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# ***Health Canada Spreadsheet Tools For Risk Assessment at Federal Contaminated Sites***

**Ian Mitchell (Meridian Environmental Inc.)  
David Williams (Meridian Environmental Inc.)  
Lindsay Smith (Health Canada)  
Sanya Petrovic (Health Canada)**



Health  
Canada

Santé  
Canada

# *Outline*

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- Introduction
- Development of Spreadsheets
- PQRA Spreadsheet
- DQRA (SSRA) Spreadsheet
- Conclusions

# *Introduction*

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- MS Excel® spreadsheets to assist with the implementation of Health Canada guidance
  - PQRA & DQRA guidance
- Promote consistency for FCSAP sites
- May have some application for other sites and jurisdictions

# *Introduction*

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- Standardized calculation methods
- Fate and transport models endorsed by CCME and/or Health Canada
- Standard assumptions (though customization possible)
- Transparent calculations

# *History of PQRA Spreadsheet*

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- Original PQRA Spreadsheet
  - Could handle any chemical
  - Very limited fate and transport models
  - Chemical database was never populated
- PHC PQRA Spreadsheet
  - Included CCME fate and transport models
  - Only handled PHC fractions and BTEX
- Vapour Intrusion Spreadsheet
  - Large chemical database
  - Vapour intrusion pathway only

# ***History of PQRA Spreadsheet***

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- 2007 PQRA Spreadsheet
  - Combines features from all previous spreadsheets
- Late 2007 – separate PQRA and SSRA (now DQRA) versions
- Current versions: April 21, 2008

# ***Current Spreadsheet Features***

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- Incorporates fate and transport models
- Outdoor vapours and dermal contact with water
- Can be used for any contaminant, including PHC fractions

# ***PQRA Spreadsheet***

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- Intended for PQRA for federal contaminated sites
- Allows comparison between sites
- Relatively prescriptive; only limited site-specific adjustment
- Screening tool

# ***PQRA Spreadsheet***

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- Follows PQRA guidance
- All chemicals for which Health Canada has TRVs; PHC fractions
- Large database of physical-chemical properties for other contaminants
- Atlantic RBCA TPH conversion

# ***PQRA Spreadsheet***

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- Models endorsed by Health Canada, CCME; very limited adjustment of parameters
- Vapour intrusion: Health Canada attenuation curves
  - No soil vapour or subslab vapour data
- Groundwater – Domenico model
  - constrained; steady state, no biodegradation

# PQRA Spreadsheet - Input

<b>Operative Pathways (Yes/No)</b>		Default
Inadvertent ingestion of soil		Yes
Inhalation of soil particles		Yes
Inhalation of indoor contaminant vapours		Yes
Inhalation of outdoor contaminant vapours		Yes
Ingestion of drinking water		Yes
Dermal contact with soil		Yes
Dermal contact with water		Yes
Ingestion of contaminated food		No
<b>Vapour Transport Modelling</b>		
Vapour source for exposure calculations		Most Conservative
<b>Active Critical Receptors (Yes/No)</b>		
Infant		Yes
Toddler		Yes
Child		Yes
Teen		Yes
Adult		Yes
Other		No
specify:		

# PQRA Spreadsheet - Input

<b>Contaminant Concentrations</b>			
Chemical Name		required	Benzene
Soil (mg/kg)		required	1
Groundwater - source (mg/L)		optional	
Drinking water (mg/L)		optional	
Bathing/swimming water (mg/L)		optional	
Indoor air - vapours (mg/m <sup>3</sup> )		optional	
Outdoor air - vapours (mg/m <sup>3</sup> )		optional	
Outdoor air - particulate (mg/m <sup>3</sup> )		optional	
Root vegetables (mg/kg wet weight)		optional	
Other vegetables (mg/kg wet weight)		optional	
Fish (mg/kg wet weight)		optional	
Wild game (mg/kg wet weight)		optional	

# ***PQRA Fate and Transport Input***

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- Soil type
  - Coarse or fine
- Basic site characteristics
  - Depth to contamination/groundwater, location of receptors relative to contamination, site dustiness
- Building type
  - Residential or commercial

# ***PQRA Spreadsheet - Output***

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- Outputs for each age group
  - Calculated concentrations in exposure media
  - Calculated exposures
  - Hazard indices/cancer risks
- Summary output page
  - Highest hazard/risk for each chemical, exposure route
  - Critical receptors identified
  - Key calculated model parameters
  - Information/warning messages

# PQRA Spreadsheet - Output

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Chemical Concentrations	Units	Benzene
Soil	mg/kg	1.00E+00
Drinking water	mg/L	5.97E-01
Bathing/swimming water	mg/L	5.97E-01
Indoor air vapours	mg/m <sup>3</sup>	1.27E+00
Outdoor air vapours	mg/m <sup>3</sup>	1.80E-04
Outdoor air particulate	mg/m <sup>3</sup>	6.05E-10
Amortized total air concentration	mg/m <sup>3</sup>	1.19E+00
Root vegetables	mg/kg wet wt	not evaluated
Other vegetables	mg/kg wet wt	not evaluated
Fish	mg/kg wet wt	not evaluated
Wild game	mg/kg wet wt	not evaluated

# PQRA Spreadsheet - Output

			Exposure (mg/kg/d)
			Benzene
Inadvertent ingestion of contaminated soil			2.83E-07
Inhalation of contaminated soil particles			8.45E-12
Inhalation of contaminant vapours - indoor			2.66E-01
Inhalation of contaminant vapours - outdoor			2.51E-06
Ingestion of contaminated drinking water			1.27E-02
Dermal contact with contaminated soil			1.94E-07
Dermal contact with water			3.48E-03
Ingestion of contaminated food			0.00E+00
Total ingestion exposure			1.27E-02
Total dermal exposure			3.48E-03
Ingestion + dermal exposure			1.61E-02
Total inhalation exposure			2.66E-01
Total Exposure (all pathways)			2.83E-01

# PQRA Spreadsheet - Output

			Maximum Hazard/Risk Estimates
			Benzene
Hazard Quotient - Oral/Dermal			NA
Hazard Quotient - Inhalation			NA
Hazard Index - Total			NA
Target Hazard Index:		0.2	
Cancer Risk - Oral			2.86E-03
Cancer Risk - Dermal			7.86E-04
Cancer Risk - Oral + Dermal			3.65E-03
Cancer Risk - Inhalation			3.93E-03
Cancer Risk - Total			7.58E-03
Target Cancer Risk:		1.00E-05	Target Cancer Risk Exceeded
			Critical Receptors
			Benzene
Oral/Dermal - non-cancer effects			NA
Inhalation - non-cancer effects			NA
Total - non-cancer effects			NA
Oral - cancer effects			Adult
Dermal - cancer effects			Adult
Oral + Dermal - cancer effects			Adult
Inhalation - cancer effects			Adult

# ***DQRA Spreadsheet***

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- More site-specific evaluation of risks
- Intended for federal contaminated sites
  - Underlying principles similar to other jurisdictions
- May not be suitable for all risk assessments

# ***DQRA Spreadsheet***

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- Layout very similar to PQRA Spreadsheet
- Has all features of PQRA Spreadsheet
- More customization of model input parameters
- Can select vapour intrusion modelling approach (attenuation curves or full model)
- Can use soil vapour/subslab data

# ***DQRA Fate and Transport Input***

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- Basic site characteristics
- Soil type
  - Coarse, fine, sand, loamy sand, sandy loam, loam
- Soil properties, hydrogeological parameters
- Building type and characteristics

# ***DQRA – Cleanup Criteria***

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- Approach developed to calculate risk-based cleanup criteria
- Accounts for simultaneous exposure to soil, water, air, food
- Not yet reviewed/approved by Health Canada
  - Not in distributed version of DQRA spreadsheet

# *Status of spreadsheets*

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- Regularly updated
- Latest versions dated April 21, 2008
- Possible future updates
  - Revised PQRA guidance
  - Assessment of cancer risks for less-than-lifetime exposure
  - Dermal toxicity reference values

# ***Conclusions***

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- Spreadsheets developed to promote consistency in human health risk assessments
- Spreadsheets are only tools – do not substitute for experience and judgment of risk assessor
- Results only meaningful if inputs are appropriate
- Don't trust the computer!

# ***Acknowledgments***

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- Health Canada staff (Sanya Petrovic, Lindsay Smith, Heather Jones-Otazo)
- Golder Associates (Ian Hers)
- Everyone who provided comments on beta/draft versions