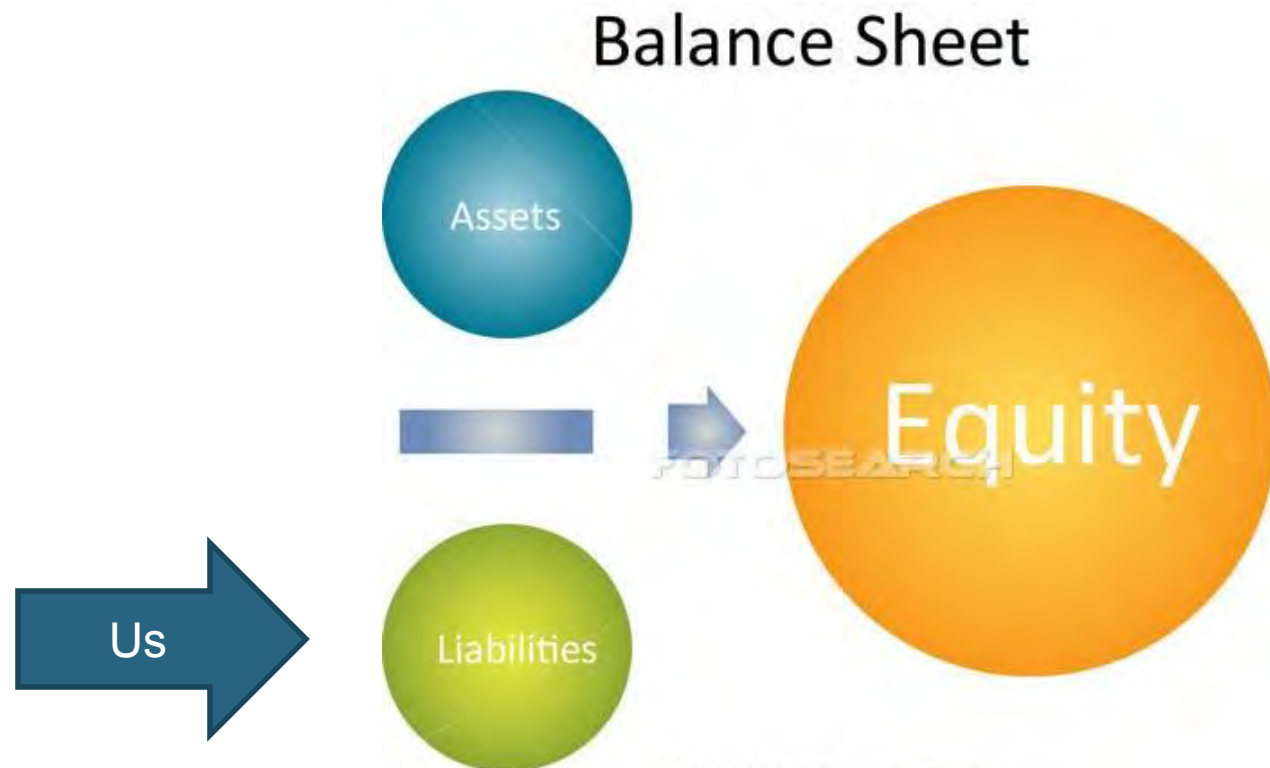


SOIL VAPOUR BASED RISK ASSESSMENT

Overview and Analysis of Cost for Soil Vapour
Based Assessment vs. Direct Remediation

Contaminated Sites Management

As managers of contaminated sites we are on the wrong site of the balance sheet.



Atlantic Partnership in RBCA Implementation (PIRI)



A multi-stakeholder group responsible with the adoption, development, and promotion of the RBCA process within the Atlantic Canada regulatory framework

Supported by the four Atlantic Deputy Ministers of Environment (MOU, 2008)

A risk-based approach to determine soil and groundwater remedial objectives of impacted sites in Atlantic Canada since 1999, “The Toolkit”

Risk Assessment allows remedial effort to be commensurate with risk to human health and the environment

Who is Rebecca?

RBCA = Risk Based Corrective Action

PIRI = Partnership In RBCA Implementation



What is the Toolkit ?

Tier 1, Pathway Specific, Tier II, Tier III, Excavation, Chemical Oxidation, Pump and Treat, VES, Barriers(Active or Passive), MPVE, Bio piles, Natural Attenuation, Bio-remediation, Thermal Remediation, Phytoremediation, etc.



The RBCA Approach

Actions to remove /reduce one of the three, typically;

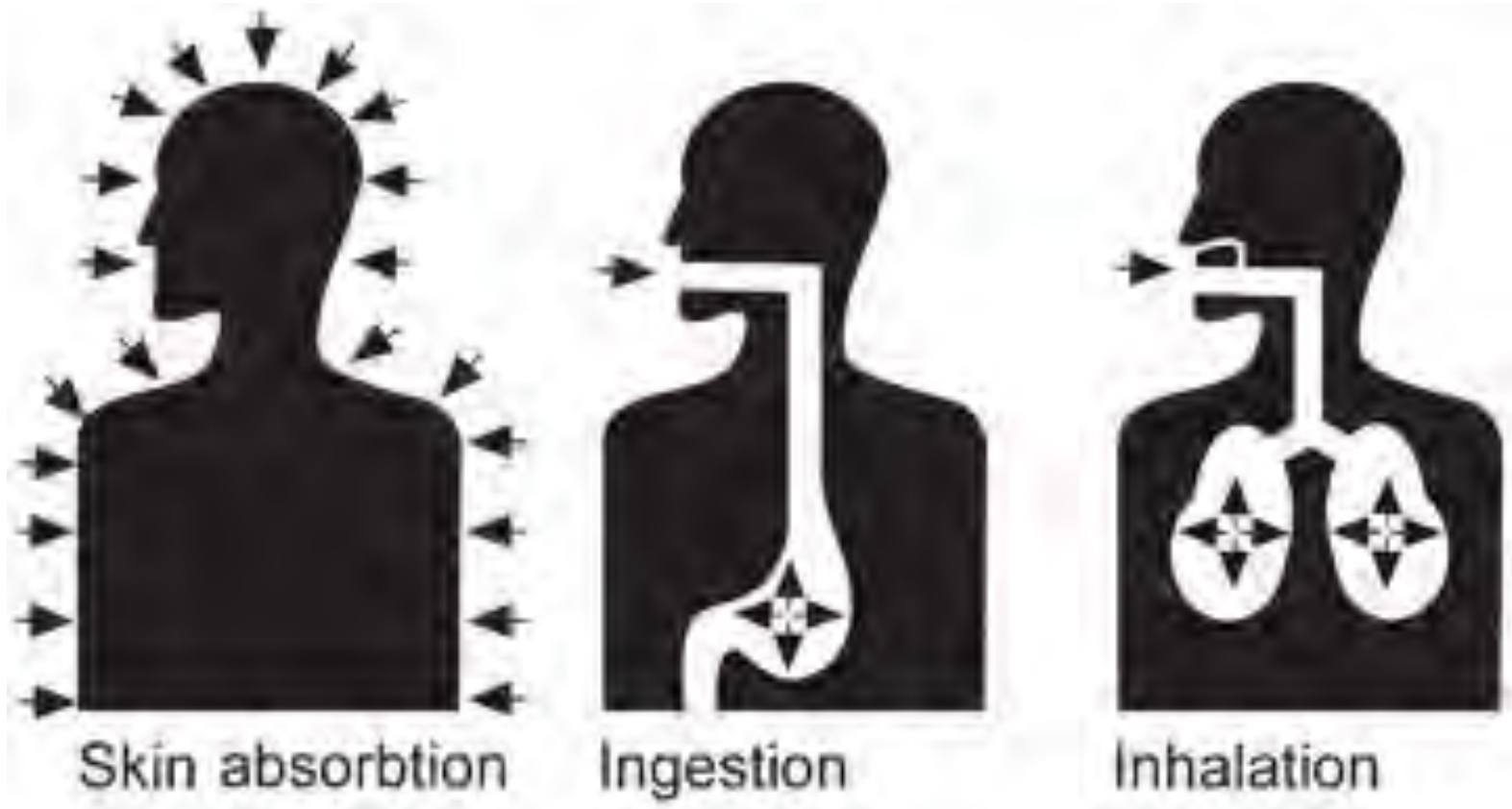
**Hazard reduction by
*Remediation***

Exposure pathways by *Risk Assessment* and *engineered controls*

Receptor by *Land Use Controls*

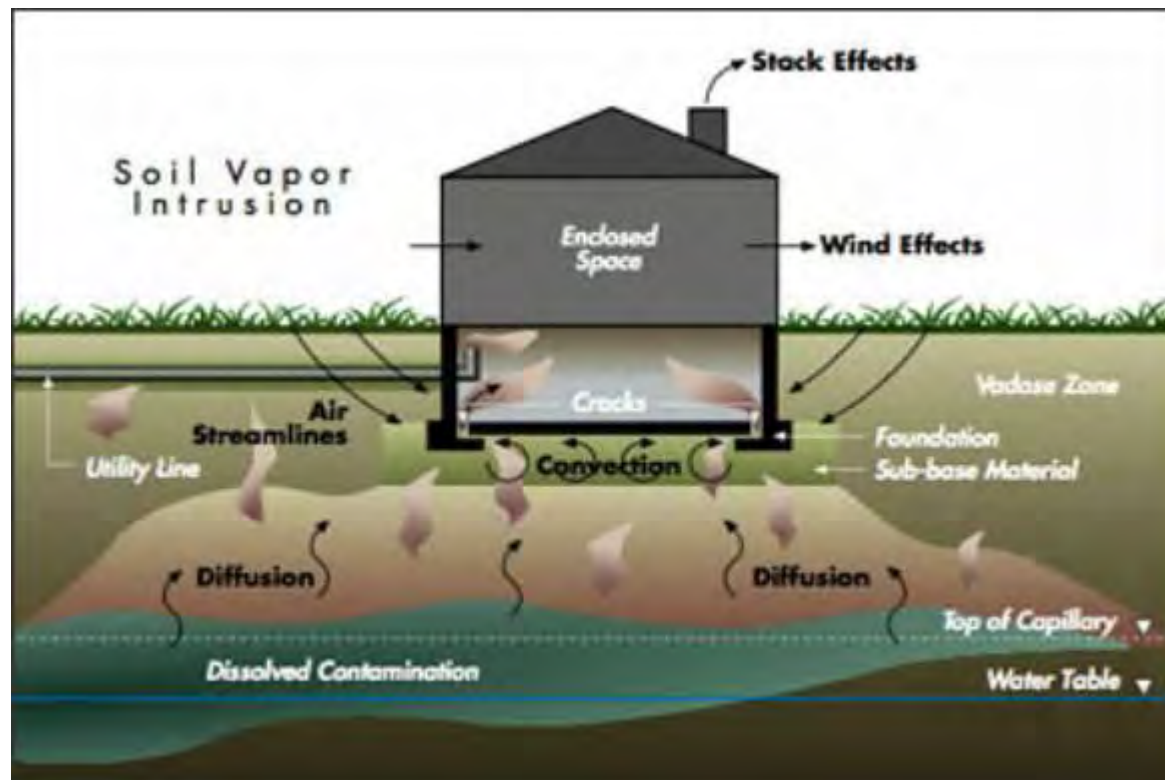


Exposure Pathways

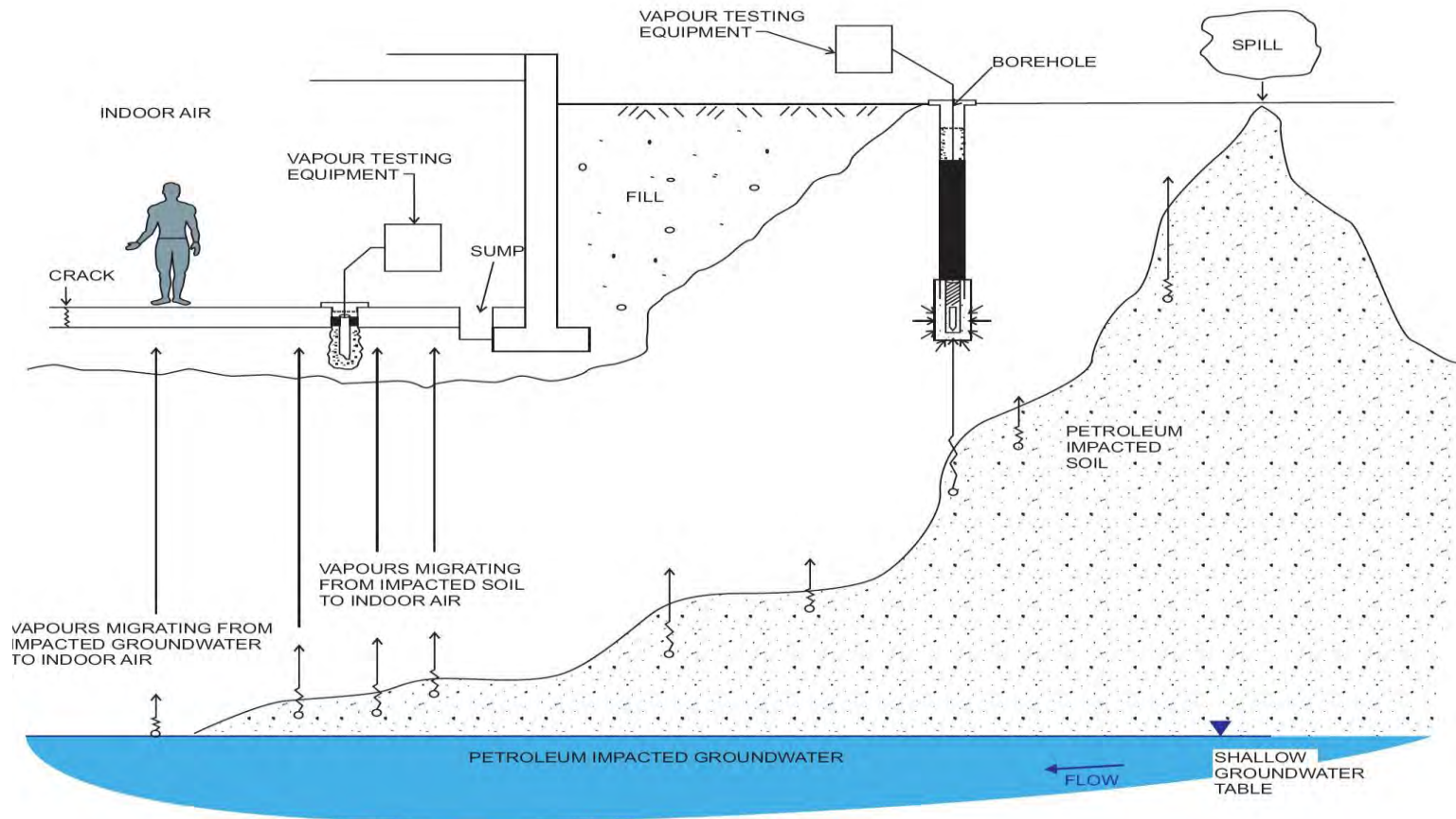


Inhalation Via Indoor Air

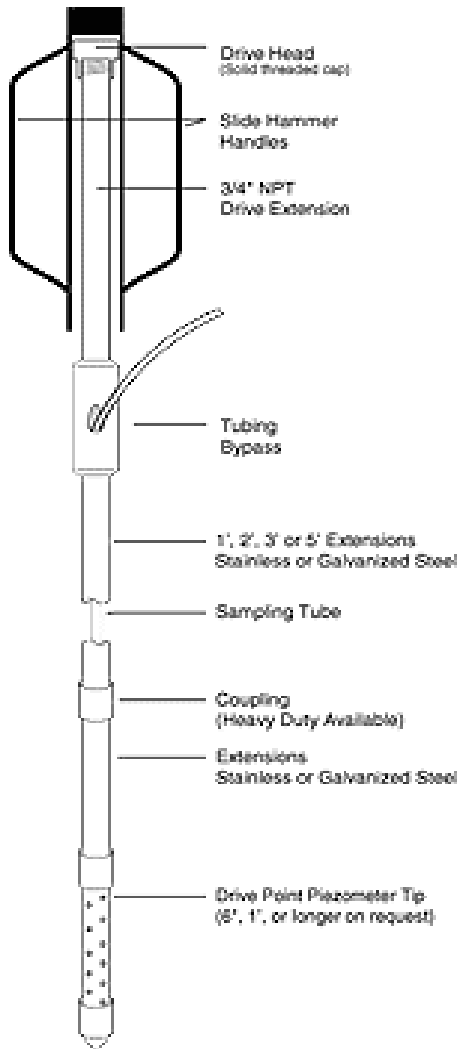
Lookup tables are conservative by design. **Soil vapour assessment** allows direct measurement of soil vapour at the source, near the receptor, or at the receptor.



Soil Vapour Assessment



Soil Vapour Assessment



Remediation Options



Excavation

- Most Common Method
- Applicable for all soil types and conditions
- High Cost



Chemical Oxidation

- Applicable in a range of soil types and conditions
- Can be high cost



Bioremediation

- Applicable in permeable soil types/conditions
- Low to Moderate Cost

Other technologies are available, including soil vapour extraction (SVE) and passive remediation.

Techniques selected are generally site specific.

Soil Vapour Assessment vs. Excavation

Advantages Soil Vapour

- Minimal Installation Times
- Can Effectively Assess Large Volumes
- Minimally Invasive
- Typically high ROI

Advantages Excavation

- Simple Application
- Short Timeframe
- Can be applied earlier in the process
- Surety

Disadvantages Soil Vapour

- Site and Contaminant Specific
- Requires higher level of assessment
- May require land use restrictions
- Results may vary

Disadvantages Excavation

- Access
- Groundwater
- Defining final boundaries
- Cost

A sophisticated tool vs. a blunt instrument

Soil Vapour Assessment vs. Excavation

Case Studies;

1. A vacant site in PEI with Commercial Land Use in a municipality
2. A vacant site in New Brunswick with Commercial Land Use and potable water
3. A site in New Brunswick with Residential Land use and potable water (third party ownership)



Case Study 1; PEI



Case Study 1; PEI

Site Details

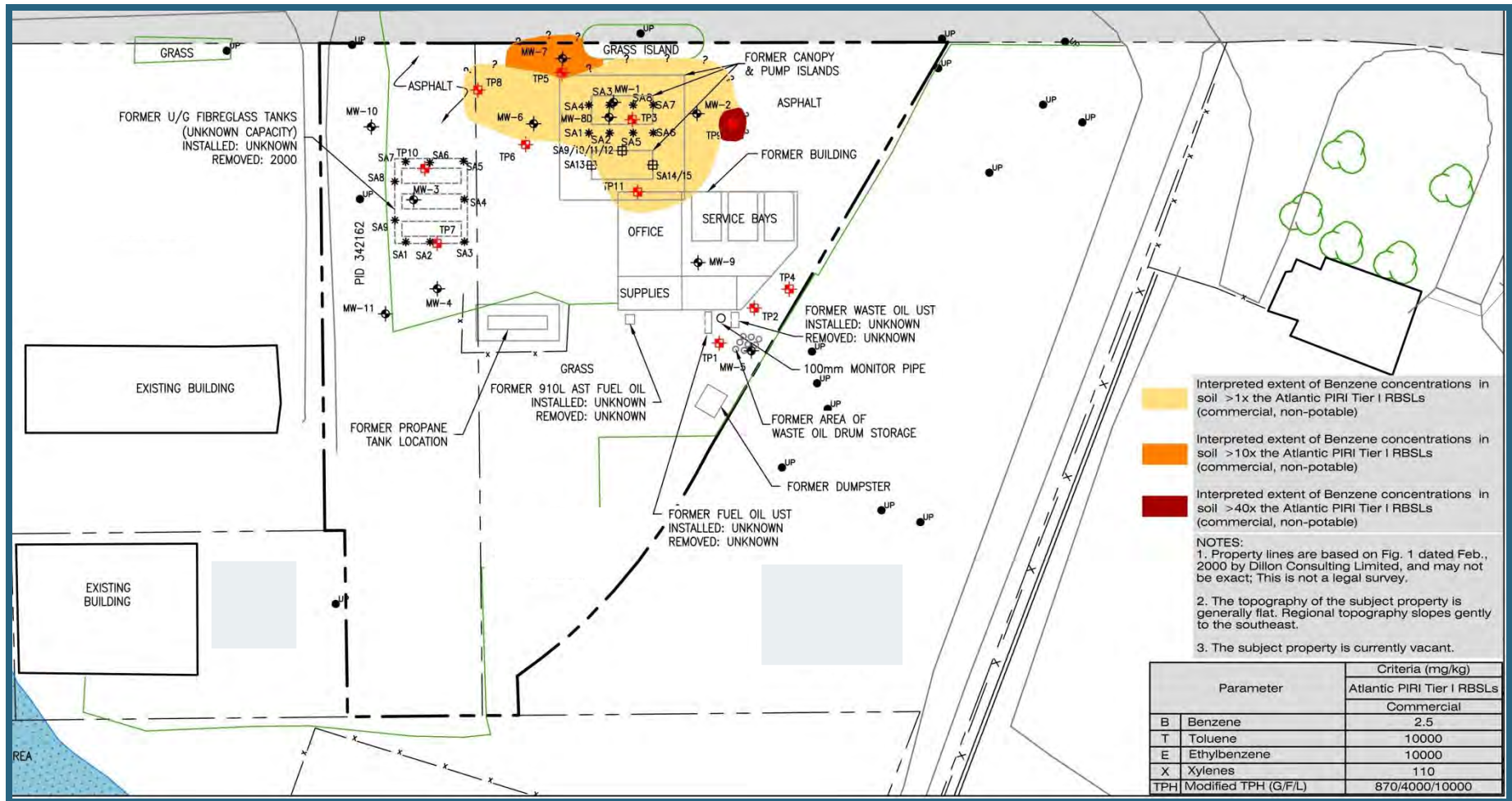
- A petroleum retail outlet operated on the subject site until 1999 when all infrastructure was decommissioned.
- Some soil was removed as part of the decommissioning activities.
- The site is located in a commercial area.
- The subject site is classified as having **commercial** land use, **non-potable** groundwater usage, **coarse grained** soils and impacts resembling **gasoline**.

Case Study 1; PEI

Petroleum Hydrocarbon Impact Details

- Petroleum hydrocarbon impacts in soil exceeding applicable Tier I RBSLs were identified in the former pump island area (with pockets of higher concentrations located to the north and east).
- Petroleum hydrocarbon impacts in groundwater exceeding applicable Tier I RBSLs were identified in the former pump island area.
- MtBE concentrations in groundwater exceed the PEI Environmental Protection Act.

Case Study 1; PEI



Case Study 1; PEI

REMEDIAL OPTIONS CONSIDERED

Option 1

- Remedial Excavation of impacted soil exceeding Tier I RBSLs
- Approximately 7000 t to be removed
- Subsequent groundwater monitoring

Option 2

- Remedial Excavation of source soil
- Approximately 2000 t to be removed followed by HHRA
- Subsequent groundwater monitoring

Option 3

- Risk Based Remediation File Closure following a Human Health Risk Assessment (HHRA)
- Groundwater and soil vapour monitoring required
- Property restriction of 'no build' zones may be required

Case Study 1; PEI

Option	Tonnage to be Removed	Cost of Remedial Efforts	Cost to Regulatory File Closure	Anticipated Timeline	Property Restrictions
Remedial Excavation of Soil Exceeding Tier I RBSLs	7000 t	\$650 000	\$ 750 000	3 to 5 years	No Property Restrictions
Remedial Excavation of Source Soil and HHRA	2000 t	\$ 200 000	\$ 250 000	2 to 4 years	No Property Restrictions
Risk Based Closure and HHRA	0 t	\$ 0	\$ 50 000	2 to 3 years	No Build Zones may be required

Case Study 2; Central NB



Case Study 2; Central NB

Site Details

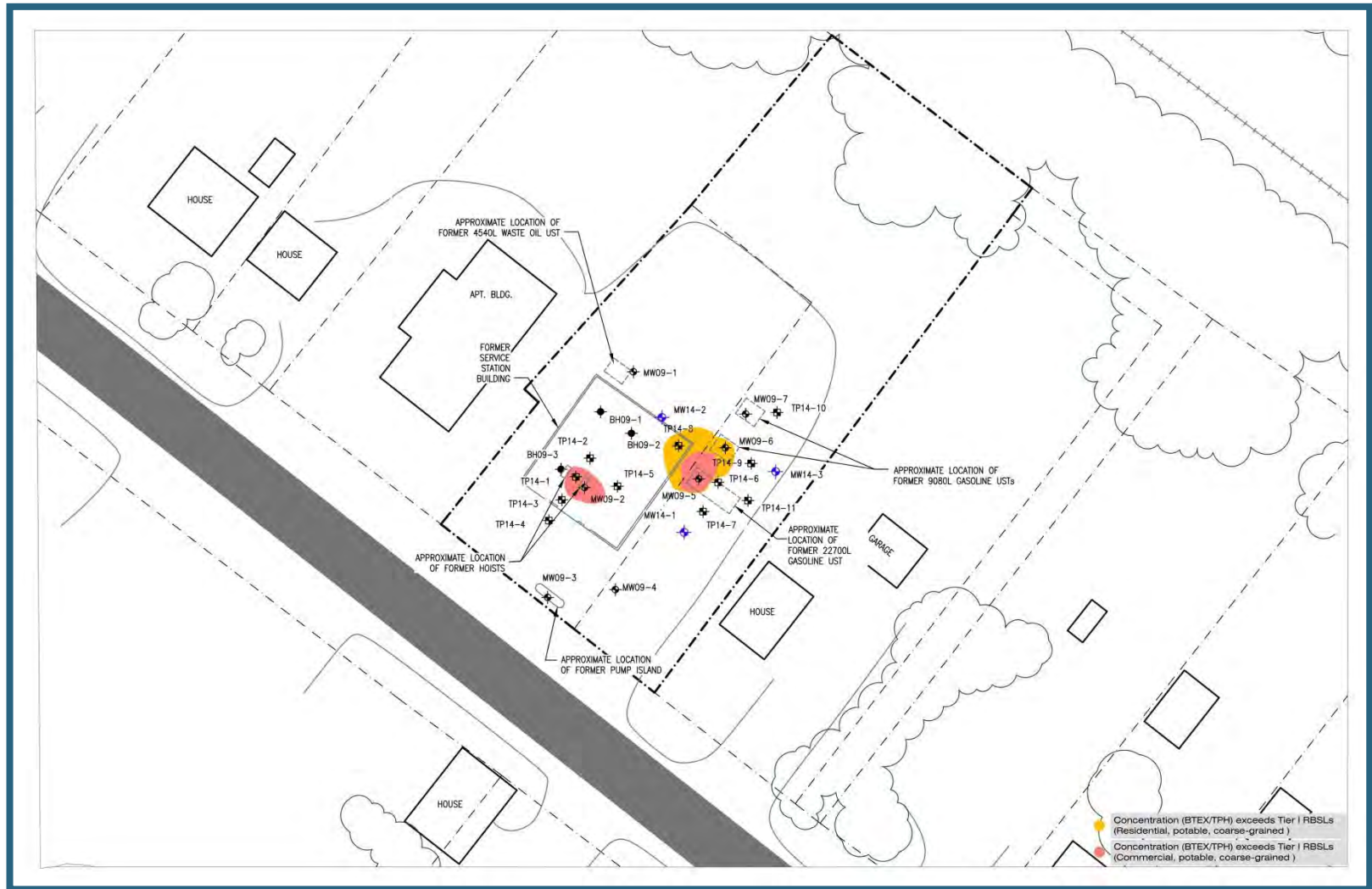
- A petroleum retail outlet and service station operated on the subject site from the 1950's until 1992 when all infrastructure was decommissioned.
- The site is located in a residential area and an active Canadian National rail line borders the site to the north.
- The subject site is classified as having **commercial** land use, **potable** groundwater usage, **coarse grained** soils and impacts resembling **gasoline and lube oil**.

Case Study 2; Central NB

Petroleum Hydrocarbon Impact Details

- Petroleum hydrocarbon impacts in soil exceeding applicable Tier I RBSLs were identified in two distinct areas;
 1. the former service bay area (resembling waste oil), and
 2. the former tank farm area (resembling weathered gasoline).
- Petroleum hydrocarbon impacts in groundwater exceeding applicable Tier I RBSLs were identified in the former service bay area.
- MtBE concentrations in groundwater do not exceed the Health Canada Guidelines for Drinking Water Quality.
- Delineation to applicable Tier I RBSLs has been achieved in soil and groundwater.

Case Study 2; Central NB



Case Study 2; Central NB

REMEDIAL OPTIONS CONSIDERED

Option 1

- Remedial Excavation of impacted soil exceeding Tier I RBSLs
- Approximately 600 t to be removed
- Subsequent groundwater monitoring

Option 2

- Risk Based Remediation File Closure following a Human Health Risk Assessment (HHRA)
- Groundwater and soil vapour monitoring required
- Property restriction of 'no build' and 'no potable wells' zones may be required

Case Study 2; Central NB

Option	Tonnage to be Removed	Cost of Remedial Efforts	Cost to Regulatory File Closure	Anticipated Timeline	Property Restrictions
Remedial Excavation of Soil Exceeding Tier I RBSLs	600 t	\$ 75 000	\$ 125 000	3 to 5 years	No Property Restrictions
Risk Based Closure and HHRA	0 t	\$ 0	\$ 55 000	1 to 2 years	No Well Zone may be required

Case Study 3; Southern NB



Case Study 3; Southern NB

Site Details

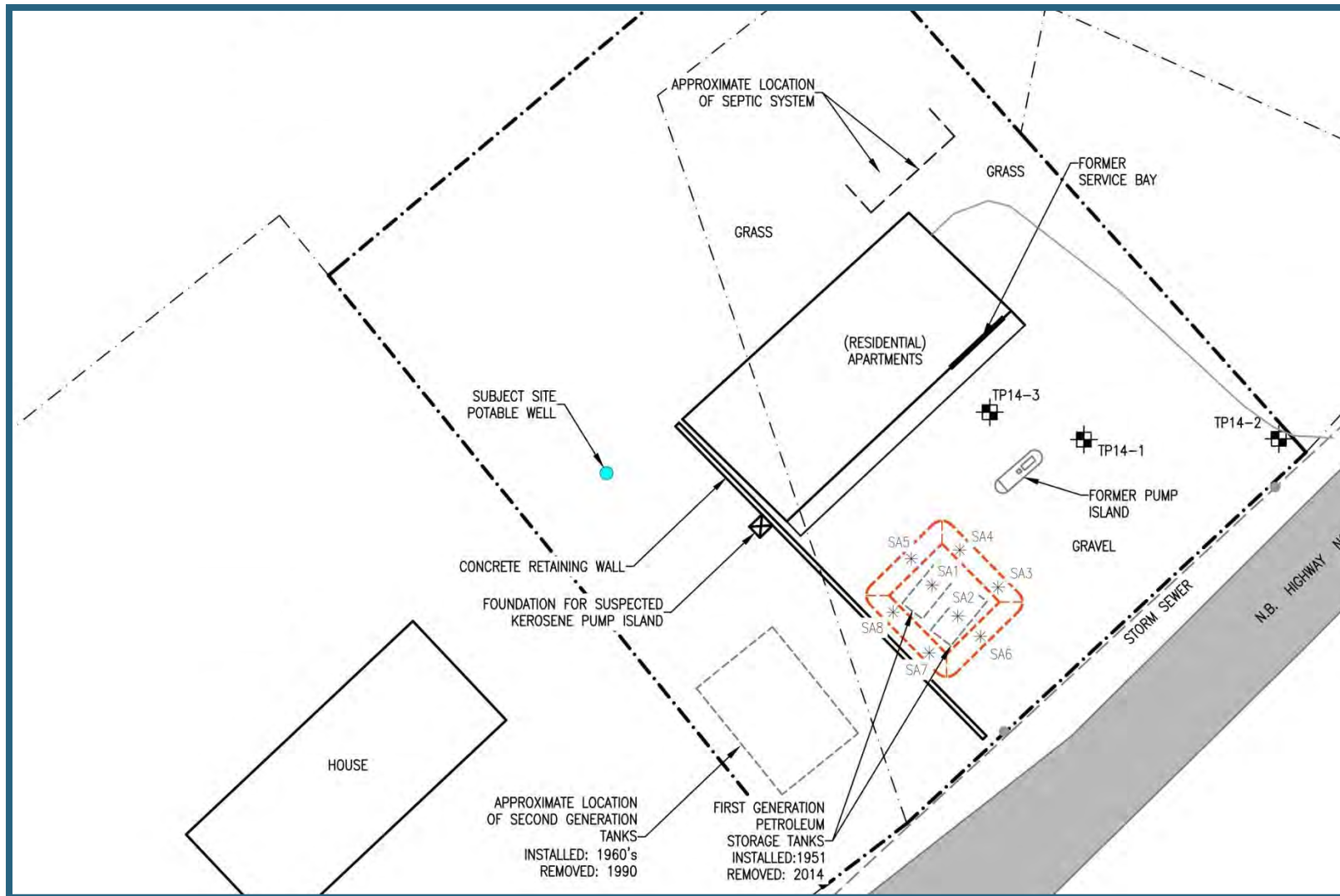
- A petroleum retail outlet operated on the subject site from the 1951 until 1990 when all infrastructure was decommissioned.
- A service station operated on the subject site from 1951 until 2001.
- The site is located in a residential area.
- The subject site is classified as having **residential** land use, **potable** groundwater usage, **coarse grained** soils and impacts resembling **fuel oil**.

Case Study 3; Southern NB

Petroleum Hydrocarbon Impact Details

- Petroleum hydrocarbon impacts in soil exceeding applicable Tier I RBSLs were identified in the former tank farm area (resembling lube oil).
- Petroleum hydrocarbon impacts in groundwater exceeding applicable Tier I RBSLs were identified in the former tank farm area.
- MtBE concentrations in groundwater do not exceed the Health Canada Guidelines for Drinking Water Quality.
- Delineation to applicable Tier I RBSLs has been achieved in soil and groundwater.

Case Study 3; Southern NB



Case Study 3; Southern NB

REMEDIAL OPTIONS CONSIDERED

Option 1

- Remedial Excavation of impacted soil exceeding Tier I RBSLs
- Approximately 400 t to be removed
- Subsequent groundwater and potable water monitoring

Option 2

- Risk Based Remediation File Closure following a Human Health Risk Assessment (HHRA)
- Groundwater and soil vapour monitoring required
- Property restriction of 'no build' and 'no potable wells' zones may be required

Case Study 3; Southern NB

Option	Tonnage to be Removed	Cost of Remedial Efforts	Cost to Regulatory File Closure	Anticipated Timeline	Property Restrictions
Remedial Excavation of Soil Exceeding Tier I RBSLs	400 t	\$ 125 000	\$ 185 000	5 to 10 years	No Property Restrictions
Risk Based Closure and HHRA	0 t	\$ 0	\$65 000	1 to 2 years	No Build and No Well Zones may be required

Questions?