

# Geosciences

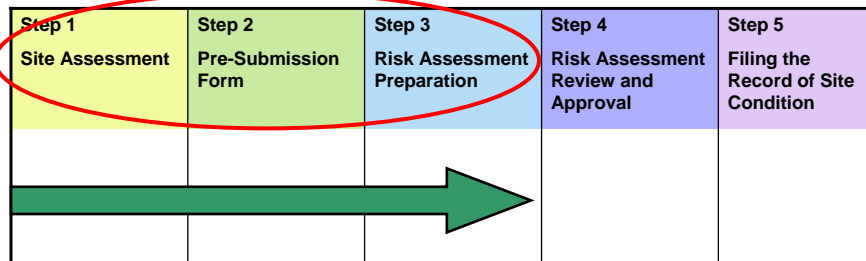
**Documenting Site Characterization to support  
Risk Assessment**

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## Risk Assessment Process



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## Topics to be Addressed

- Property Information
- Site Plan and Site Characterization / Assessment
  - Topography, stratigraphy, geology, hydrology, hydrogeology and contaminant hydrogeology
  - Phase 1 and 2 ESA's must be sufficient to support the RA
- COCs

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## Property Information

- Location - augment with map or drawing
- Current ownership - since when?
- Property size and shape – introduce key areas, buildings, or other features; describe locations and sizes of impacts; augment with a drawing
- Types and locations of services/utilities; zoning as appropriate

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## Property Information (Problem Identification)

- Summarize past and current potentially contaminating uses on the property and on adjacent lands if relevant
  - What issues, concerns, contaminants did the Phase I ESA highlight?
- Identify potential **on-site** and **off-site** sources of impacts – and potential contaminants of concern?
- Identify potential **on-site** and **off-site** receptors of interest – types, distances, and directions from RA property (precursor to CSM in Section 4)
- Identify proposed/future use of the property

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## Schedule C, 4.(6)4.requires that an RA include:

*A summary of the phase one environmental assessment and phase two environmental assessment reports, including justification for the sampling program used in undertaking the phase two environmental assessment, summary of quality assurance and quality controls used for the sampling program and analysis of the samples, an assessment of whether the sampling program is sufficient for the purposes of the risk assessment and if not, a description of what further site investigations were conducted to support the risk assessment.*

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## What to include in Site Plan and Site Characterization Summary to Demonstrate that Site Characterization support RA

- Textual discussion, tables, maps, cross-sections and appendices which is, in essence, the Conceptual Site Model
- Level of detail and amount of information needed will depend on the specific RA (ie. Surficial soil vs. subsurface contamination, type of RA (regular, modified generic, flow through etc.)
- Assumptions and data quality key

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## Geography / Geology

- Site Geography including topography and surface water and drainage features
  - influences runoff, may be indicator of ground water flow direction, may act as pathways
- Geology – soil / overburden and bedrock types and stratigraphy: thicknesses, texture, morphology, structure, etc.; based on site investigations (i.e. Ph II ESA or supplemental)
  - influence vertical and lateral movement of COCs, screening criteria, designation as environmentally sensitive site, etc.

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# Hydrology

- Surface water features which may:
  - influence ground water flow direction and / or contaminant transport
  - require site designation as an environmentally sensitive area (within 30m of a water body)
  - act as a receptor?
- and their characteristics

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# Hydrogeology

- Physical Hydrogeology – often key if COCs are even moderately soluble; need data such as water table, direction of flow; hydraulic conductivity, effective permeability and gradients
- Soil and groundwater chemistry
  - **Soil pH** (single pH value outside of range will make site sensitive)
  - Organic carbon content of soil for attenuation and soil vapour assessments
  - Provide natural background concentrations

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## Discussion of Site Characterization

- Phase 1 and 2 and any additional investigations
- Site physical and chemical hydrogeology and relevant components of regional and local hydrogeology
- Contaminant Source(s): each contaminant issue, COCs, and area of contamination being addressed in RA
- Pathways and receptor assessment, including constructed pathways if relevant
- Assumptions and choice of parameters, characteristics, etc. used in assessment (ie. potable/non potable, medium-fine/coarse, porosity, k, etc.)
- Data quality, and QA/QC
- Clear links and discussion of data presented in tables, maps, etc.

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## Tables

- One or more **tables** to summarize findings :
  - Potential sources identified in the Phase 1, the associated contaminants, how each potential issue / source was investigated in the Phase 2 and any additional investigations, what the investigation results were
  - Consolidating by media laboratory analyses used to support RA, comparing data to screening criteria and identifying COC's
  - Geological and hydrogeological data used in pathway assessments

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## Maps / Plans

- **maps** to support description to illustrate:
  - Potential and identified (past and present) sources and of impacts
  - Sample locations with contaminant concentrations (all date used in RA, not just most recent)
  - Delineate lateral extent of impacted area(s)
  - Direction(s) impacts are migrating
  - Significant surface water and natural and manmade drainage feature (s)
  - Other requirements in clause 3(8)a of Schedule C

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## Cross-Sections

- **Cross-sections** need to illustrate:
  - Boreholes, monitoring wells, well screen intervals
  - **Soil and bedrock** strata in terms of thicknesses, texture, etc.
  - Preferential pathways where present (utilities, etc.)
  - Strata impacted, strata in which COCs are moving and how stratigraphy influences COC movement
  - Horizontal and vertical extent of plume
  - Contaminant concentrations (all data used, not just most recent)
  - Relevant groundwater flow (heads, directions, etc.)
  - Natural and artificial drainage and surface water features
  - Unit(s) used as water source(s)
  - Other requirements in clause 3(8)a of Schedule C

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## Schedule C, 3.(8)a

- (a) a site plan of the RA property and a diagram that shows one or more cross-sections of the property which convey,
- (i) existing and historical sources of contaminants,
  - (ii) surface and sub-surface structures that affect contaminant distribution and transport
  - (iii) locations where samples were taken at the RA property and which will be relied on for the purposes of the risk assessment, and
  - (iv) geological and hydrogeological interpretations which will be relied on in the risk assessment

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## Discussion of COCs

- Briefly describe activities that produced the data to be used. Who collected it? When? Why? What chemicals were analyzed (based on Phase I ESA)?
- If any data are to be ignored, QP must explain why (i.e. data are out of date, no longer represent conditions on the property, QA/QC concerns)
- Make links to maps and cross-sections
- Provide a summary of all COCs, the benchmarks used, and the results (or at least the maximum on-site values for each COC) that exceed the benchmarks
- Often useful to create separate COC discussions for each environmental compartment investigated

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## Demonstrating Adequacy of Sampling Programs

- Do the sample locations and analyses provide enough information to support the assumptions made in the RA?
- Sampling Program discussions should explain how the assembled data either supports, imposes limitations, or introduces uncertainties in the RA
- Have appropriate locations and adequate numbers of samples been analyzed relative to the size, location and characteristics of the impacted area?
- Have samples been taken at key depths, specific water-bearing units, locations important to receptors, etc.?

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## Local Background RA's

- For a **local background RA**:
  - need to describe the methods used to derive or calculate background standards [subsections 8(4) to 8(9)].
  - If measured concentrations exceed Table 2 SCS, then a local background RA may not be viable (for example, sodium concentrations may be very high, naturally above Table 2 value).

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## MODELLING

- At a minimum:
  - Demonstrate that flow, transport, vapour or other models used are appropriate
  - Provide a summary of the modelling done, the assumptions made and the uncertainty analysis and what it means to the RA
  - Provide a table(s) identifying all of the parameters used in the model and justification
  - provide model generated maps and / or cross-sections

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## Quality of Data

- Data quality is multi-dimensional:
  - Recently collected vs. “stale” data
  - Analysis conducted by an accredited lab using accredited analytical methods
  - Methods used by the lab (QC Batches, surrogate recoveries, lab duplicates, etc.)
  - Methods used by the sampler (duplicates, replicates, split samples, travel blanks, etc.)
- Describe QA/QC procedures in the RA

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## Deficiencies & Tips

(Information often identified as missing or problematic when reviewing risk assessments)

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- All potential sources of contamination identified should be accounted for
  - If sampling indicates no concern, identify this
  - Each area of sampling should be adequately characterized (it is not appropriate to use upgradient of a source to support the claim that groundwater is not impacted)
  - If a site has a complex history and it is not possible to ensure that all potential sources of contamination have been identified and investigated, address this in the site characterization description and Risk Management Plan
  - Double check to be sure that the appropriate standards or other benchmarks are used to identify COCs.

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- Table 1 SCS **must** be used at any environmentally sensitive site (for all media)
  - In defining ESS, note *Clause 41.(1)(e) a qualified person is of the opinion that, given the characteristics of the property and the certifications the qualified person would be required to make in a record of site condition in relation to the property as specified in Schedule A, it is appropriate to apply this section to the property.*
- To use SCSs for medium-fine textured soil must define soil texture down to the water table and demonstrate where and how the contaminants are moving
  - if contaminants are moving in coarse grained materials is will likely not be appropriate to screen using medium-fine textured SCS's.

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- When using average or other statistically derived physical or chemical characteristics from site characterization in risk assessment consider the implications to environmental and human health
  - For multi property “sites” or sites with multiple contaminant sources, such numbers may not be adequately protective for all future landuse locations and uses
  - Contaminated sites do not lend themselves well to statistics – make sure if statistically deriving maximum concentrations they are realistic for the contaminants, hydrogeologic unit, site, etc.
- If RA is for a complex site or multiple properties may want to attached Phase 2 ESA to support RA
- Scale and quality of maps and cross-sections are important
  - need to be of a scale that can be used in evaluating details of site conditions
  - Photo overlays do not photocopy well!

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## Conclusion

1. Demonstrate that the site has been adequately assessed and the conceptual site models, data used and assumptions made are supportable.
2. Look at the site characterization critically before submitting. Are there gaps that RA reviewers may feel should be investigated?
3. Are potential off-site issues addressed?
4. Document, document and document!

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