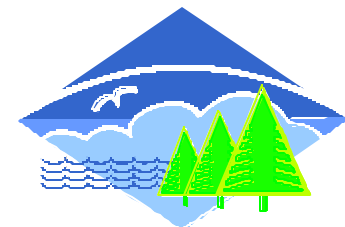


Remediation Guidelines for Upstream Oil and Gas Sites in Alberta

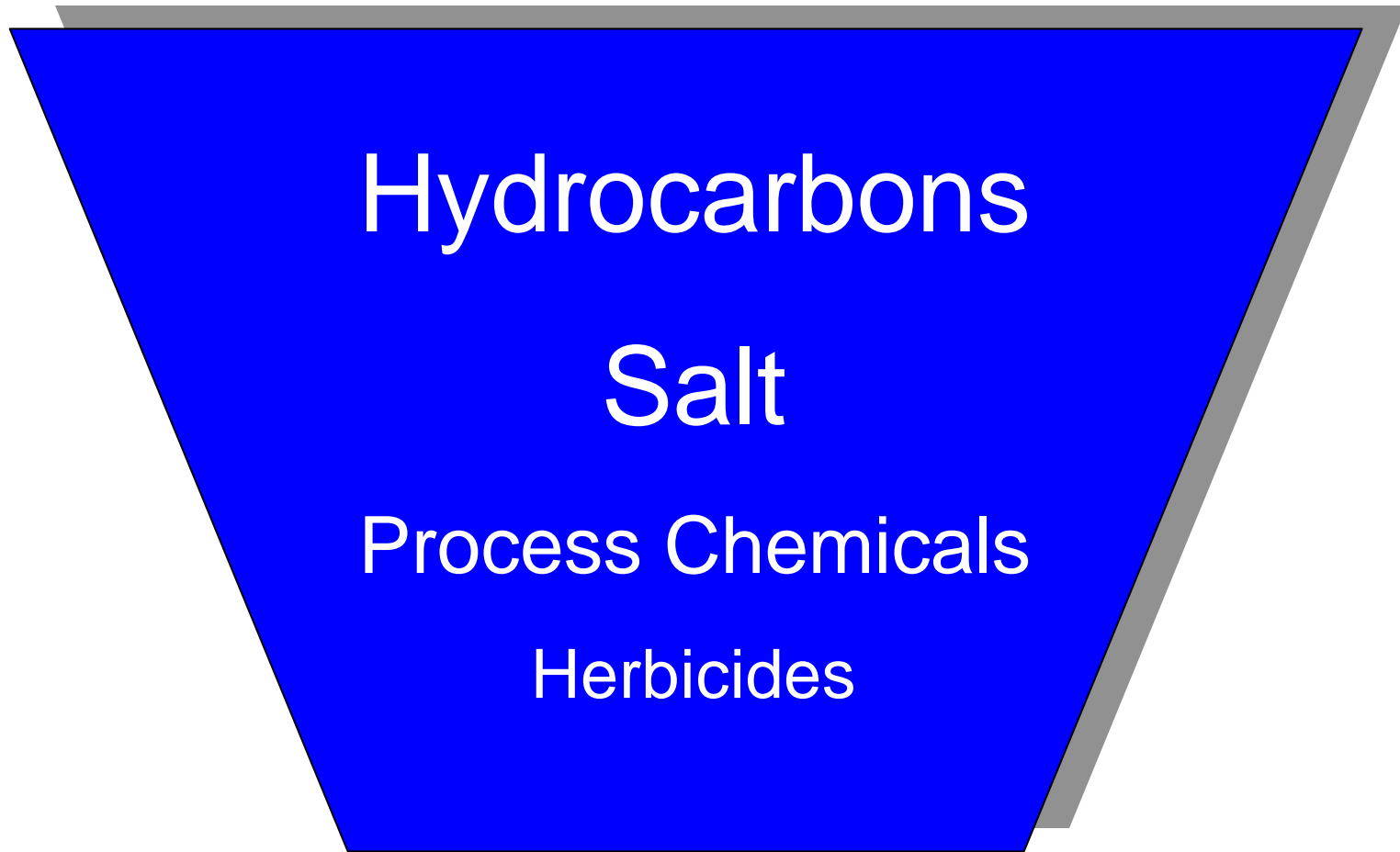
Recap of Day One Materials and Presentations

Ted Nason

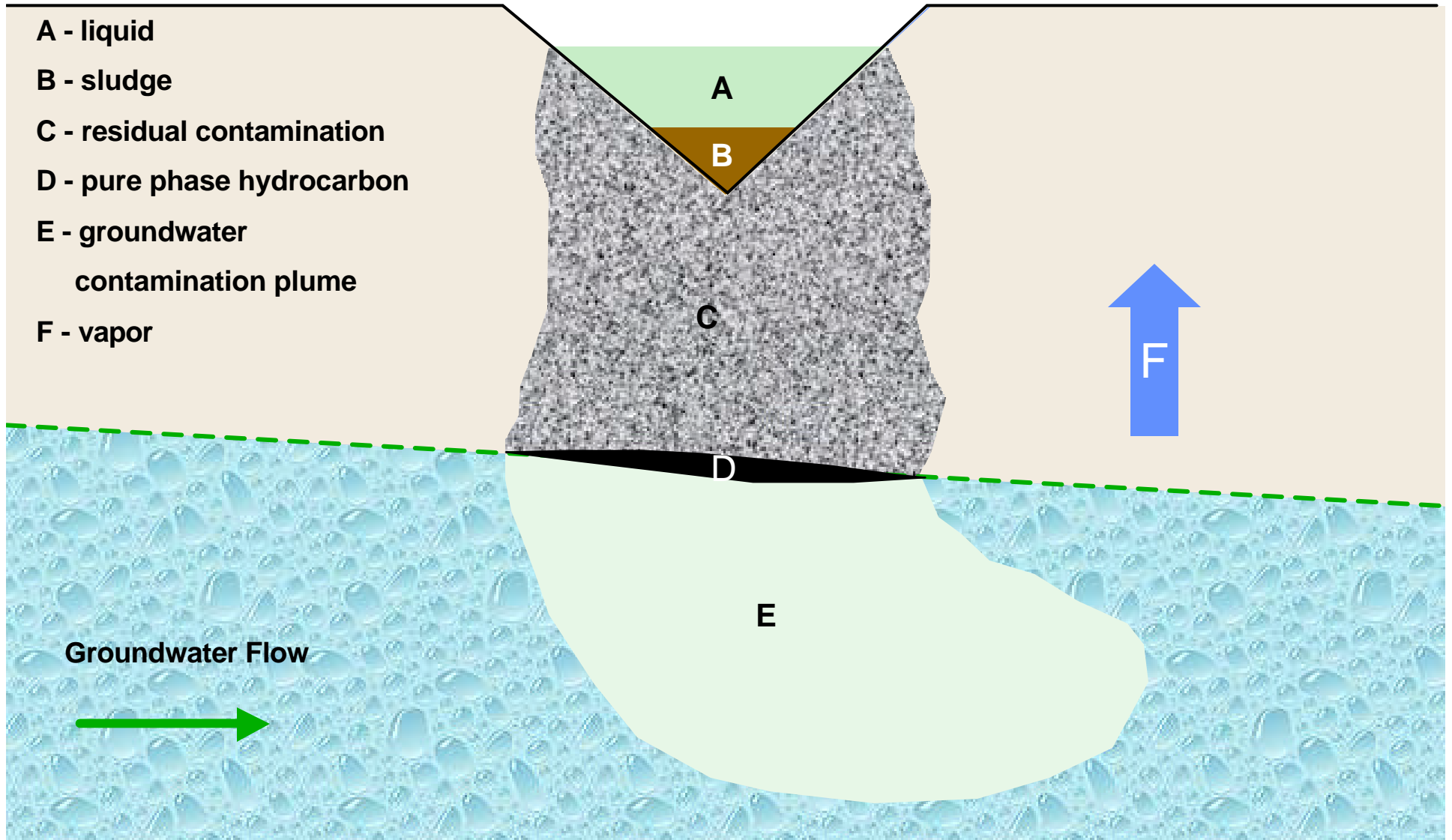
Environmental Sciences Division



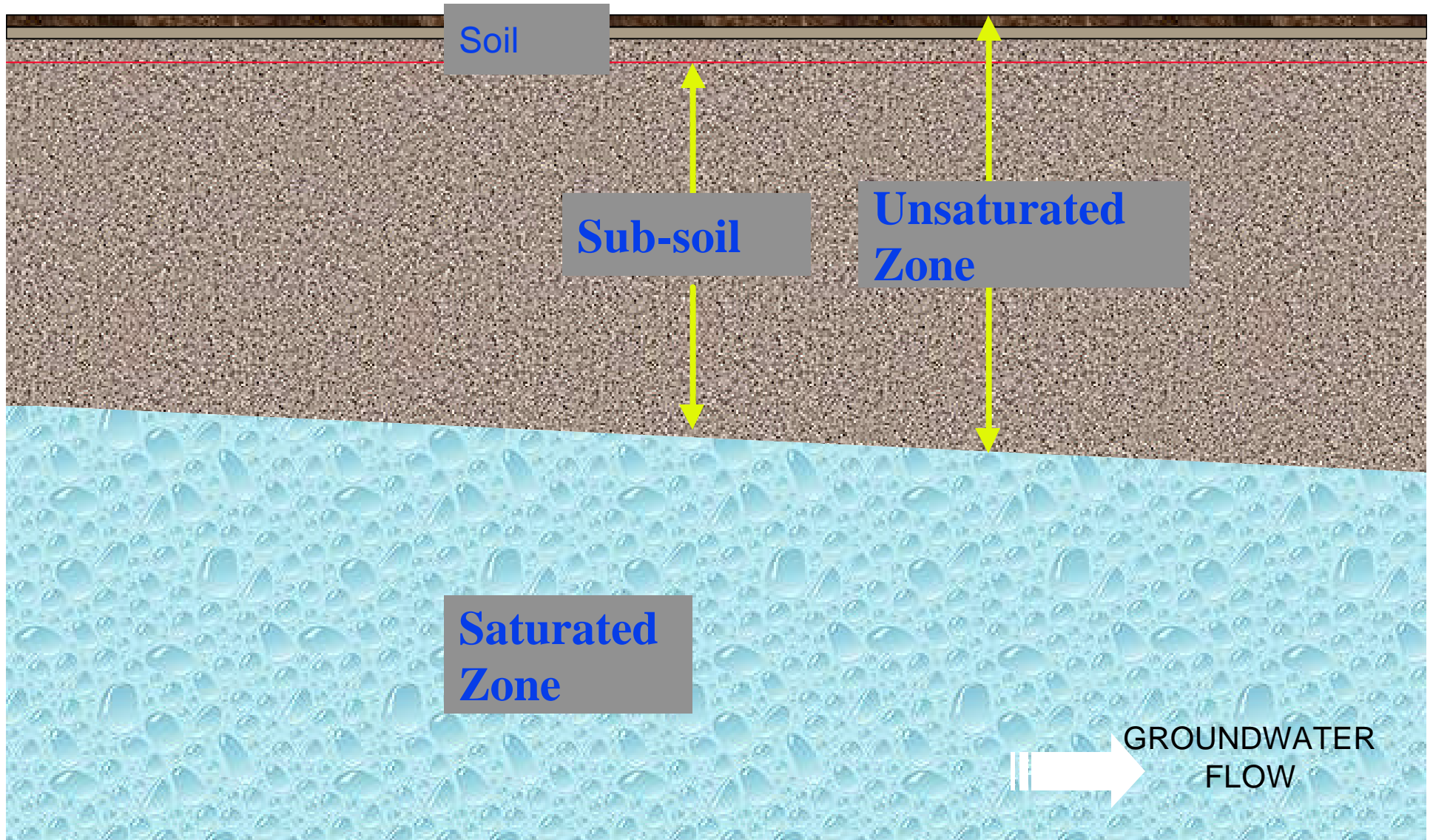
Contaminants at Upstream Facilities



Contamination at Upstream Sites



Components of the Geo-Environment



Geo-Environmental Quality:

The ability or suitability of land (soil, subsoil, groundwater) to support various uses

Regulatory Overview

EUB Information Letter 98-02

EUB responsibility

- ◆ exploration and operations phases
- ◆ includes waste management, ex-situ treatment, well abandonment

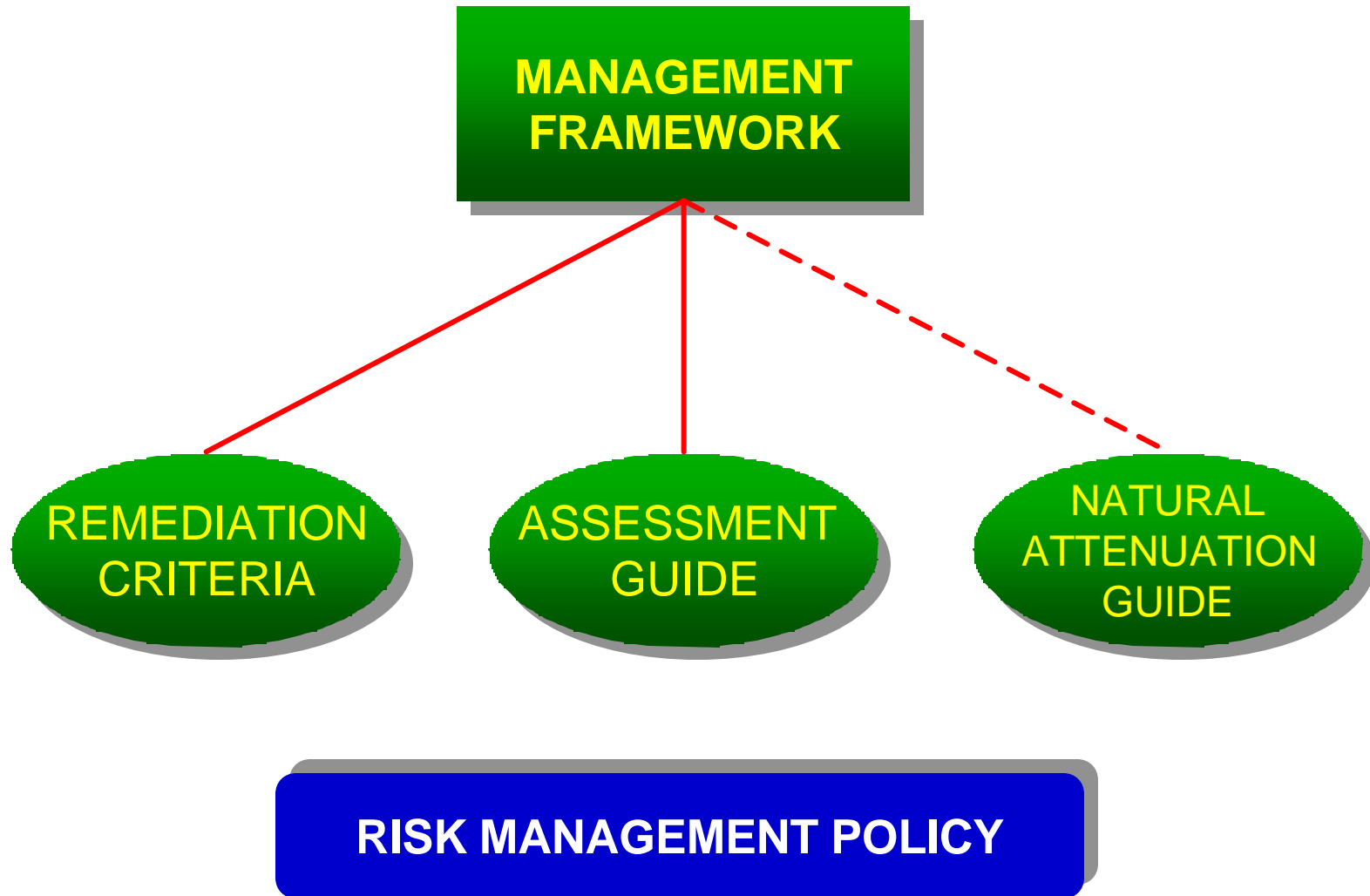
AENV responsibility

- ◆ remediation (contamination) and surface land reclamation
- ◆ standards for both
- ◆ in-situ contaminant management
- ◆ reclamation certificates

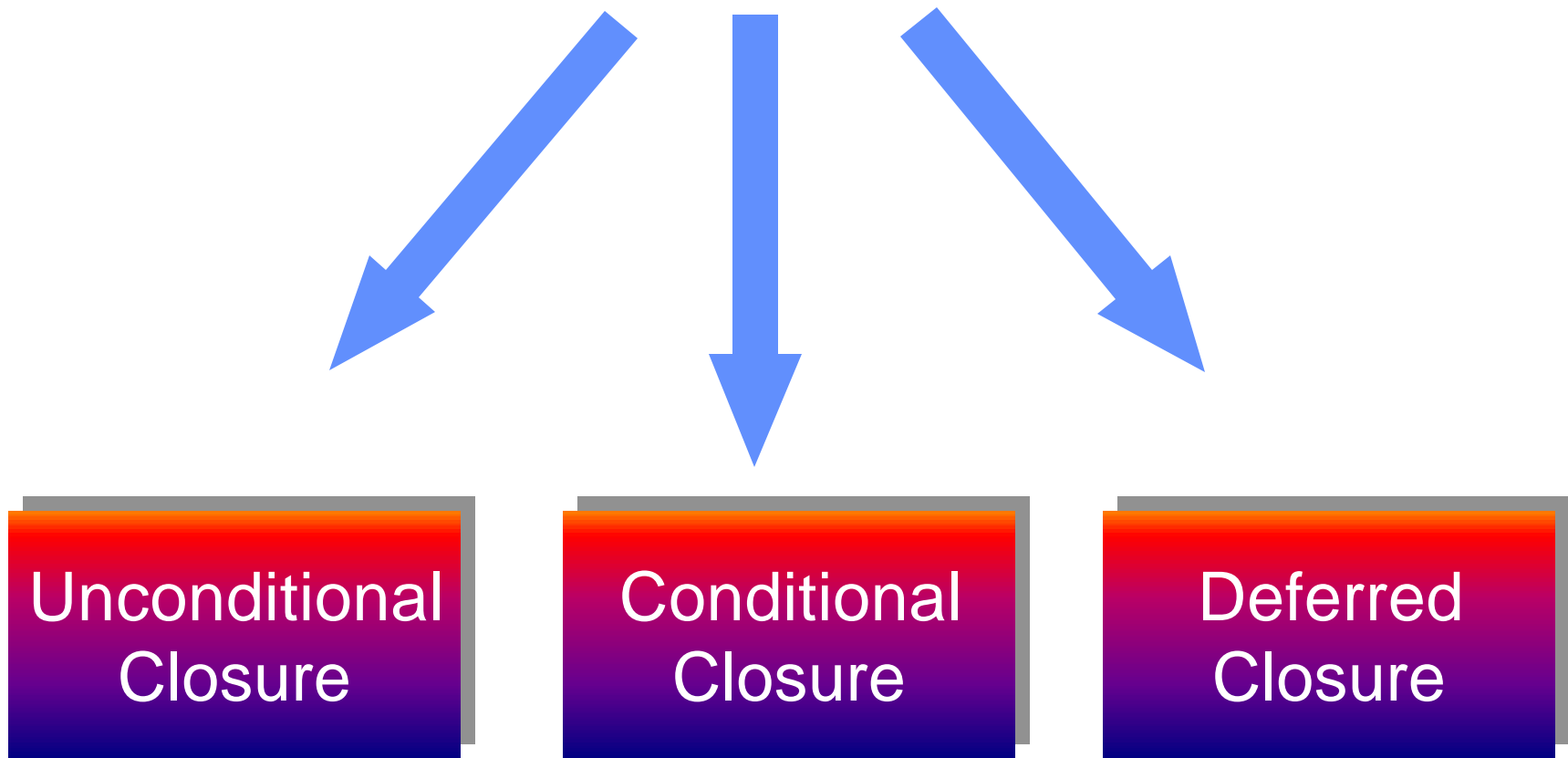
Relationship Between Reclamation and Remediation

- ◆ **Uncertain due to lack of science-based criteria for assessment**
- ◆ **To clarify, the following tools developed as part of a framework:**
 - ◆ Phase I ESA
 - ◆ Salt Management Guide
 - ◆ CWS PHC

Proposed Management Framework



Management Framework Options



- objective is protection of human health and environment

Contaminants of Concern

◆ Toxic Natural Products

- ◆ benzene, toluene, ethylbenzene, xylenes (“BTEX”), petroleum hydrocarbons (PHC), polycyclic aromatic hydrocarbons (PAH)

◆ “Heavy” Metals (rare at upstream sites)

- ◆ Cu, Cd, Cr, Hg, Pb etc.

◆ Other Inorganics

- ◆ sulfur, salts

Contaminant Assessment: 2 approaches

1. Guidelines approach

- ◆ contaminant concentrations compared to tabular numerical values**
- ◆ aka: “criteria”, “generic approach”, “remediation objectives”, “Tier 1/ Tier 2”**

2. Site-specific risk assessment

- ◆ assessment based specifically on properties of site, receptors, pathways, contaminants**
- ◆ aka “Tier 3”**
- ◆ rigour meets or exceeds Tier 1, 2**

Likelihood of Adverse Effects



Guidelines as Benchmarks

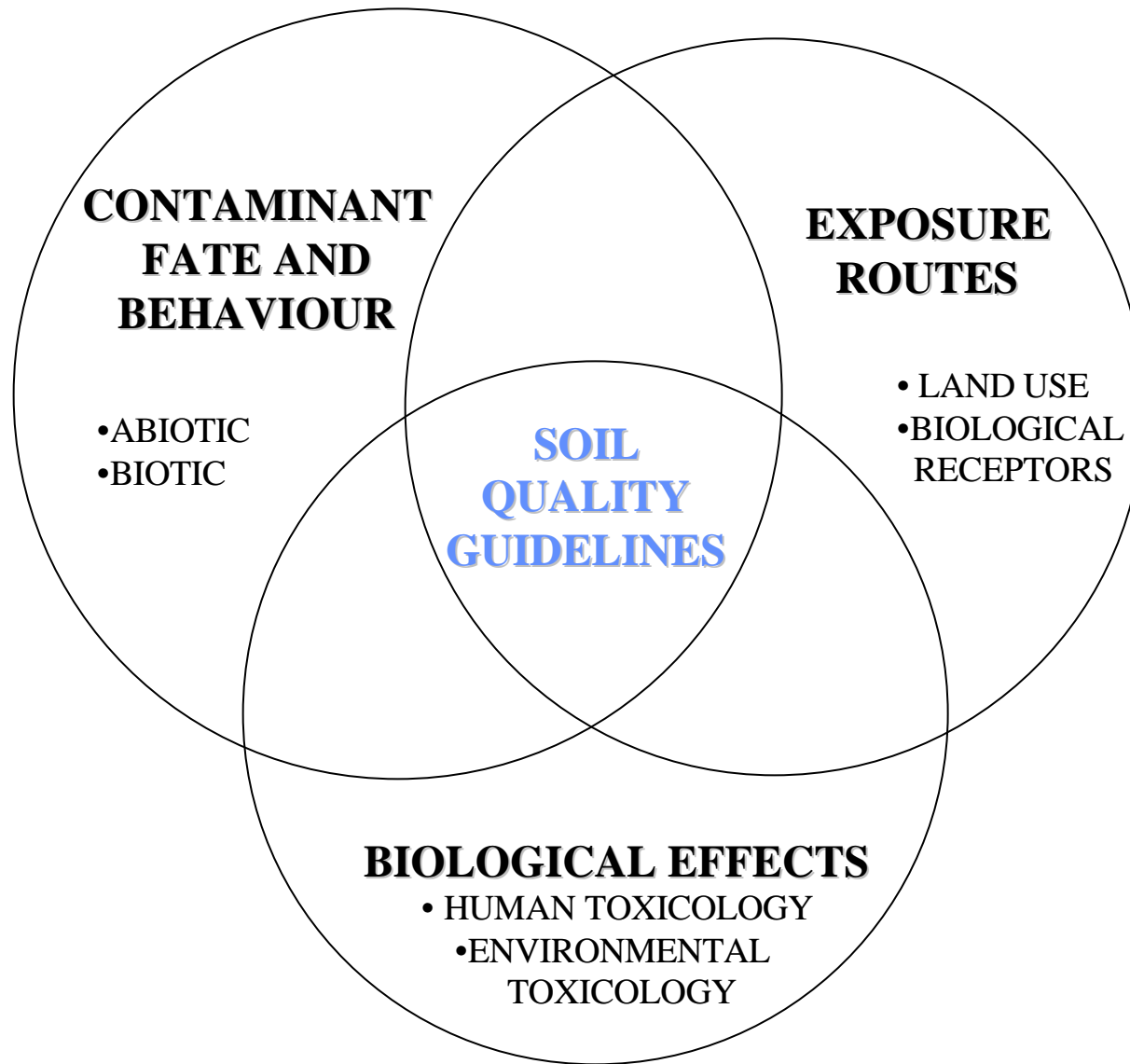
*Occurrence of Adverse Effects
Dependent on Site-Specific Factors*

Environmental Quality Guidelines

No Adverse Effects Predicted

CCME = Canadian Council of Ministers of the Environment

- ◆ Intergovernmental council
- ◆ 14 ministers of environment
- ◆ Forum for joint discussion and action
- ◆ Issues of intergovernmental nature and national significance
- ◆ Consensus-based decision making
- ◆ Equal membership, Chair rotates
- ◆ Collective workplans
- ◆ historically, voluntary implementation of products



Domains of information considered in guideline development

Canadian Environmental Quality Guidelines (CCME 1999)

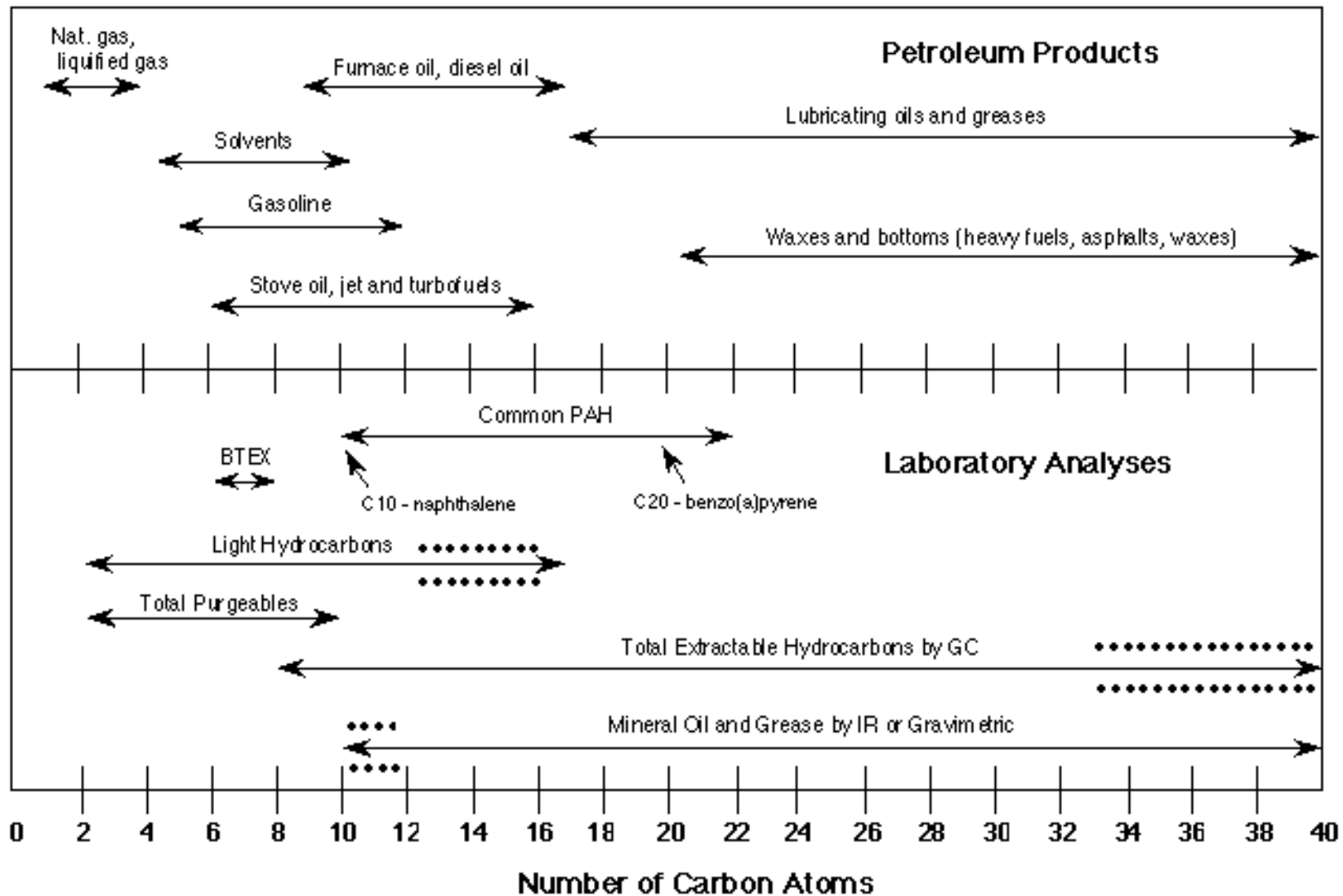
- ◆ A compilation of existing Canadian environmental quality criteria for various media:
 - ◆ air quality
 - ◆ water quality for drinking water supplies, recreational use, freshwater life and agricultural use
 - ◆ sediment quality
 - ◆ soil quality based on 1996 protocol (agricultural, residential/parkland, commercial and industrial uses)
 - ◆ includes listing of older CCME (1991) Interim Criteria
 - ◆ **does not include petroleum hydrocarbons (PHC)**

PETROLEUM HYDROCARBONS

Laboratory Analysis Methods

High Mobility

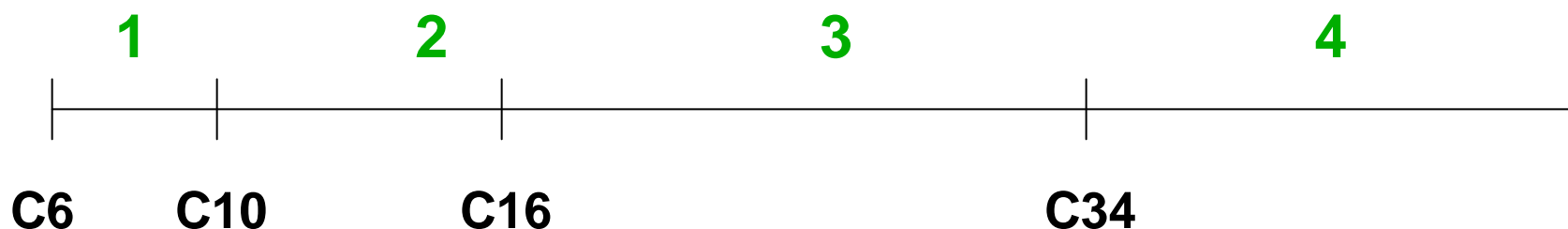
Low Mobility



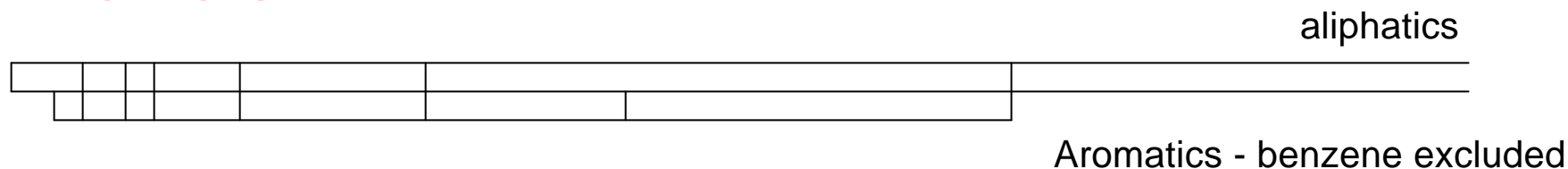
Note:  Test recoveries in these ranges are inefficient

Grouping US TPH Criteria Working Group Sub-fractions

CCME "Fractions":

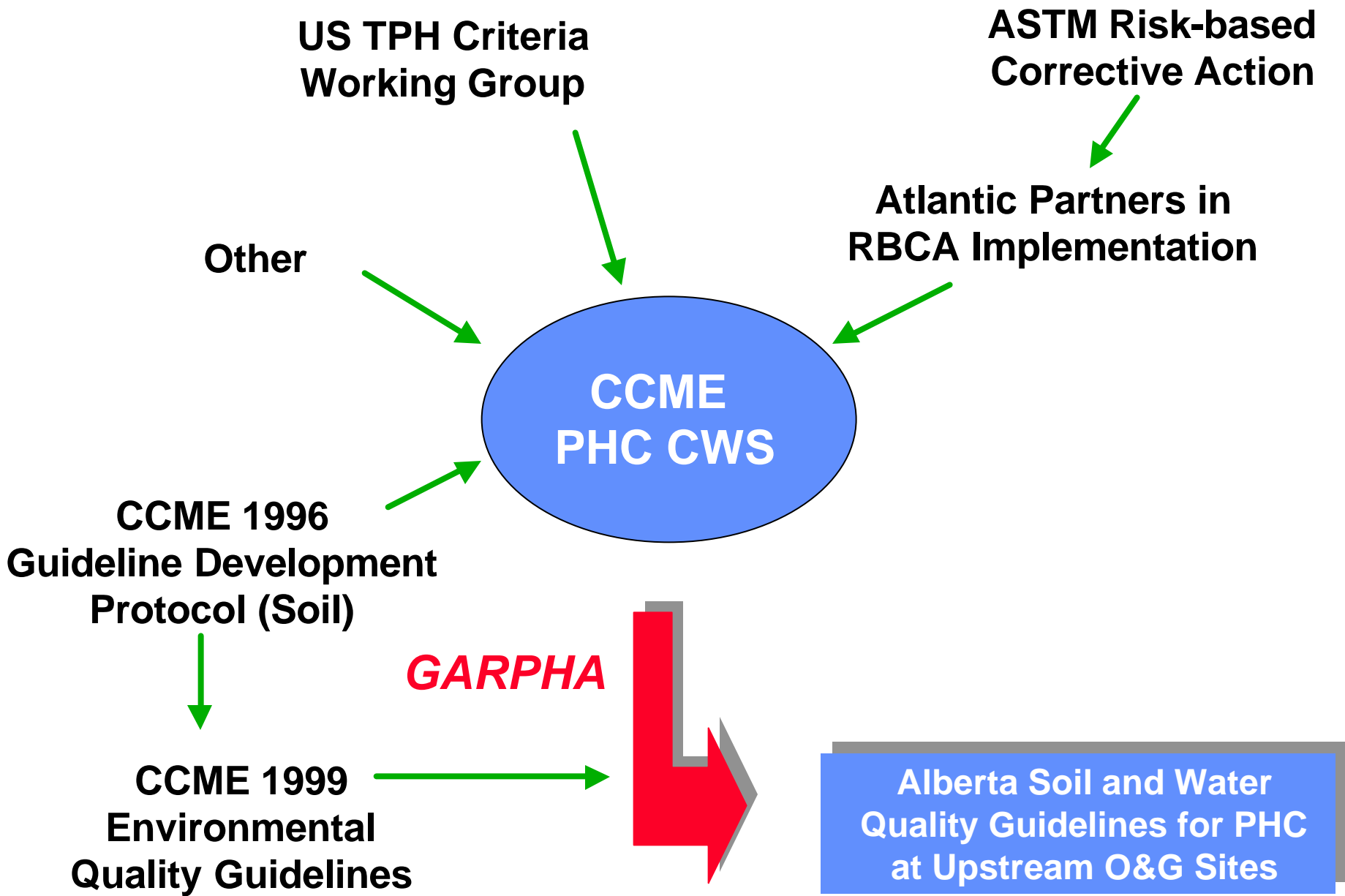


TPHCWG Sub-fractions:



Canada-Wide Standard on Petroleum Hydrocarbons in Soil - Summary

- **Three tiers with consistent protection at all tiers**
- **Different numerical Tier 1 levels for different land uses and petroleum hydrocarbon types**
- **Four fractions - C6-C10, >C10-C16, >C16-C34, C35+**
- **Soil, subsoil; coarse and fine textures**
- **BTEX “backed out” -- managed as a separate (but related) environmental issue**
- **Specific implementation measures up to each jurisdiction but must report to public and Ministers on actions and results**





Sources of Salt Contamination

- ◆ Road salt storage yards
 - ◆ NaCl, CaCl, KCl
 - ◆ **Produced water spills**
 - ◆ NaCl
 - ◆ Animal slaughter operations
 - ◆ NaCl
 - ◆ Pulp mills
 - ◆ NaSO₄
-



Environmental Effects

◆ Plant growth

- ◆ inhibits water uptake
- ◆ chloride toxicity
- ◆ sodium toxicity

◆ Soil quality

- ◆ crusting
- ◆ inhibits water movement through soil
- ◆ trafficability, tilth

◆ Groundwater quality



Generic Soil Guidelines

- ◆ **Separate values for surface (A horizon) and subsurface (B,C horizons)**
 - ◆ **Classify control soils into suitability rating category**
 - ◆ **Choose remediation objective from within same suitability category**
 - ◆ **Sites zoned for industrial use may default to industrial guidelines**
-



Risk Assessment

- ◆ **Estimate the potential for adverse effects from site-specific information:**
 - ◆ extent and severity of contamination
 - ◆ potential for contamination to spread
 - ◆ receptors that may be affected
 - ◆ **Use risk characterization to plan:**
 - ◆ remediation program
 - ◆ remediation objectives
 - ◆ risk management solutions
-

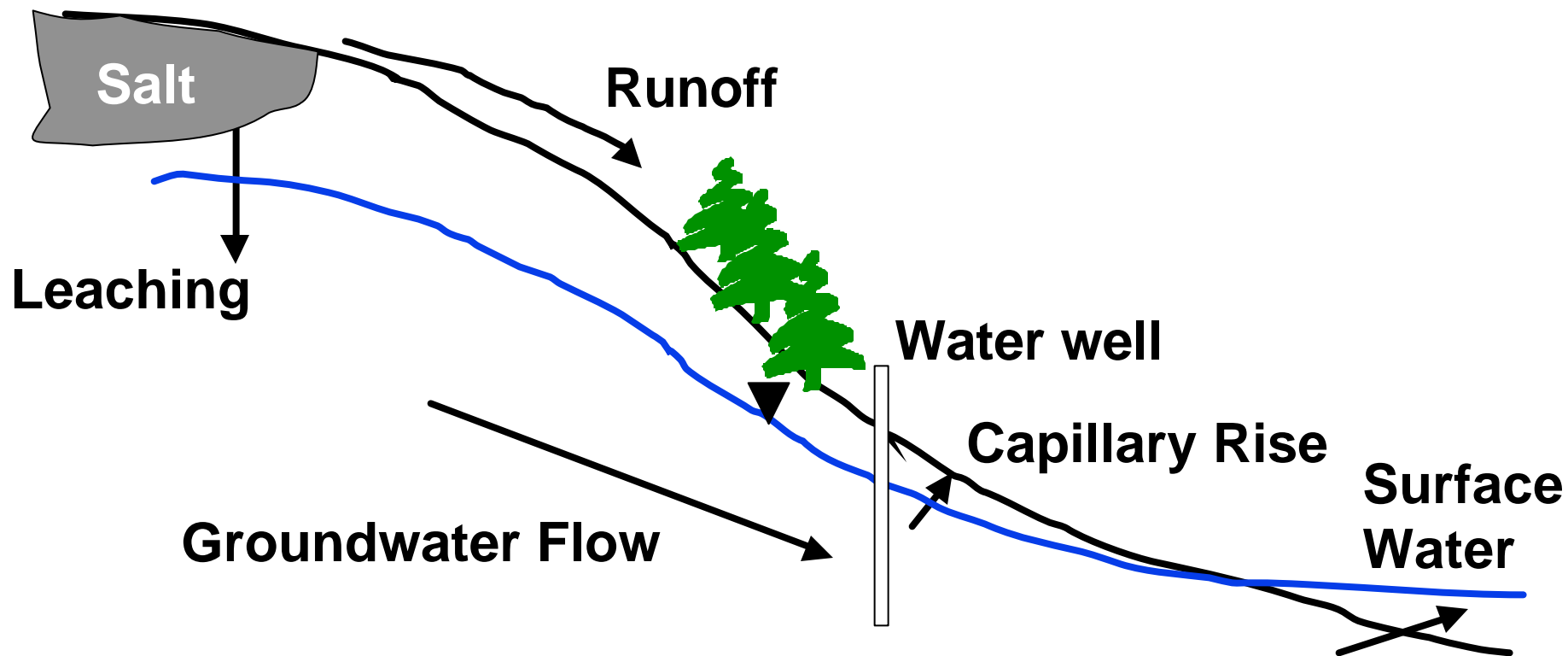


Risk Assessment

- ◆ **Risk assessment is appropriate when:**
 - ◆ generic guidelines do not account for site-specific exposure conditions
 - ◆ significant or sensitive receptors
 - ◆ **Risk assessment endpoints may support:**
 - ◆ equivalent land capability, or
 - ◆ risk management and land use restrictions
-



Pathways of Salt Movement





Remediation Options

- ◆ **Reduce salt concentrations**
 - ◆ **Provide calcium to replace sodium**
 - ◆ **Methods include:**
 - ◆ Excavation and disposal
 - ◆ In-situ flushing
 - ◆ Groundwater interception and disposal
 - ◆ Excavation and washing
-



Conclusions

- ◆ **Guidelines provide:**
 - ◆ options for developing remediation objectives
 - generic guidelines
 - site-specific risk based objectives
 - risk management programs
 - ◆ site assessment guidance
 - ◆ potential remediation techniques
 - ◆ scientific background
-



Why Conduct a Phase 1 ESA?

- ◆ **A Phase 1 Environmental Site Assessment (ESA):**
 - ◆ Provides information on what was on the site prior to abandonment
 - ◆ Indicates location of potential contamination and adverse effects
 - ◆ Offers increased confidence for reclamation certification
-



Types of Sites

- ◆ **A Phase 1 ESA will be required for all upstream oil and gas sites:**
 - ◆ Wellsite
 - ◆ Pipeline
 - ◆ Battery
 - ◆ Oil production site
-



Information Required

- ◆ **Information is obtained from:**
 - ◆ A desktop review
 - ◆ Interviews
 - ◆ A site visit
 - ◆ **No physical sampling of soils**
-



Forms

- ◆ **Results of Phase 1 ESA to be completed on the form found in Appendix 3 of the document, *Phase 1 Environmental Site Assessment Guideline for Upstream Oil and Gas Sites*.**
 - ◆ ***Wellsite Reclamation Application Form Revised 2001* includes a Phase 1 ESA question.**
-



Phase 2 ESA

- ◆ **If contamination is suspected at a site, a Phase 2 ESA may be required to determine if contamination is present.**
 - ◆ **Currently, Alberta Environment does not require the results of any Phase 2 ESAs or the remediation work that flows from the Phase 2 ESA to be submitted.**
-



Phase 1 ESA Audit

- ◆ **Approximately 10% of WRCAs received in Edmonton will be randomly audited for the Phase 1 ESA.**
 - ◆ **Operators will have 30 calendar days to provide Phase 1 ESA to Alberta Environment.**
-



Phase 1 ESA Audit Results

- ◆ **Audit results will be tracked on Alberta Environment's database.**
 - ◆ **Sites that fail the Phase 1 ESA audit must supply an acceptable Phase 1 ESA when the operator re-applies for a reclamation certificate.**
-



Conclusions

- ◆ **If the Phase 1 ESA or requested information is not provided, the Director can refuse to accept WRCA or if inquiry has been held, Reclamation Inspector can refuse to issue a Reclamation Certificate.**
-