Atlantic RBCA V.3 Information Session

Moncton, NB - October 2, 2012

Halifax, NS - October 3, 2012

St. John's, NL - October 16,2012

Welcome

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Ecological Screening Protocol

Appendix 2, Atlantic RBCA Ver 3
User Guidance

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Ecological Screening in ARBCA To Date

- RBCA Toolkit provides for human health based criteria
- Identification of potential ecological concerns addressed via a one page screening form
- Questions focused on habitat presence/ absence
- Limited modifications since 1996

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Canada Wide Standard for Petroleum Hydrocarbons in Soil

- CCME CWS for PHC issued in 2000 and updated in 2008
- Provides screening criteria for both human health and ecological based receptors
- 4 Atlantic provinces are signatories to CWS and must ensure their approaches are “equal to or better than” the protection provided by CWS
- PIRI decision made to examine the eco-screening of RBCA process to ensure this commitment was being fulfilled

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EcoTask Group

- Formed in 2006
- Members:
  - Ken Doe, Environment Canada
  - Ulysses Klee, Stantec (formerly Dillon)
  - Peter Miasek, Imperial Oil
  - Rita Mroz, Environment Canada
  - Malcolm Stephenson, Stantec
  - Rob Willis, Dillon (formerly Intrinsik)
  - Affiliate members: Chris Allaway, EC (Ottawa) and Thomas Parkerton, Exxon Mobil (New Jersey)
- Purpose: Update/revise eco-screening checklist in RBCA User Guidance
  - Improve guidance
  - Include eco-based criteria for soil, sediment, surface water and ground water

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Resulting Protocol

- Promotes consistent screening of potential ecological risks
- Provides guidance
- Robust and defensible process
- In line with similar practices across Canada
- Ground-breaking: no other jurisdiction in Canada has sediment criteria for PHCs

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Result

Tier One Check List for

Ecological Receptor Assessment in Atlantic Canada (since 1996)

Ecological Screening Protocol

For Petroleum Hydrocarbon Impacted Sites in Atlantic Canada (2012)

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Overview of Protocol

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Guiding Principles

Principle 1 – Both human health and ecological health are important considerations in the overall health and sustainability of our environment (including natural ecosystems and built environments).

Principle 2 – Society recognizes and accepts differences between natural ecosystems and built/urban environments (areas which result from the development and expectations of society).

Principle 3 – Ecological values should be maintained in those areas where they are determined to be important to the health and sustainability of the environment, particularly where this is of value to society.

Principle 4 – It follows that for some land uses or situations, ecologically driven remediation may be of varying value or importance. Environmental standards for the protection of ecological receptors should be applied where the maintenance of their abundance and diversity is considered to be a priority, reflecting appropriate choices relative to land use. The application of ecological standards should also consider long term integrity and sustainability planning of our environment.

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3 Parts

- Based on the three key components of ecological risk assessment:
  - Part I. Identification of BTEX/PHC hazards in site media or site influenced media
  - Part II. Identification of habitat and/or ecological receptors on or near a site
  - Part III. Identification of exposure pathways by which receptors could come into contact with site PHCs

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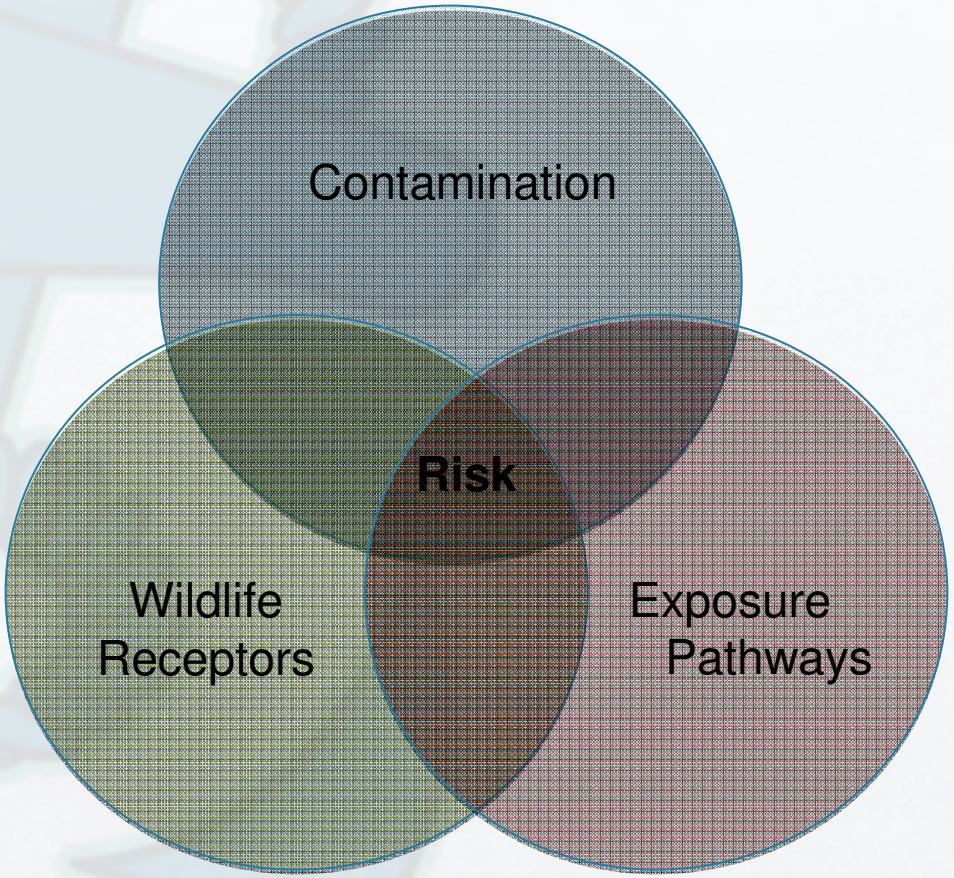
Risk Assessment Triad



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Overview

- While protocol determines whether chemical hazards, receptors and/or exposure pathways are present at a site, completion does not suggest an ERA has been conducted
- Rather, protocol outcomes determine need for further assessment, ERA and/or remediation/risk management
- Protocol intended to be used in conjunction with Appendix 1 of the Atlantic RBCA Version 3 User Guidance (*i.e.*, "Best Management Practices for Environmental Assessment of Petroleum Impacted Sites in Atlantic Canada"); these site characterization guidelines should be met prior to completing protocol

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Overview of Protocol

Main Elements:

- For BTEX/PHC-impacted sites
- Ecological screening levels (ESLs) for BTEX/PHCs to which site assessment data can be compared
- Series of questions to determine if receptors/habitats are present and potential exposure pathways exist between identified receptors/habitat and site PHCs at concentrations >ESLs

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Important Factors

- Provinces may provide additional clarification regarding use of Tier 1 ESLs
- If BTEX/PHCs present in site media <ESLs, or no receptors/habitat or exposure pathways evident, then further action not necessary in most circumstances; however, if professional judgment suggests additional action is warranted, then protocol should not be considered limiting
- Provides steps beyond traditional Tier 1 evaluation (often limited to comparing site chemistry data to benchmarks)
  - considers habitat, receptors and exposure pathways too (elements common to ERA)
  - allows user to potentially exclude sites from further ecological investigation even if PHCs in site media (or media on adjacent properties) > Tier 1 ESLs
- Protocol should be completed by individuals familiar with/ experienced in ecological/biological assessment and/or ERA; qualifications for persons completing protocol may be requested.

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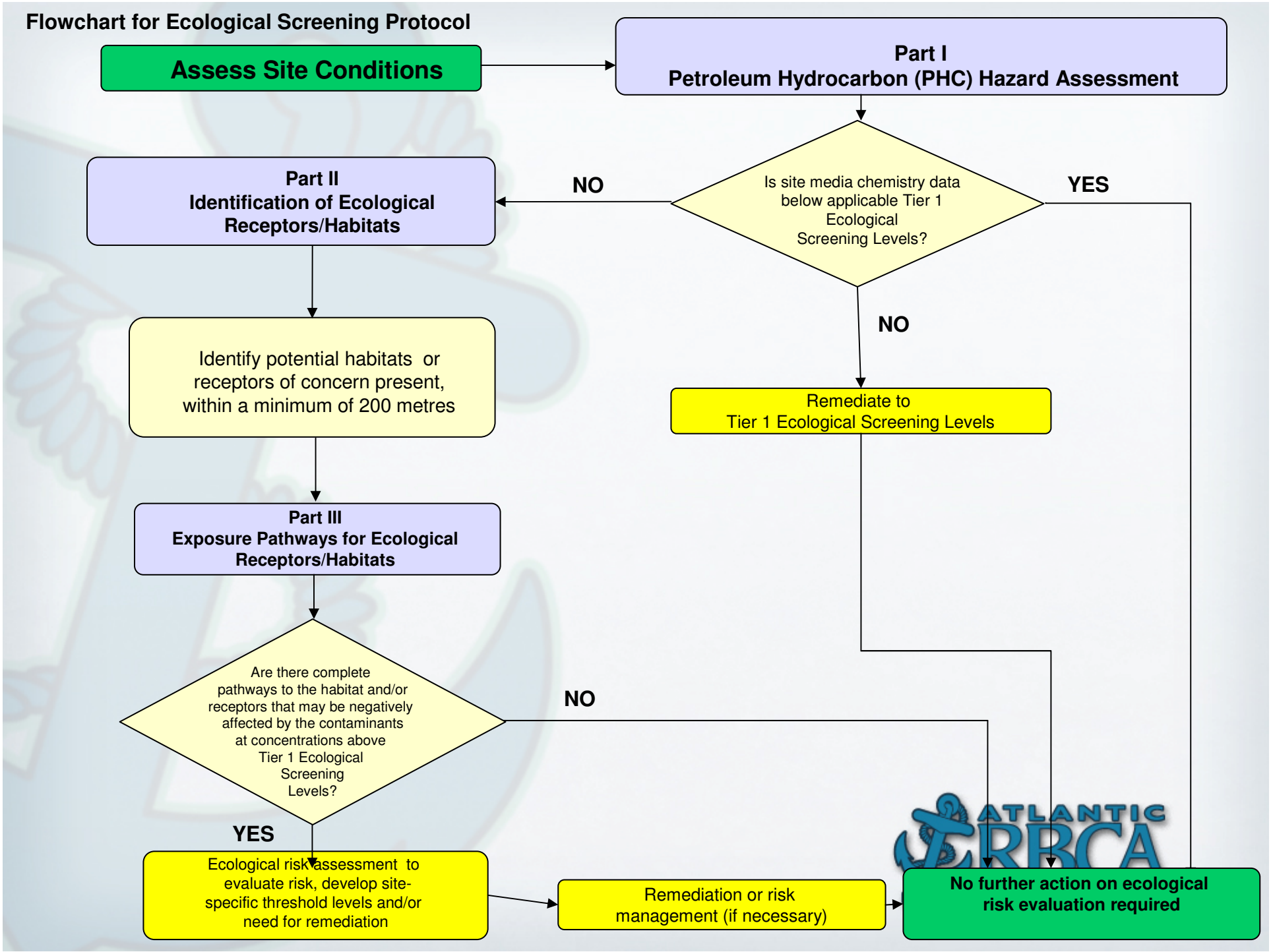
Flowchart for Ecological Screening Protocol
Assess Site Conditions
Part I
Petroleum Hydrocarbon (PHC) Hazard Assessment
Is site media chemistry data below applicable Tier 1 Ecological Screening Levels?
NO
YES
Part II
Identification of Ecological Receptors/Habitats
NO
Identify potential habitats or receptors of concern present, within a minimum of 200 metres
Remediate to Tier 1 Ecological Screening Levels
Part III
Exposure Pathways for Ecological Receptors/Habitats
Are there complete pathways to the habitat and/or receptors that may be negatively affected by the contaminants at concentrations above Tier 1 Ecological Screening Levels?
NO
YES
Ecological risk assessment to evaluate risk, develop site-specific threshold levels and/or need for remediation
Remediation or risk management (if necessary)
No further action on ecological risk evaluation required
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PART I

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Part I: PHC Hazard Assessment

- Identification of potential PHCs of concern
- Use of ecological risk-based screening levels (Tier 1)
- ESLs have been assembled for
  - surface soil
  - groundwater
  - surface water
  - sediments

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Soil EcoScreening Levels

- Adopted from the CCME CWS (Table 1a) and Alberta Environment (Table 1b)
- BTEX and PHC Fractions (F1 to F4)
  - Note: CCME CWS “fractions” (F1-F4) differ from RBCA’s “products” (gas, diesel, lube)
  - Site professionals must ensure data is in the F1-F4 fractions for using Tables 1a and 1b.
  - Since 2010, lab reports have been provided in a format amendable to both CWS and RBCA

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ARBCA Laboratory Guidelines - 2010

Major Change – Change reporting ranges for PIRI carbon ranges

Reason – to enable comparison of analytical results using either PIRI or CCME guidelines

CWS	RBCA
• F1: C6 - C10	• Gasoline: C6 – C10
• F2: C10 - C16	• Diesel: C10 – C21
• F3: C16 - C34	• Lube: C21 – C32
• F4: C34 – C50	• "Modified TPH" (all 3)

Lab Report	RBCA
C6-C10(less BTEX)	C6-C10(less BTEX)
>C10-C16	>C10-C21 (Fuel Oil)
>C16-C21	
>C21-C32	>C21-C32 (Lube Oil)

Lab Report	CWS
C6-C10(less BTEX)	F1 (less BTEX)
>C10-C16	F2 (C10-C16)
>C16-C21	F3 (C16-C34)
>C21-C32	

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What about cases where F4 is required?

Atlantic labs have the following options:

1. If chromatogram has returned to baseline at C32 this is an indication that there is no material beyond C32 – no action required

2. Modify Gas Chromatographic method for PIRI hydrocarbon to extend to C50 – equivalent to F4 analysis

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Soil EcoScreening Levels

- Table 1a protective of plants and soil invertebrates (direct contact)
  - CCME CWS (2008)
  - Coarse and fine grain surface soils (<1.5m)
  - Agricultural, residential, commercial, industrial property use
- Table 1b protective of avian and mammalian wildlife under agricultural (environmental) property use
  - Alberta Environment (2010)
  - Focus on the soil ingestion pathway
  - For both fine & coarse grain soils (<1.5m)

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Groundwater EcoScreening Levels

Table 2 protective of plants and invertebrates in direct contact with shallow groundwater (<3m)

- Alberta Environment
- Based on the soil screening levels with the application of equilibrium partitioning equation to derive appropriate water based concentrations
- Default values used in the equation are consistent with Atlantic RBCA model
- Same range of property uses and fine/coarse soil
- F1 and F2 values. No values for F3 or F4 due to low solubility in water

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Groundwater/Surface Water EcoScreening Levels

Table 3a and table 3b: protection of aquatic life (plants, fish invertebrates)

- Surface water and groundwater
- CCME does not have groundwater criteria
- CCME does not have surface water criteria for PHCs
- CCME does have surface water criteria for benzene, toluene and ethyl benzene but not xylene (late 1990's)
- Task Group considered options to derive both BTEX and PHCs screening values – selected PETROTOX
- Derived surface water levels using PETROTOX
- Used surface water screening levels to derive groundwater screening levels:
  - PETROTOX-derived surface water levels x10 (attenuation factor)
  - compared to acute LC_{50} (trout)
  - chose the lower of the two
- Screening levels for BTEX, gasoline, diesel, and lube oil

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PETROTOX Model

Developed by CONCAWE (Conservation of Clean Air and Water in Europe)

Regulatory Developments:

- REACH legislation in EU
- Requirement for conducting environmental risk assessments for petroleum substances
- New initiatives aimed at avoiding / reducing animal toxicity testing

In Canada: Used by EC/HC in CMP for screening assessments for petroleum products in CEPA programs

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PETROTOX Model

Model Features:

- Calculates toxicity of petroleum products to aquatic organisms
- Based on quantitative relationships between hydrocarbon structure and ecotoxicity (QSAR model)
- Applies target lipid narcosis model (widely assumed for non-polar organics)
- toxicity database for 42 aquatic species (fish, amphibians, invertebrates and algae) and 1457 hydrocarbons
- Phys chem property database for PHCs (BP, Wsol, Kow, HLC, MW etc.) for 1462 hydrocarbons; model calculates Wsol and toxicity calculations, and calculates distribution among water, headspace and free product phases
- Assumes hydrocarbon toxicity is additive (toxic unit theory of additivity)
- User-defined version exists - can enter own phys chem properties
- Estimates predicted-no-effect-concentration (PNECs) for aquatic species exposed to PHCs (including BTEX, gasoline, diesel, lube oil) based on HC5 (5^{th} percentile) of species sensitivity distributions

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Example of Species Sensitivity Distribution from PETRTOX - #2 Oil

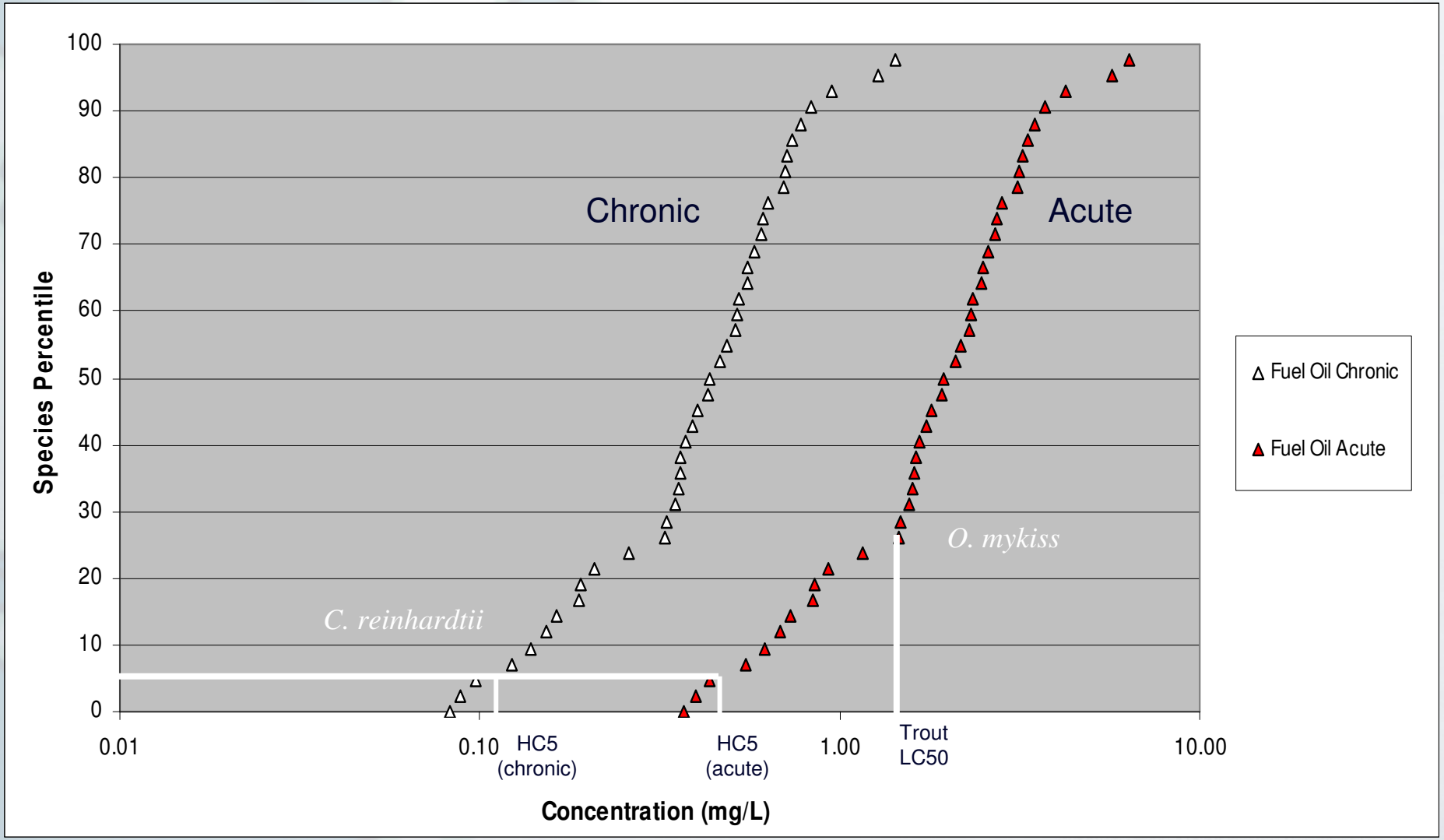

Table 3a

Table 3a: Tier 1 Surface Water and Groundwater Ecological Screening Levels for the Protection of Freshwater and Marine Aquatic Life (mg/L)

Water Type	Substance						
	Benzene	Toluene	Ethyl Benzene	Xylenes	Modified TPH		
					Gas	Diesel/#2	#6 oil/lube
Surface Water	2.1	0.77	0.32	0.33	1.5	0.10	0.10 [b]
Groundwater[a]	4.6	4.2	3.2	2.8	13	0.84	0.48

Source: PETROTOX Ver 3.06 See Rationale document for full derivation of these values.

a) Groundwater screening levels can be used for evaluating groundwater quality at locations greater than 10 metres from a freshwater or marine water body. It is recommended that surface water screening levels should be applied directly (or unadjusted) when evaluating groundwater quality at locations within 10 metres of a freshwater or marine surface water body.

b) This screening level set to the RDL for #6 oil/lube (actual derived screening level = 0.06 mg/L)

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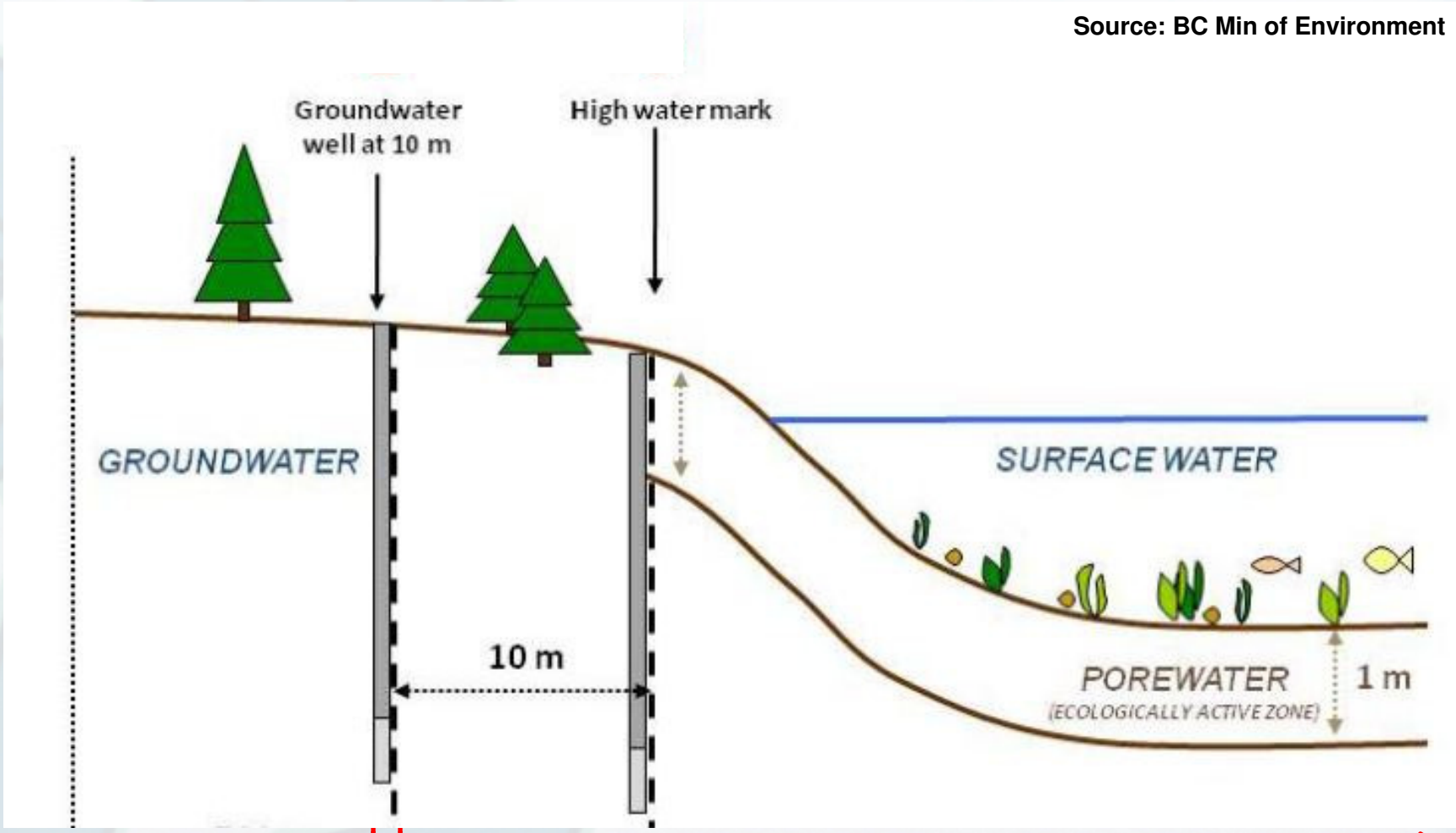
Where do the screening levels apply?

Source: BC Min of Environment



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Groundwater Screening Levels at Distance from Source to aquatic receiving environment

Domenico (1987) analytical solute transport model consistent with RBCA Toolkit v.3.2

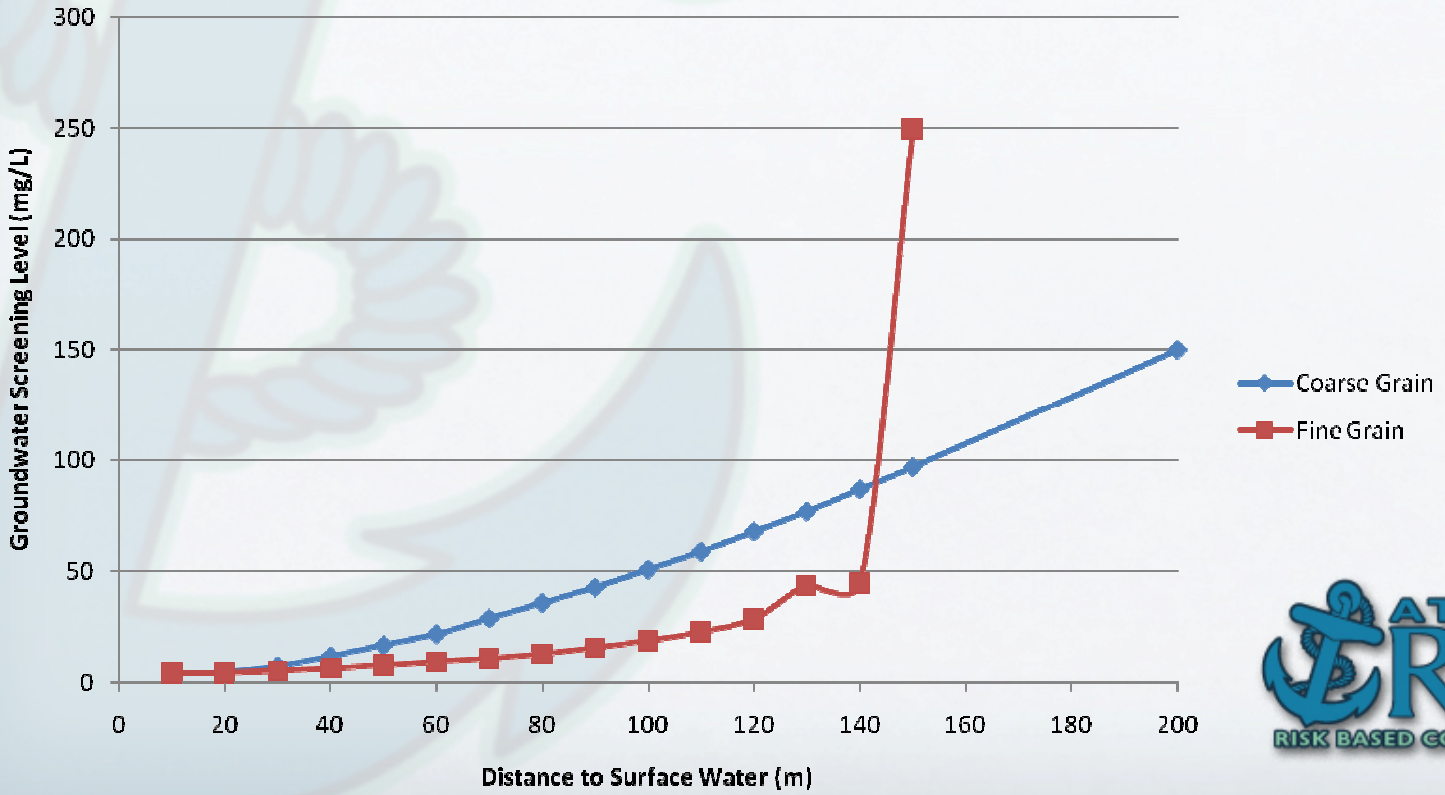

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Table 3b

Table 3b: Tier 1 Groundwater Ecological Screening Levels for the Protection of Freshwater and Marine Aquatic Life (mg/L), adjusted for distance to receiving aquatic environment and soil type

Distance to Surface Water [a]	Benzene (mg/L)		Toluene (mg/L)		Ethyl benzene (mg/L)		Xylenes (mg/L)		Modified TPH					
									Gasoline (mg/L)		Diesel (mg/L)		Lube Oil (mg/L)	
(m)	Coarse	Fine	Coarse	Fine	Coarse	Fine	Coarse	Fine	Coarse	Fine	Coarse	Fine	Coarse	Fine
10	4.6		4.2		3.2		2.8		13		0.84		0.48	
20	5	4.6	4.6	4.2	3.5	3.2	3	2.8	13	13	0.85	4.5	1.3	18
30	7.6	4.8	6.9	4.4	5.3	3.4	4.6	2.9	13	14	1.3	24	2.2	113
40	12	5.6	11	5.1	8.0	3.9	7	3.4	15	37	2.9	178	4.9	1070
50	17	6.7	15	6.1	11	4.7	10	4.1	22	86	6	>sol	22	>sol
60	22	8.1	20	7.4	15	5.6	14	5.5	37	495	14	>sol	56	>sol
70	29	9.7	26	8.8	20	7.5	17	7.5	55	>sol	21	>sol	85	>sol
80	36	11	33	10	25	9.9	22	11	75	>sol	28	>sol	117	>sol
90	43	13	39	14	30	13	26	18	92	>sol	39	>sol	161	>sol
100	51	16	47	17	36	20	31	30	114	>sol	85	>sol	511	>sol
110	59	19	54	21	41	28	36	49	139	>sol	207	>sol	1243	>sol
120	68	23	62	27	47	45	42	92	171	>sol	333	>sol	1996	>sol
130	77	29	71	35	54	76	47	>sol	207	>sol	436	>sol	2615	>sol
140	87	44	79	69	60	130	53	>sol	467	>sol	>sol	>sol	>sol	>sol
150	97	45	88	70	67	>sol	59	>sol	750	>sol	>sol	>sol	>sol	>sol
200	150	250	140	>sol	100	>sol	91	>sol	>sol	>sol	>sol	>sol	>sol	>sol
Solubility (SOL)[b]	1,780		515		150		160		TDB		TDB		TDB	

Source: PETROTOX Ver 3.06 See Rationale document for full derivation of these values.

a) This table should not be used if preferential pathways exist at the site. If such pathways exist, use screening levels in Table 3a.

b) SOL is the groundwater concentration representing the solubility limit for the compound. Beyond this point, a separate, non-aqueous phase liquid layer will begin to form. Above SOL concentrations, NAPL will form and will initially be non-mobile, but at higher concentrations will be subject to gravitational forces, be measurable and become mobile (Atlantic PIRI, 2012)

Sediment Screening Levels

- Protective of aquatic plants, invertebrates and fish
  - Equilibrium partitioning model (EqP)
    - toxicity of a chemical in sediment is the result of chemical concentration in the aqueous phase
    - partitioning behaviour of an organic is a function of the chemical's Koc and the sediment's fraction organic carbon (Foc)
    - Sediment ESL = surface water ESL x Koc x Foc
    - adjust for site-specific Foc (ARBCA eco screening levels assume default Foc of 0.01)
    - Maximum of 500 mg/kg TPH ("management limit")
  - Validation of EqP-based values conducted (Sed Tox Testing)

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Two sediment categories

- "Typical": sediment where sediment is used to support sensitive components of aquatic ecosystems (eg. fish spawning, intertidal zones that are important for the preservation of fish & wildlife, etc.)
  - Recommend sediment first screened against this criteria
- "Other": for sediments not classified as "typical" (eg. ditches, industrial- influenced receiving areas, etc.)

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Sediment Toxicity Tests

- # 2 Oil (Winter Diesel) and # 6 Oil (Bunker C)
- *Hyalella azteca* (amphipod) and *Chironomus dilutus (*midge*)*
- EC methods
- Artificial Sediment
- Static and static/renewal

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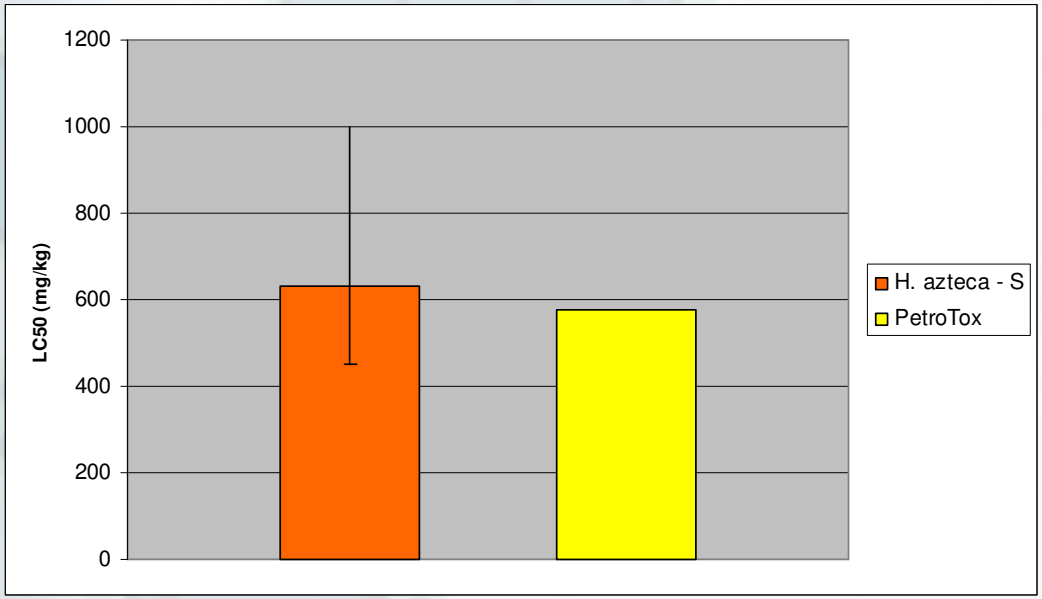
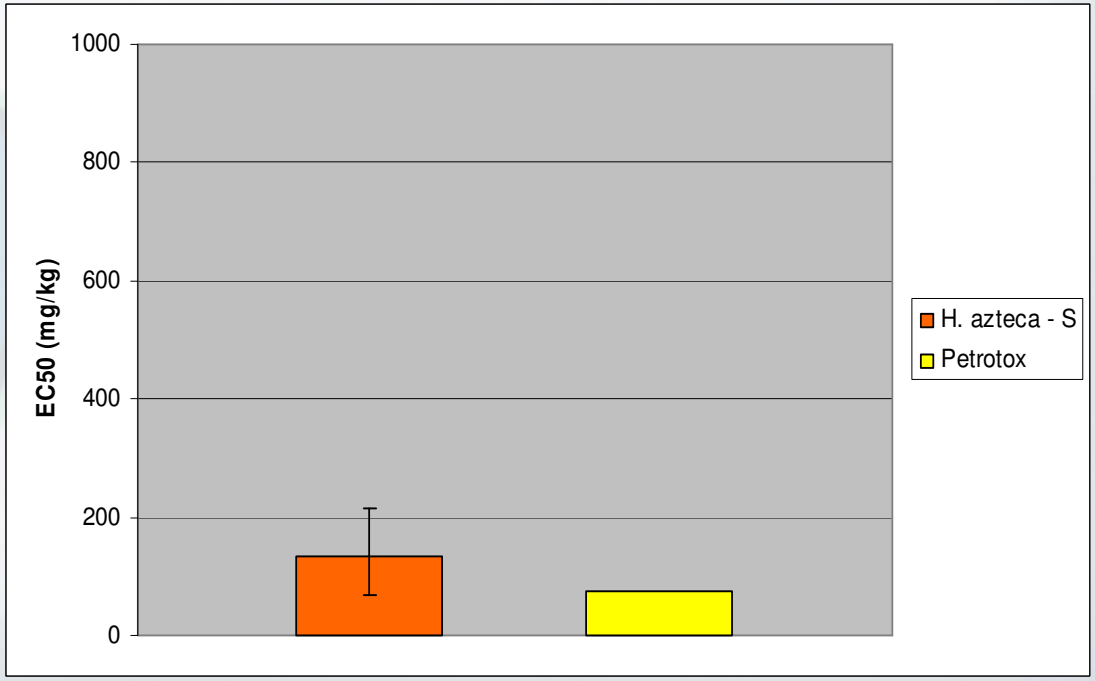
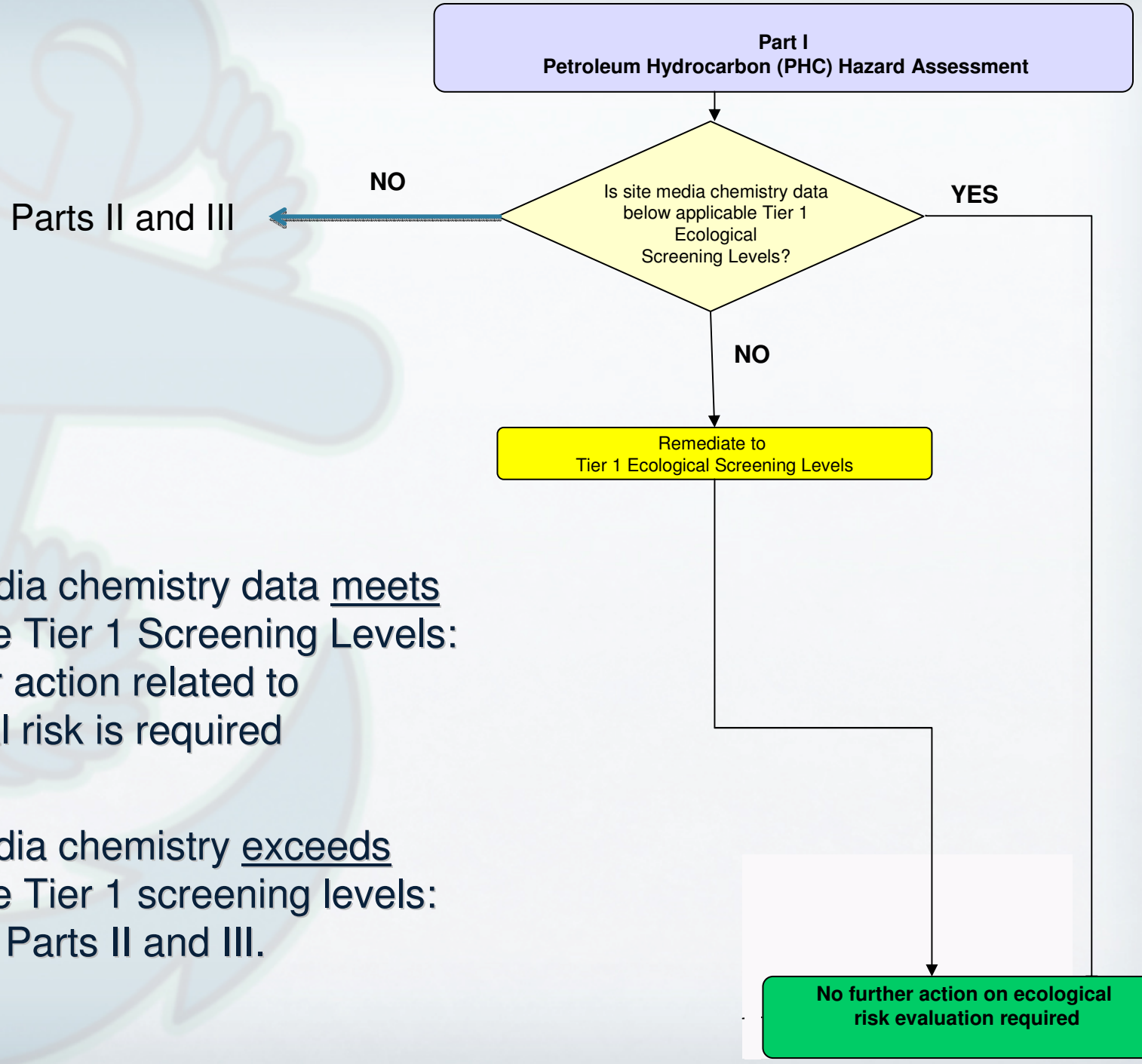
Results: #6 Oil







- If site media chemistry data meets applicable Tier 1 Screening Levels: no further action related to ecological risk is required

- If site media chemistry exceeds applicable Tier 1 screening levels: complete Parts II and III.

PART II

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Part II

- Essentially, same as former checklist, with added guidance
- Focus on identification of habitat and receptors on or near a site,

Where,

- Habitat = areas where ecological receptors occur, live, breed or forage

- Receptors = non-human organism, species, population, community, or ecosystems that are potentially exposed to PHCs originating from an impacted site

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Part II

Habitat – Ques 1 relates to the habitat in the area of the site. Almost identical to former eco checklist in previous User Guidance

1. Are the following habitat types or conditions present on the site or proximate to the site?

a) Wetland habitats such as marshes, swamps, tidal flats, beaches?

b) Aquatic habitats such as rivers, lakes, streams, estuaries, marine water bodies?

c) Forested habitats?

d) Grassland habitats?

e) Provincial/National parks or ecological reserves?

f) Known rare, threatened or endangered species populations?

g) Other known critical or sensitive habitat for wildlife (such as breeding or nesting areas for migratory species)?

h) Are there other local or regional receptor or habitat concerns that need to be addressed or considered?

For 1(a) to 1(g), minimum distance of 200 m considered when determining if habitat and/or receptors are proximate to site

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Part II

- Why **200 m** minimum distance? Previous RBCA Checklist recommended 150 m
  - updated information about distance typical groundwater hydrocarbon plume will travel; eg. study of 500 TPH sites in California found that max distance PHCs travelled in GW was ~185 m (Shih et al. 2004)

- Wetlands: Users should refer to their provincial jurisdictions for definitions of wetlands

- Urban green spaces:
  - managed urban "green spaces" (e.g., lawns, playgrounds, fairgrounds, sports fields, zoos, biking and walking trails, etc.) may not be productive ecological habitat.
  - Possible exception for "green spaces" that are managed for the purpose of providing habitat

- If a site or portion of such sites are excluded from further consideration, needs justification, and consultation with the responsible regulatory authority is strongly recommended

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Part II

- Guidance included to determining if identified terrestrial habitat (on or near site) is of sufficient size and/or quality likely to support wildlife populations, ASTM (2002; 2011)
- Note: 200 m distance and spatial/habitat criteria are general guidance
  - may not be applicable for all sites
  - site-specific conditions and professional judgment must be considered in determining likelihood that receptors and/or habitat are present on/near site
- No spatial criteria are presently suggested for aquatic habitat or site vegetation and soil invertebrate communities

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Part II

Receptors: Questions 2, 3 and 4 relate to potential for receptors to be present:

2.Are there indications of stressed vegetation on the site?

4.Would mammalian, avian, or herptile terrestrial wildlife receptors be expected to forage on/near contaminated areas of site, such that oral or dermal exposure to contaminated media could occur?

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Former gas station, proposed condo development

Gas station, landscaped area

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Gas station, adjacent to urban wetland

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Vehicle Accident, June 2011

Photos by BRIAN MEDEL Yarmouth Bureau

9,000 L diesel
32,000 L gasoline

Adjacent to a wetland, approx 400 metres from protected area

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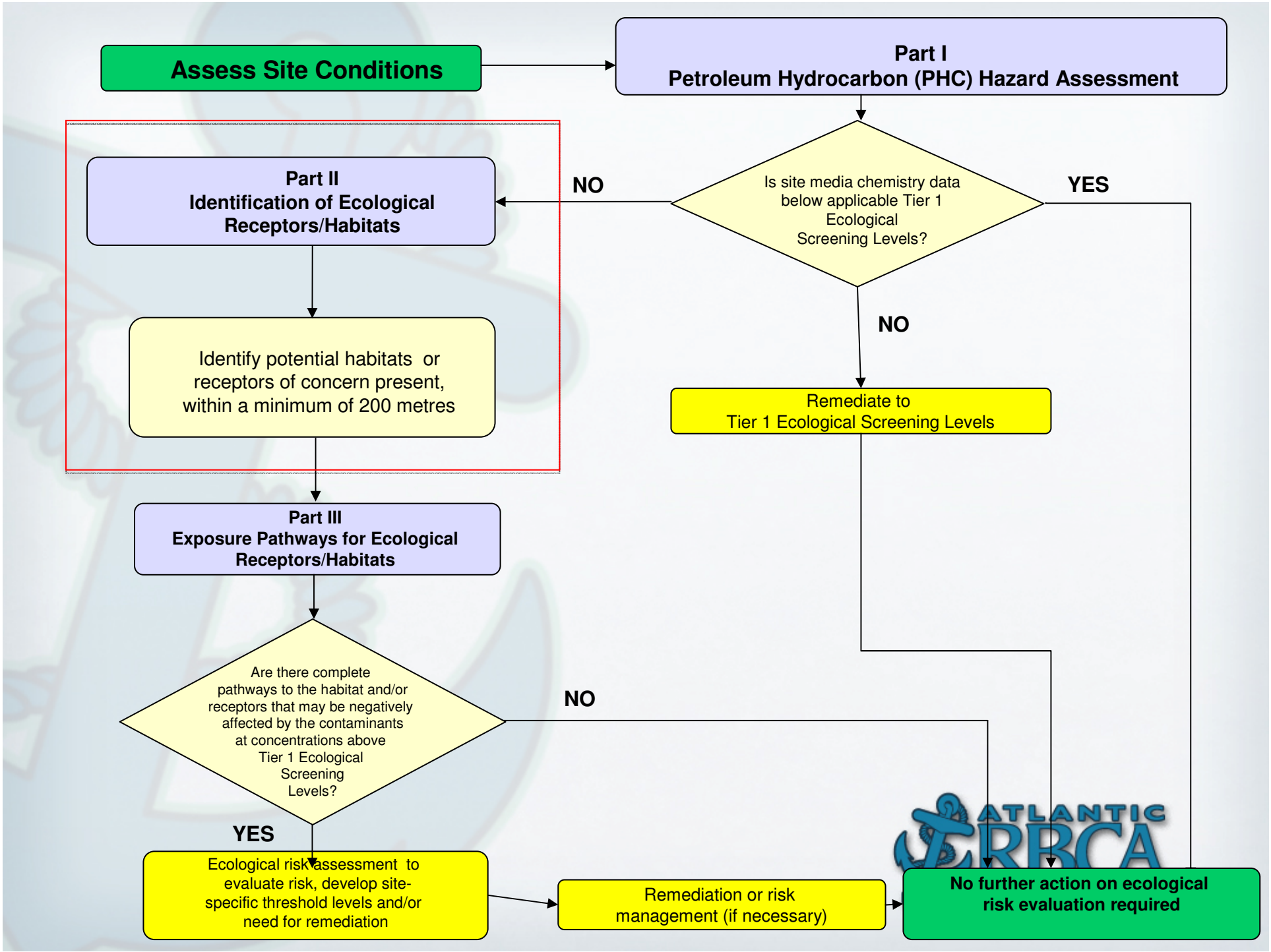
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Identify potential habitats or receptors of concern present, within a minimum of 200 metres
NO
Remediate to Tier 1 Ecological Screening Levels
Part III
Exposure Pathways for Ecological Receptors/Habitats
Are there complete pathways to the habitat and/or receptors that may be negatively affected by the contaminants at concentrations above Tier 1 Ecological Screening Levels?
NO
YES
Ecological risk assessment to evaluate risk, develop site-specific threshold levels and/or need for remediation
Remediation or risk management (if necessary)
No further action on ecological risk evaluation required
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PART III

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Part III Summary

- Completed after Part II; not optional
- Focus on identifying exposure pathways by which receptors could come into contact with site PHCs
- Goal: determine if potential operable exposure pathways exist between PHC present above screening levels (Part I) and identified receptors/habitat (Part II)
- Information/data gathered in Part II will assist in answering questions in Part III.
- Professional judgment: 200 m distance guideline from Part II may not be appropriate for all sites. Part III questions/responses should consider possibility/likelihood that exposure pathway may be operable even if distance between site and receptors/habitat is > 200 m (preferential pathways)
- Depth to contamination: protocol assumes CCME depth cutoffs (i.e., ≤1.5 m represents soil for eco-soil contact).

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Part III Summary

“Is it reasonable”…..

4.Is it reasonable to conclude that site PHC contamination could impact aquatic receptors or aquatic habitat in surface water bodies via the following

a. surface runoff

b. preferential overland flow pathways (*e.g.* drainage ditch, slope, swale)

c. preferential subsurface flow pathways (*e.g.* culvert, trench, sewer line, pipelines)

such that aqueous media concentrations would potentially exceed surface water and/or sediment quality ESLs (Table 3a and Table 4)?

If answer to any of questions 1 to 4 in Part III is “**YES**”, further action is required as potential eco risks have been identified

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What is “Further Action”?

- Additional data should be gathered to enhance the knowledge of the site specific hazards, receptors and exposure pathways.
- Remediation to ecological screening levels
- Delineation: not required at the start of the protocol however delineation to ecological screening levels in those media for which Parts II and III cannot exclude the presence of habitat/receptors and pathways
- Complete an ERA (may also include fate and transport modeling, habitat or ecological surveys and other types of biological/ecological assessment, and ecotoxicity tests)

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Next Steps

- E-learning, in conjunction with the Version 3 Toolkit
- Interest expressed by other jurisdictions
  - BC Ministry of Environment interested in the sediment ESLs
  - CCME in November
- Possible activities
  - FAQs to PIRI website
  - Further validation of surface water/sediment ESLs
  - Guidance re: habitat assessment

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Overview of Changes in Atlantic RBCA Version 3

Human Health

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So why the changes?

- Canada Wide Standards (2008)
  - New default modeling parameters
  - Addition of agricultural and industrial land uses
- Incorporated new information
  - Health Canada
  - Approaches to drinking water and well dilution

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Other Opportunities for Improvement

- Provided clarification regarding Free Product
- Improved consistency regarding:
  - minimum site assessment requirements (Appendix 6)
  - mandatory requirements (Appendix 6)
  - Best management practices (Appendix 1)
- New Atlantic RBCA Closure Checklist

And we made the Guidance for Soil Vapour and Indoor Air Monitoring Assessments a separate document…

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What we're going to cover

- Changes to the default parameters
  - What they are
  - How change would be expected to affect SSTLs, and how addressed in the Tool Kit
- New RBSLs
- Errata for Soil Vapour and Indoor Air Monitoring Assessments

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TEX at Tier II

- Consistent with CWS:
  - TEX are assessed separately at Tier II for all pathways
  - TEX are not added to Modified TPH at Tier II

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RISK BASED CORRECTIVE ACTION

Updated Toxicity Values

Chemical	Version 2	Version 3
Benzene	SFo = 0.31 $(mg/kg\text{-}d)^{-1}$	SFo = 0.226 $(mg/kg\text{-}d)^{-1}$
Toluene	RfC = 0.4 mg/m^3	RfC = 3.8 mg/m^3

PCE, TCE, DCE, VC toxicity values in Atlantic RBCA Toolkit updated to reflect Health Canada recommended values.

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Phys/Chem Properties

- Physical and chemical properties for BTEX, PCE, TCE, DCE, VC updated
  - Henry's Law constants, solubility, log Kow, etc
  - Based on a review, Atlantic PIRI confirmed that values used by Health Canada were appropriate
  - Generally, minor effect
- No Change for TPH fractions

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Soil Properties

Coarse-grained Soil

Property	Version 2	Version 3
Total porosity	0.40	0.36
Volumetric air content	0.281	0.241
Volumetric water content	0.119	0.119

Fine-grained Soil

Property	Version 2	Version 3
Total porosity	0.30	0.47
Volumetric air content	0.132	0.302
Volumetric water content	0.168	0.168

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Relative Dermal Adsorption Factors

Chemical	Version 2	Version 3
Benzene	0.5	0.03
Toluene	0.5	0.03
Ethyl benzene	0.5	0.03
Xylenes	0.5	0.03
TPH fractions	0.5	0.2
PCE, TCE, DCE, VC	-	0.03

For soil ingestion and dermal contact pathway:

less absorption through the skin ⟹ higher SSTL

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Target Hazard Quotients

Chemical	Version 2	Version 3
Toluene	1	0.5
Ethylbenzene	1	0.5
Xylenes	1	0.5

Lower target HQs ⇒ lower SSTLs

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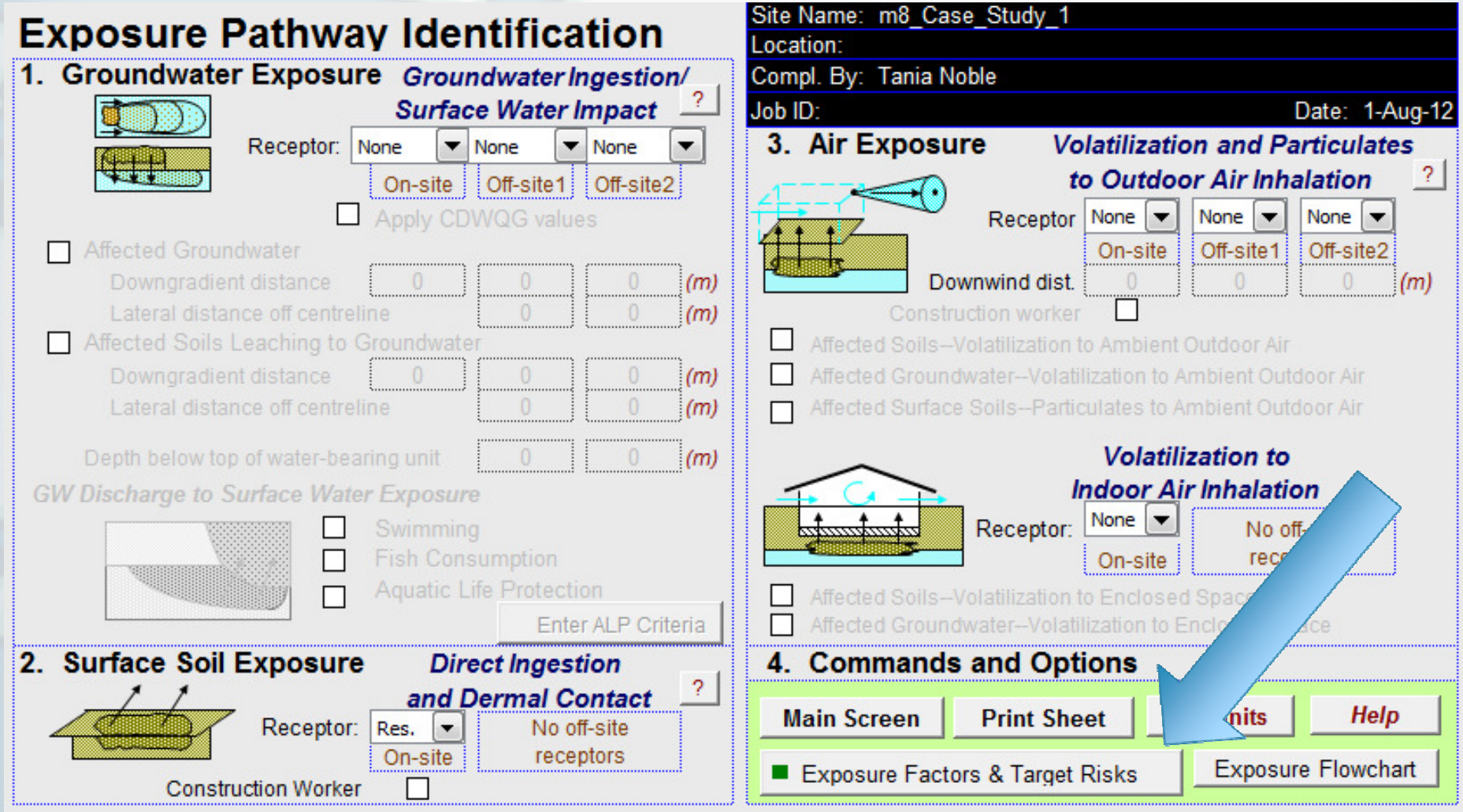
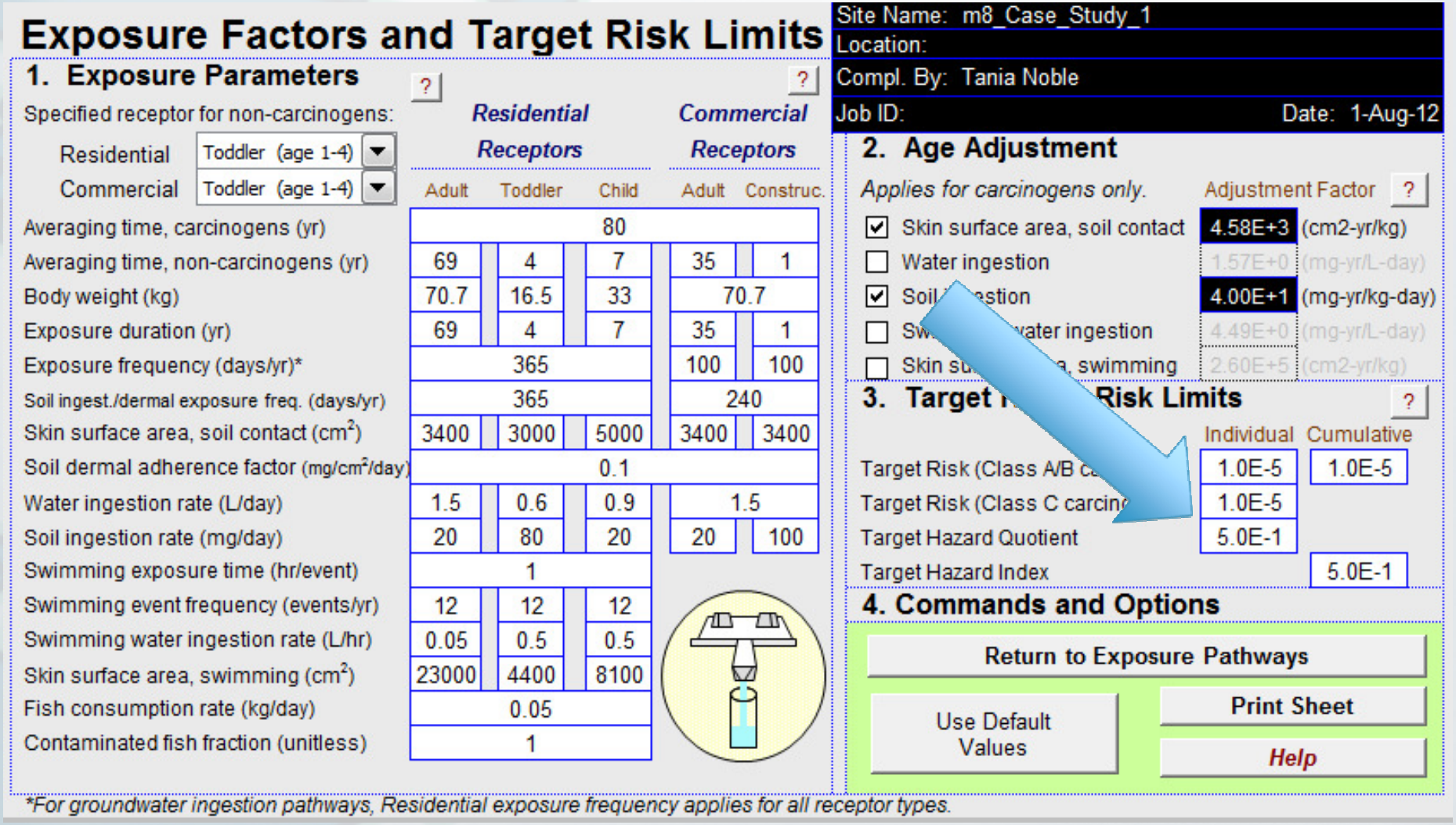
Incorporating into the Tool Kit



Incorporating into the Tool Kit



Exposure Factors and Target Risk Limits

1. Exposure Parameters

Specified receptor for non-carcinogens:

Residential: Toddler (age 1-4)

Commercial: Toddler (age 1-4)

	Residential Receptors			Commercial Receptors	
	Adult	Toddler	Child	Adult	Construc.
Averaging time, carcinogens (yr)	80				
Averaging time, non-carcinogens (yr)	69	4	7	35	1
Body weight (kg)	70.7	16.5	33	70.7	
Exposure duration (yr)	69	4	7	35	1
Exposure frequency (days/yr)*	365			100	100
Soil ingest./dermal exposure freq. (days/yr)	365			240	
Skin surface area, soil contact (cm^2)	3400	3000	5000	3400	3400
Soil dermal adherence factor ($mg/cm^2/day$)	0.1				
Water ingestion rate (L/day)	1.5	0.6	0.9	1.5	
Soil ingestion rate (mg/day)	20	80	20	20	100
Swimming exposure time (hr/event)	1				
Swimming event frequency (events/yr)	12	12	12		
Swimming water ingestion rate (L/hr)	0.05	0.5	0.5		
Skin surface area, swimming (cm^2)	23000	4400	8100		
Fish consumption rate (kg/day)	0.05				
Contaminated fish fraction (unitless)	1				

Site Name: m8_Case_Study_1
Location:
Compl. By: Tania Noble
Job ID: Date: 1-Aug-12

2. Age Adjustment

Applies for carcinogens only. Adjustment Factor

☑ Skin surface area, soil contact	4.58E+3	(cm2-yr/kg)
☐ Water ingestion	1.57E+0	(mg-yr/L-day)
☑ Soil ingestion	4.00E+1	(mg-yr/kg-day)
☐ Swimming water ingestion	4.49E+0	(mg-yr/L-day)
☐ Skin surface area, swimming	2.60E+5	(cm2-yr/kg)

3. Target Risk Limits

	Individual	Cumulative
Target Risk (Class A/B carcinogens)	1.0E-5	1.0E-5
Target Risk (Class C carcinogens)	1.0E-5	
Target Hazard Quotient	5.0E-1	
Target Hazard Index		5.0E-1

4. Commands and Options

Return to Exposure Pathways

Use Default Values

Print Sheet

Help

*For groundwater ingestion pathways, Residential exposure frequency applies for all receptor types.

Exposure

Exposure Frequency

Pathway	Version 2	Version 3
Potable water ingestion – commercial	100 days/yr	365 days/yr
Soil ingestion – commercial	250 days/yr	240 days/yr

Amortization

Land Use	Version 2	Version 3
Agricultural & Residential (multiple life stages)	25 year exposure over 78 yr lifetime	80 year exposure over 80 yr lifetime
Commercial & Industrial (adult)	25 year exposure over 78 yr lifetime	35 year exposure over 80 yr lifetime

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Hydraulic Gradient

Version 2	Version 3
0.05	0.028

- Based on hydraulic gradients from 105 randomly selected sites in Atlantic Canada
  - Mean = 0.028
  - Median = 0.03
- For soil leaching to groundwater:

lower gradient → less mixing → lower SSTL

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Mixing Zone Depth

Soil Type	Version 2	Version 3
Coarse-grained	200 cm	72 cm
Fine-grained	200 cm	220 cm

- New information: equation to estimate mixing zone depth (rather than default of 200 cm)
- For soil leaching to groundwater:

  smaller mixing zone → less mixing → lower SSTL

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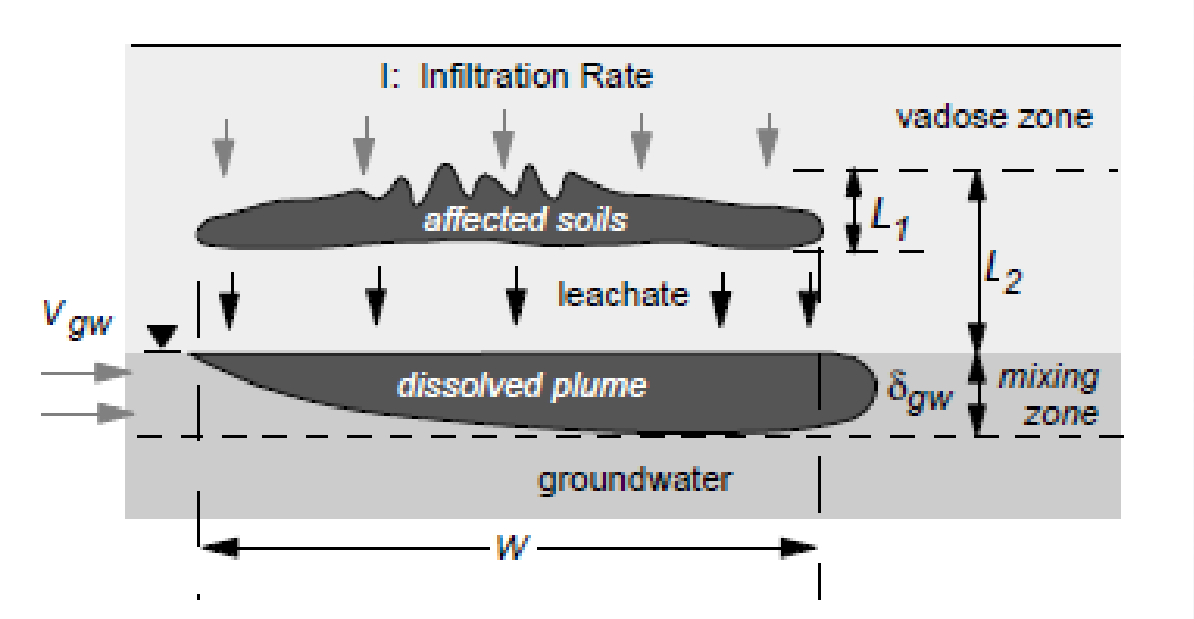
RISK BASED CORRECTIVE ACTION

Well Dilution Factor



- Version 2: water quality in the mixing zone required to meet drinking water standards
- Version 3: groundwater flow within the mixing zone is typically not sufficient on its own to meet the water requirements of a typical domestic well

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Well Dilution Factor

- $$WDF = \frac{Ave\ Daily\ Pumping\ Rate\ (900\frac{L}{d})}{Ave\ Daily\ Flow\ Rate\ from\ Mixing\ Zone\ (\frac{L}{d})}$$

- Notes:
  - WDF not applied to Forward calculation in Tool Kit
  - Cannot be applied together with DAF

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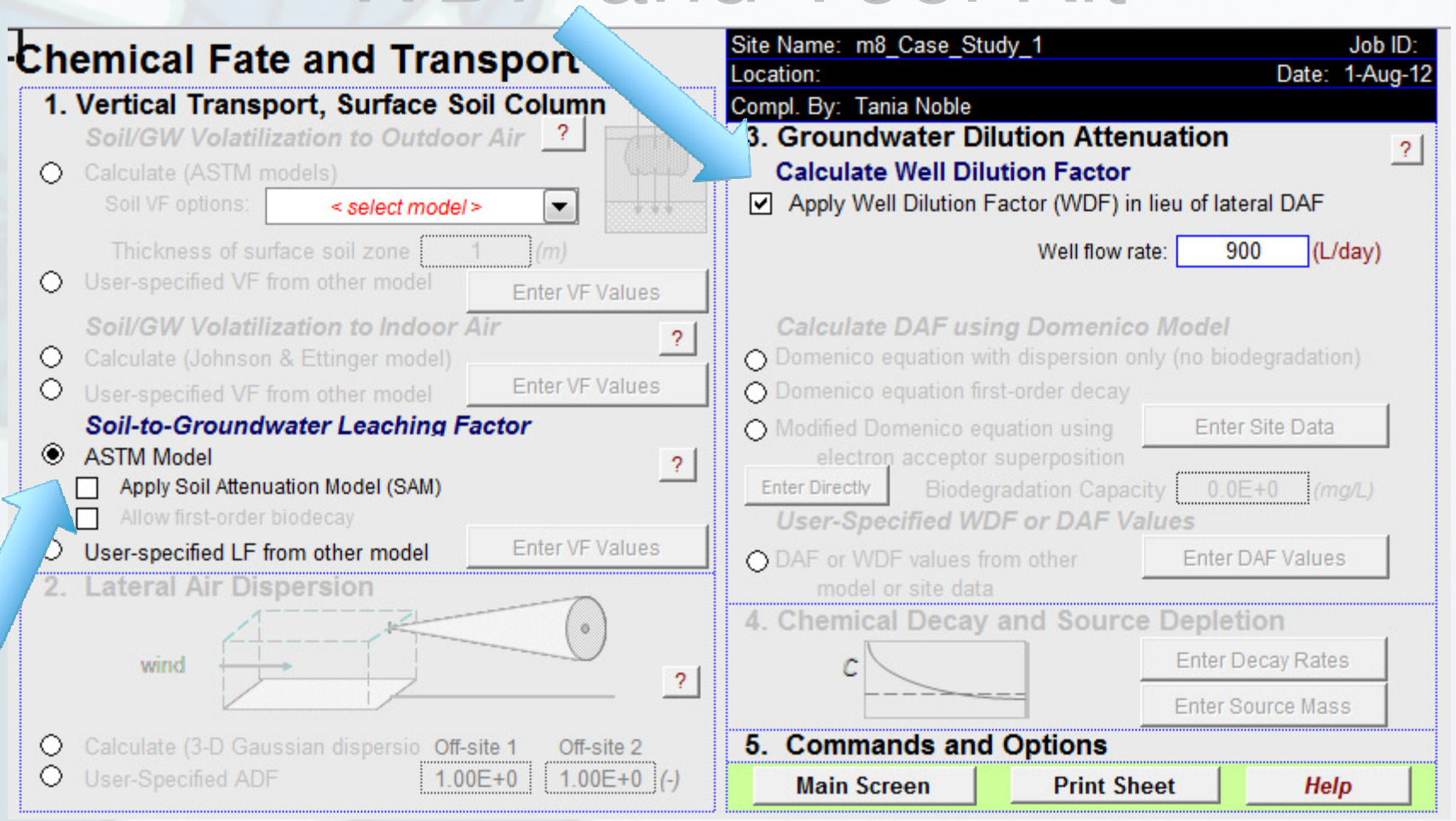
RISK BASED CORRECTIVE ACTION

WDF and Tool Kit



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Soil Vapour Permeability

Soil Type	Version 2	Version 3
Coarse-grained	1×10^{-12} m^2	5×10^{-12} m^2

- For indoor air pathway:
  higher permeability → higher flows → lower SSTL

ATLANTIC RBCA
RISK BASED CORRECTIVE ACTION

Building Volume-to-Area Ratio

Building Type	Version 2	Version 3
Residential	4.88 m	3.6

- For indoor air pathway:
  smaller volume ⟶ less mixing ⟶ lower SSTL

Building Air Exchange Rate

Building Type	Version 2	Version 3
Commercial	0.00038 exch/s	0.00025 exch/s

- For indoor air pathway:
  less exchange with fresh air ⟶ lower SSTL

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Adjustment Factor – Indoor Air

Version 2	Version 3
1 (i.e., no adjustment)	10

- J&E model overly conservative for PHC
- Changes to some of the defaults would make RBSLs even more conservative
- Empirical results from site in Atlantic also suggest a significant overprediction in version 3
- AF of 10 applied to indoor air results for PHCs only
- Similar factor used in other jurisdictions (CCME CWS, Alberta, Ontario)

ATLANTIC RBCA
RISK BASED CORRECTIVE ACTION

Adjustment Factor

Return | Print Sheet

RBCA SITE ASSESSMENT

Site Name: m8_Case_Study_1
Site Location:

Completed By: Tania Noble
Date Completed: 1-Aug-12

SOIL (0 - 3 m) SSTL VALUES

Target Risk (Class A & B): 1.0E-5
Target Risk (Class C): 1.0E-5
Target Hazard Quotient: 5.0E-1

SSTL Results For Comp

CONSTITUENTS OF CONCERN		Representative Concentration	Soil Ingestior	Off-site 1 (0 m)	Off-site 2 (0 m)	X Soil Vol. to Indoor Air: On-site (0 m)
CAS No.	Name	(mg/kg)		None	None	Residential
108-88-3	Toluene	2.5E-1	NA	NA	NA	7.7E+0
100-41-4	Ethylbenzene	2.1E+1	NA	NA	NA	3.0E+0
1330-20-7	Xylene (mixed isomers)	1.8E+2	NA	NA	NA	8.8E-1

">" indicates risk-based target concentration greater than constituent residual saturation value.

Chemical	SSTL (mg/kg)
Toluene	7.7 x 10 = 77
Ethylbenzene	3.0 x 10 = 30
Xylenes	0.88 x 10 = 8.8

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RISK BASED CORRECTIVE ACTION

TABLE 4a - TIER I RISK BASED SCREENING LEVELS FOR SOIL (mg/kg)									
Land Use	Groundwater Use	Soil Type	Compound of Concern						
			Benzene	Toluene	Ethyl-benzene	Xylene	Modified TPH (TPH-BTEX)		
							Gasoline	Diesel/ No. 2 Fuel Oil	No. 6 Oil/ Lube Oil
Residential	Potable	Coarse Grained	0.042	0.35	0.065	8.8	74	270	1,100
		Fine Grained	0.094	0.74	0.13	22	1,900	4,700	10,000
	Non-Potable	Coarse Grained	0.099	77	30	8.8	74	270	1,100
		Fine Grained	2.3	10,000	9,300	210	2,100	8,600	10,000
Commercial	Potable	Coarse Grained	0.042	0.35	0.065	11	870	1,800	10,000
		Fine Grained	0.094	0.74	0.13	22	1,900	4,700	10,000
	Non-Potable	Coarse Grained	2.5	10,000	10,000	110	870	4,000	10,000
		Fine Grained	33	10,000	10,000	10,000	10,000	10,000	10,000

Residential:

- BEX RBSLs on non-potable site with coarse-grained soil about half of version 2
- All other values similar to or higher than version 2

Commercial

- mTPH (diesel/No. 2 FO) much lower for potable, coarse-grained soil
- mTPH (diesel/No. 2 FO) also lower for non-potable, coarse-grained soil
- All other values similar to or higher than version 2

ATLANTIC RBCA
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Receptor	Groundwater Use	Soil Type	Compound of Concern						
							Modified TPH (TPH-BTEX)		
			Benzene	Toluene	Ethyl-benzene	Xylene	Gasoline	Diesel/ No. 2 Fuel Oil	No. 6 Oil/ Lube Oil
Residential	Potable	Coarse Grained	0.005	0.024	0.0024	0.3	4.4	3.2	7.8
		Fine Grained	0.005	0.024	0.0024	0.3	4.4	3.2	7.8
	Non-Potable	Coarse Grained	2.6	20	20	20	20	20	20
		Fine Grained	13	20	20	20	20	20	20
Commercial	Potable	Coarse Grained	0.005	0.024	0.0024	0.3	4.4	3.2	7.8
		Fine Grained	0.005	0.024	0.0024	0.3	4.4	3.2	7.8
	Non-Potable	Coarse Grained	20	20	20	20	20	20	20
		Fine Grained	20	20	20	20	20	20	20

- No change to BTEX values on potable sites
- mTPH values on potable commercial sites lower; no change on potable residential sites
- BTEX and mTPH values on non-potable sites similar to or higher than version 2

ATLANTIC RBCA
RISK BASED CORRECTIVE ACTION

Soil Vapour Guidance

- An errata sheet has been released, outlining changes that have occurred as a result of RBCA Toolkit updates.
- Some of the changes include:
  - Removal of pathway operability tables (assessment still required within 30 m).
  - Soil Gas to Indoor Air Dilution factors (Table 7)
  - Reference concentration change for toluene (Table 8)
  - Toluene, ethylbenzene, and xylenes no longer added to TPH fractions

ATLANTIC RBCA
RISK BASED CORRECTIVE ACTION

Effect of THQ Change

- Concentration is considered acceptable if:

Measured Indoor air concentration (mg/m^3) ≤ RfCi (mg/m^3)

Predicted indoor air concentration (mg/m^3) ≤ Target HQ x RfCi (mg/m^3)

Where Target HQ is 0.5 for TEX and 1.0 for TPH

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RISK BASED CORRECTIVE ACTION

Questions?

ATLANTIC RBCA
RISK BASED CORRECTIVE ACTION

Regulatory Overview

Site Professional Information Session

October 16, 2012

ATLANTIC RBCA
RISK BASED CORRECTIVE ACTION

Atlantic PIRI

- Partnership between Regulators, Industry and Consultants.
- People responsible for implementing the Atlantic RBCA process in Atlantic Canada.
- Most decisions and recommendations are brought back to the respective provinces for consideration and implementation.

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RISK BASED CORRECTIVE ACTION

Why Atlantic RBCA Version 3?

- Commitment to meet or exceed Canada's national Canada-Wide Standards.
- Commitment to continuous improvement of Atlantic RBCA software and associated tools and guidance documents.
- Because previous versions primarily assessed risks to human health and only addressed petroleum hydrocarbons sites.

ATLANTIC RBCA
RISK BASED CORRECTIVE ACTION

Recommended Transition

- V2 RAP completed before August 1, 2012 and a report has not yet been submitted, must submit report on or before February 1, 2013 **(6 months)**, otherwise, re-evaluate using V3.

- V2 RAP accepted by Regulator before August 1, 2012 may continue to use V2 and RAP must be completed and reported on or before July 31, 2013 **(1 year)**. During RAP, if site re-evaluation is required, must use V3.

- V2 RAP accepted and completed before August 1, 2012 and if site re-evaluation is required, must use V3.

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Regulatory Directives and Orders

- Directives and orders issued before August 1, 2012 and RAP has not yet been accepted or implemented, shall continue to use V2 or have an agreement with Regulator to use V3.

- Directives and orders issued before August 1, 2012 and RAP is incomplete, shall continue to use V2 or have an agreement with Regulator to use V3.

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RISK BASED CORRECTIVE ACTION

Harmonized Site Closure

- Appendix 7 User Guidance, Atlantic RBCA Site Closure Checklist
  - Part 1: Site information
  - Part 2: Documents summary
  - Part 3: Checklist with minimum submission requirements

- Prefer all required information for site closure is provided in one comprehensive report. If information is contained in more than one report, all applicable and/or reports must also be provided with the closure report.

- Additional submission requirements may apply by jurisdiction.

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RISK BASED CORRECTIVE ACTION

Other Considerations

- Some Province specific guidelines, protocols and/or regulations need updates.
- Not anticipating any file reopeners.
- Understood there will be a learning curve for practitioners, regulators and owners.
- May be other opportunities to fine tune V3 with planned future updates (chlorinated solvents and soil vapour review).

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Nova Scotia

- V.3 does not change existing interim procedures related to report submissions and checklist usage
- Business as usual with Atlantic RBCA V.3
- Domestic Fuel oil spill policy criteria automatically change with transition to V.3 See footnote in Domestic policy table(s)

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RISK BASED CORRECTIVE ACTION

New Brunswick

- Work with the Regulator who can exercise discretion with some requirements on a site-specific basis (ie. number of monitoring wells, acceptable residual impacts).
- Consult the Regulator early and as often as necessary especially when assessments and remediation are more complex or can be limited.
- Some Guideline documents require minor updates to reflect changes in V3.

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RISK BASED CORRECTIVE ACTION

Prince Edward Island

- Regulatory amendments that reflect V3 numbers are in progress.
- Upon approval, the *Environmental Protection Act Petroleum Hydrocarbon Remediation Regulations* will contain V3 lookup tables.

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RISK BASED CORRECTIVE ACTION

Newfoundland and Labrador

- NL Regulatory has remained the same with the changes in RBCA
- It should be ensured that the site is assessed/remediated in accordance with our guidance document
- Efforts should be made to meet all Atlantic RBCA requirements. If requirements cannot be met, regulators are open for discussion, as long as sufficient justification is provided.