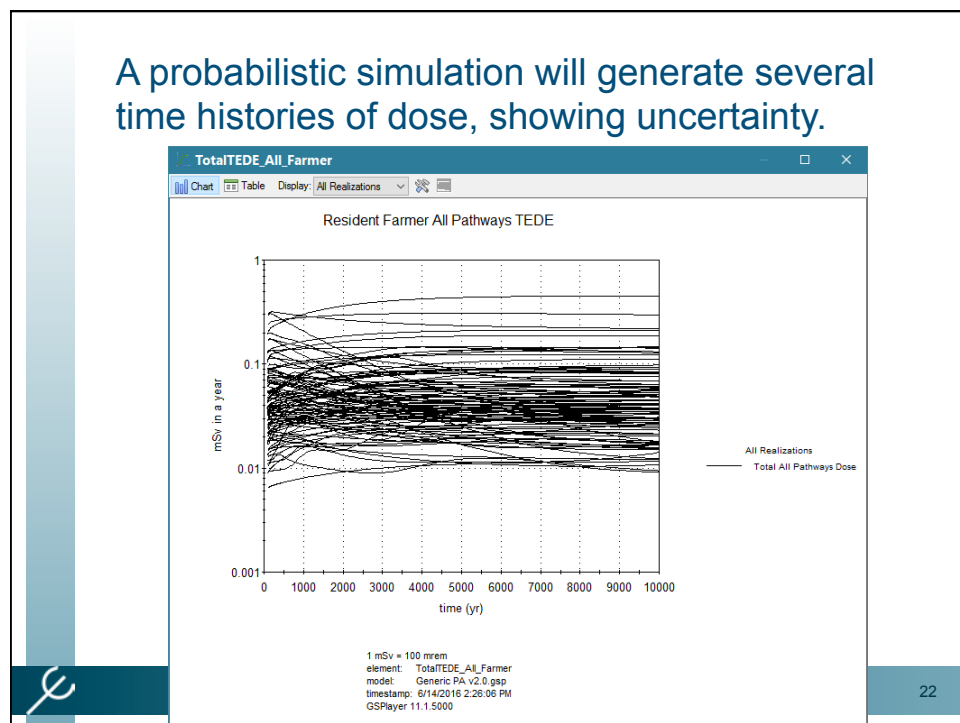
View All Results Home

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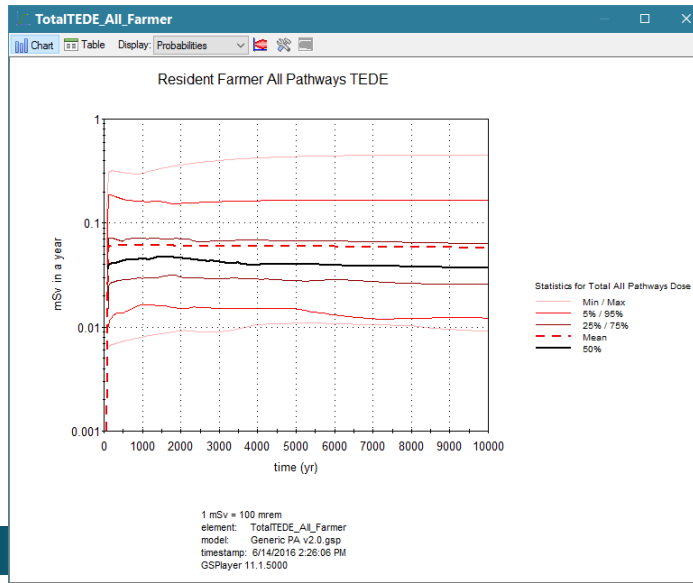
A single run (deterministic) simulation will generate a single time history of dose.



A probabilistic simulation will generate several time histories of dose, showing uncertainty.



A probabilistic simulation can also be shown using a statistical summary.



Many types of results can be examined.

Modeling results

- SensitivityAnalysis**: Result elements specifically constructed for the post-processing sensitivity analysis.
- MediaConcentrations**: The concentrations of modeled species in various environmental media are collected here and are used in dose assessment.
- FluxResults**: Some interesting results are graphs of the relative influence of various processes, expressed as net fluxes by process into the Cap1 cells.
- RadonPerformance**: Performance Assessment requires the evaluation of the fate of radon specifically, and DOE O 435.1 offers three performance objectives for compliance.
- Receptor_Doses**: Estimates of TEDE for the receptors, from calculations in the DoseAssessment container.

Result Mode Scale: 100% Filter ON Result Mode

**The Generic PA Model
is available here:**

www.neptuneinc.org/genericpa

**The GoldSim Player
is available here:**

www.goldsim.com/web/downloads

