# RISK ASSESSMENT AND ABANDONMENT STRATEGY Petroleum Production Field

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Multi-year strategy developed for remediation and risk management of a production field in central Alberta.

Strategy prepared to steer and direct ongoing

- environmental management
- site closure planning

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Objectives

- to divide the field into manageable units
- to ensure all sites were assessed and managed
- to reduce the net treatment costs

# Approach

- Qualitative risk analysis used to prioritise sites
  - Source removal
  - Manage residual contaminants in place
    - characterisation of potential risks
    - contingency planning
    - groundwater, soil and biophysical monitoring

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# FIELD DESCRIPTION

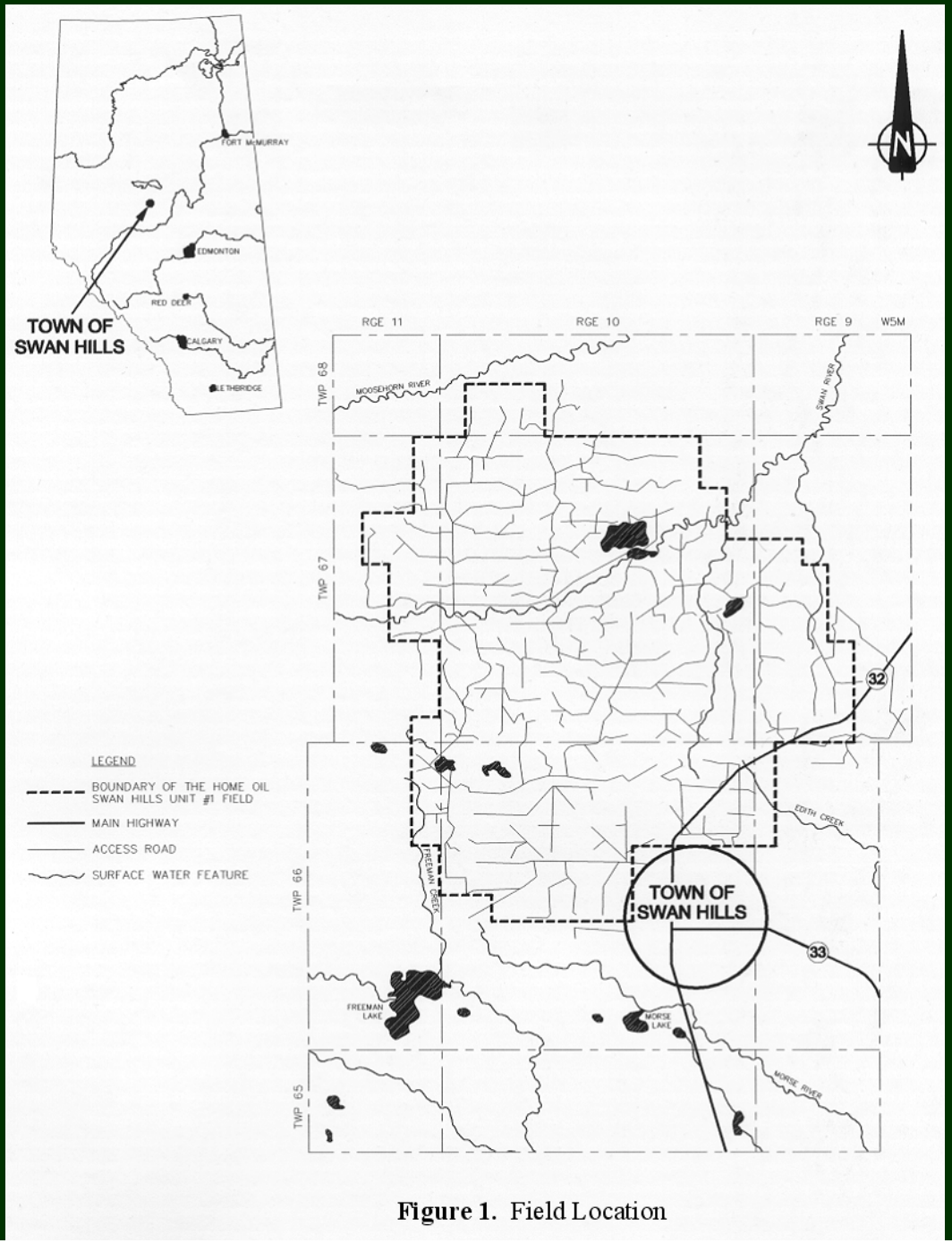


**Figure 1.** Field Location

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# FIELD DESCRIPTION

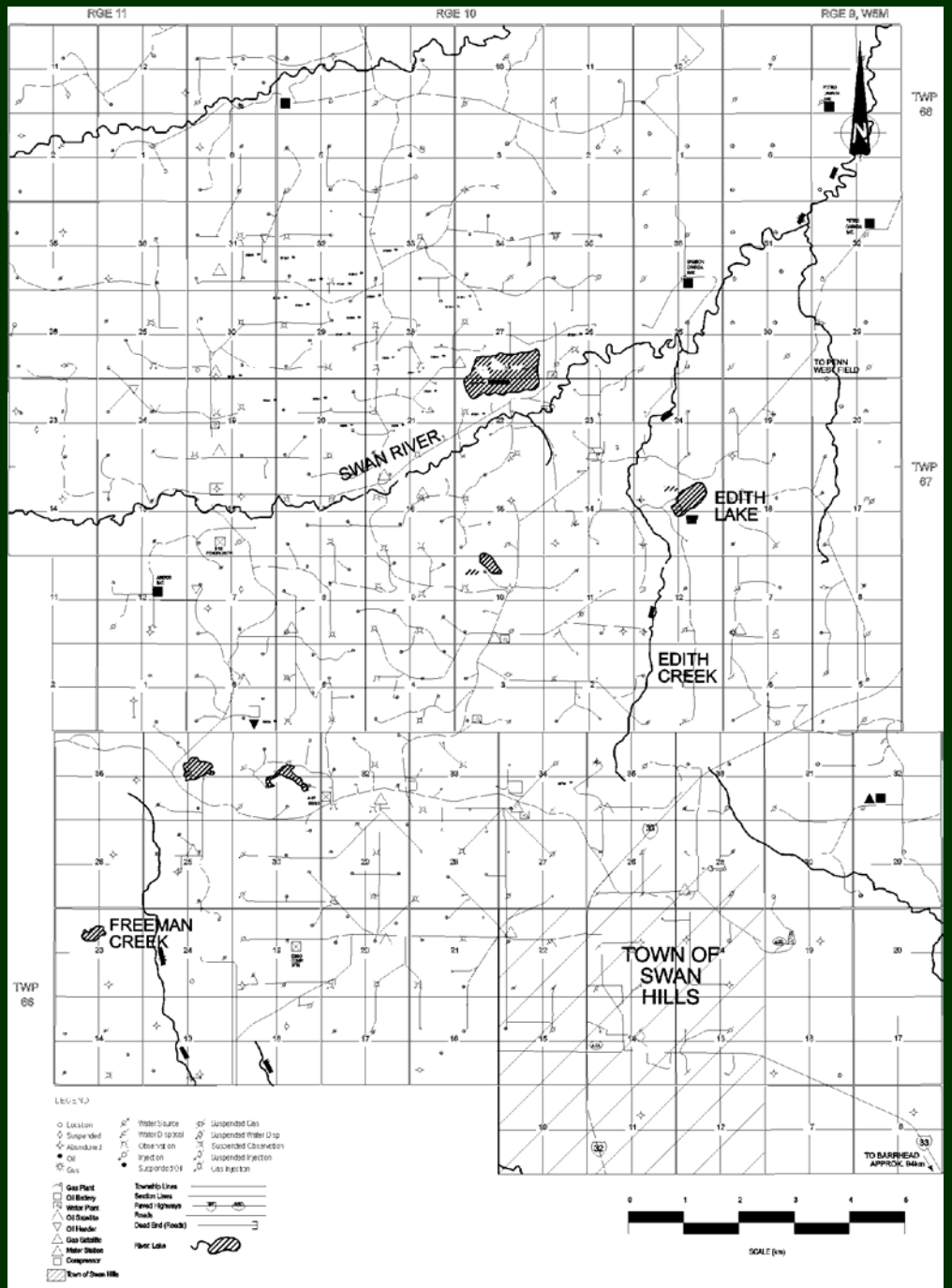


**Figure 2.** Field Map

## Terrain

- rolling to dissected

## Surficial Geology

- glacial till, silty clay
- alluvial sands and gravels

## Bedrock Geology

- feldspathic sandstone, bentonitic mudstone and coal

## Surface Water

- numerous ponds and marshes
- two small lakes
- Swan River and Edith Creek

## Habitat

- deer, moose and black bear
- numerous burrowing animals
- sport fish

# Type of Facilities and Production History

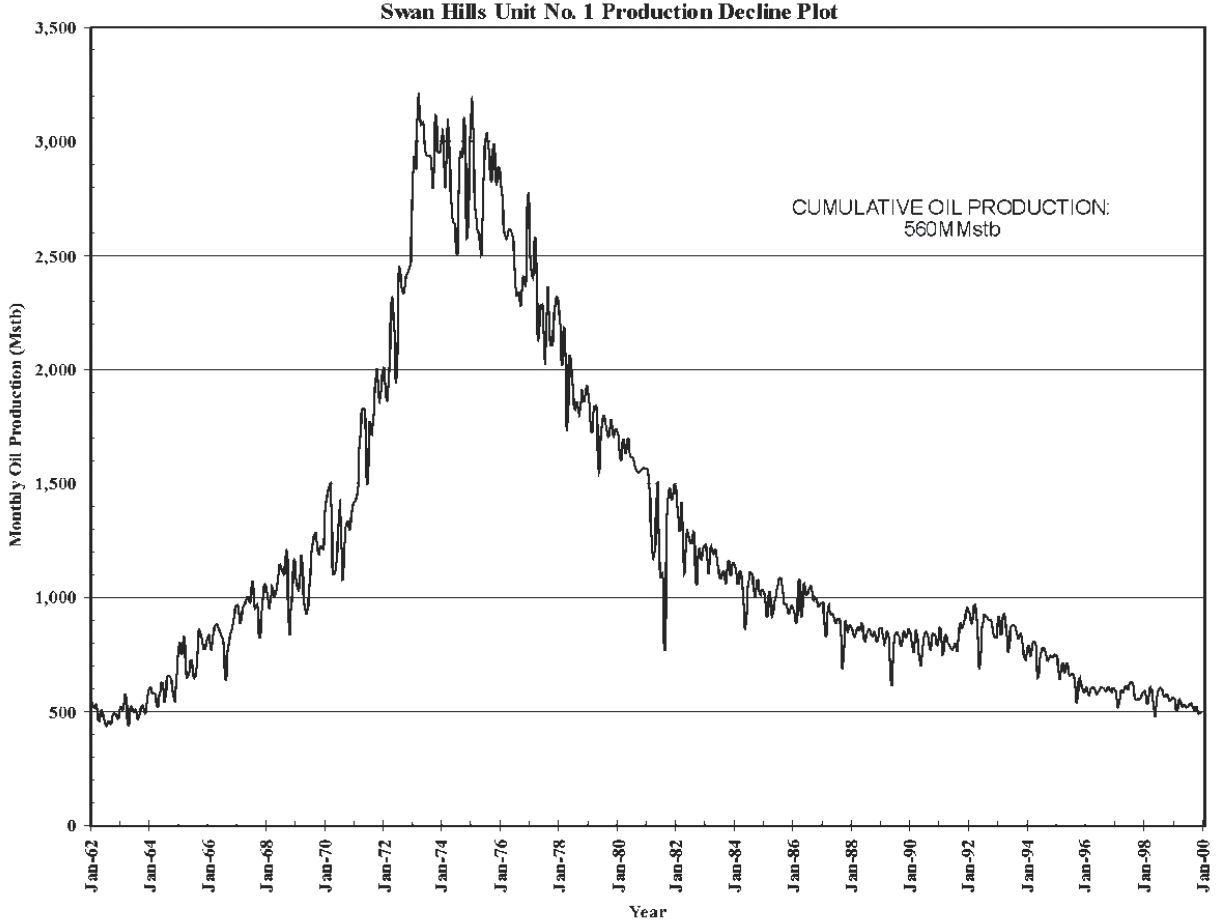


Figure 3. Production History

FIELD DESCRIPTION

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# Production facilities consist of:

- individual well sites
- batteries
- satellites
- water flood plants
- miscible flood plants

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# Potential Environmental Liabilities

Sources include:

- oily wastes and produced water in flare pits
- leakage from ASTs and USTs
- pipeline breaks

Total of 440 facilities in the field

210 considered to need some form of Environmental Management

PRIORITISATION SCHEME

- Due diligence
- Concerns of public, regulatory authorities, Senior Management
- Qualitative risk assessment
  - environmental sensitivity mapping
  - age
  - number of sources at individual facilities
- Annual priority

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## Environmental Sensitivity Mapping

- terrain type
- ecological land classification
- wildlife utilisation

## GIS System

# PRIORITISATION SCHEME

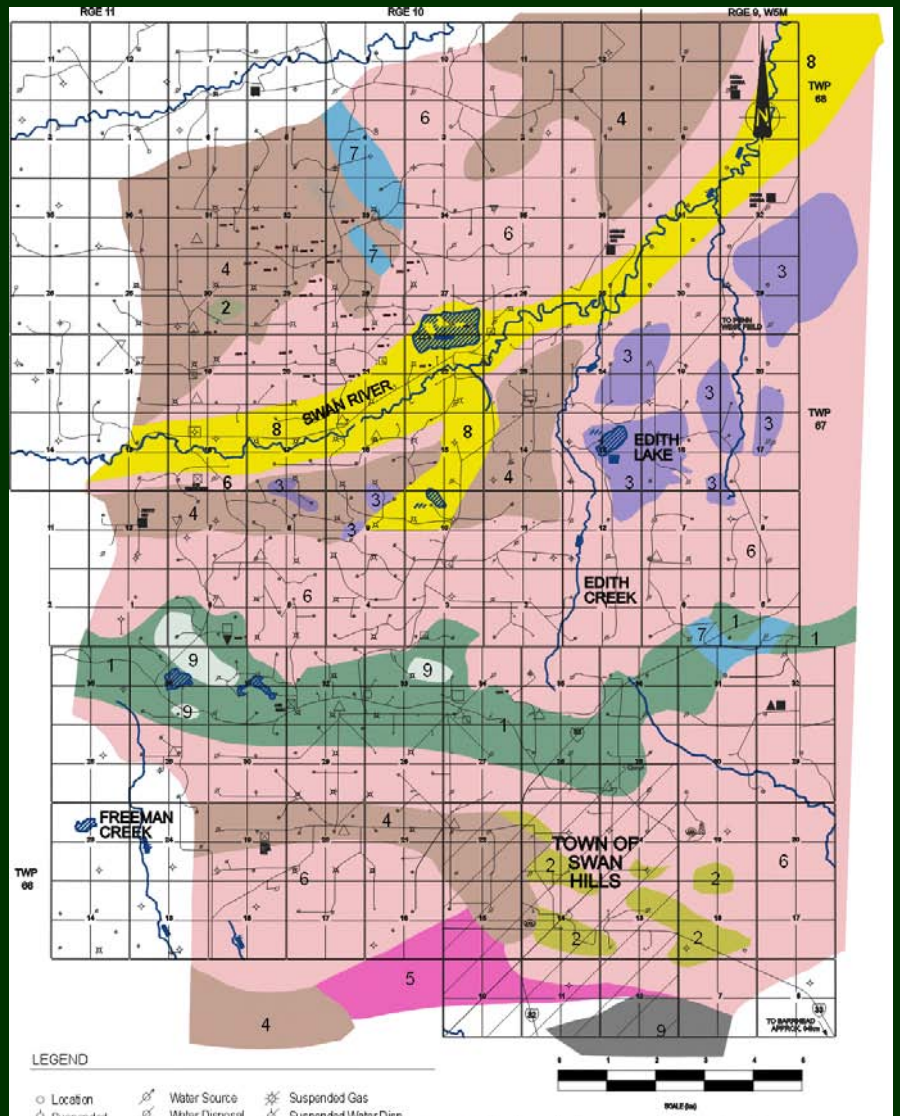


Figure 3. Surficial Geology

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# PRIORITISATION SCHEME

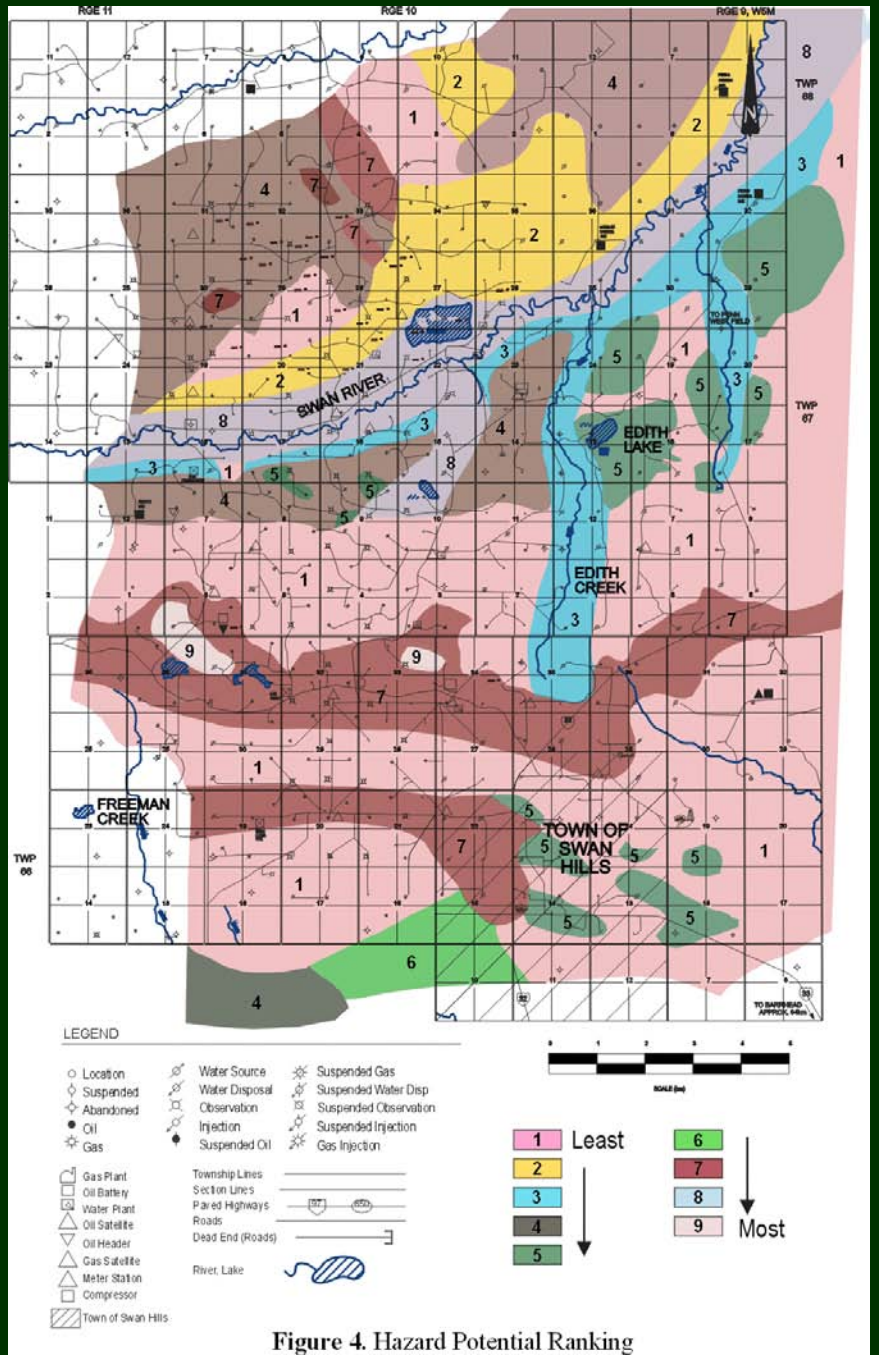


**Figure 4.** Hazard Potential Ranking

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# Site Database Attributes

## Age:

| Year | Weight |
|---|---|
| <10 | 0 |
| 10 to 20 | 5 |
| 20 to 30 | 10 |
| >30 | 15 |

## Number of Potential Sources:

| | |
|---|---|
| 0 | 0 |
| 1 | 5 |
| 2 | 10 |
| >2 | 15 |

PRIORITISATION SCHEME

**Table 2.** Priority Ranking Weighting Factors

| Activity | Factor | Total Weight | | Weighting |
|---|---|---|---|---|
| Site Assessment (100) | Progress of Site Assessment to Date | 100 | Stage 1 - Site Recommission | 10 |
| | | | Stage 2 - Subsurface Investigation | 25 |
| | | | Stage 3 - Assess Potential for Off-Site Impact | 40 |
| | | | Stage 4 - Reporting | 15 |
| Remedial Action (50) | Nature and Extent of Contamination | 10 | residual in soil > Tier I | 0 |
| | | | free product | 5 |
| | | | dissolved in groundwater | 10 |
| | Contaminant Velocity | 10 | immobile | 0 |
| | | | < 1 m/year | 5 |
| | | | > 1 m/year | 10 |
| | Distance to Sensitive Area/Water Course offsite | 10 | >100 | 0 |
| | | | 100 to 20 m | 5 |
| | | | 20 m to 0 | 10 |
| | Status of Remedial Action | 10 | landfill disposal | 0 |
| | | | on-site treatment | 5 |
| | | | barrier or containment walls | 10 |
| | Remediation Planning | 10 | proven technology | 0 |
| | | | pilot scale testing needed | 5 |
| | | | field trial needed | 10 |
| Monitoring (40) | RMP Prepared | 10 | prepared | 0 |
| | | | in preparation | 10 |
| | Monitoring Progress | 10 | > 5 years | 0 |
| | | | < 5 years | 5 |
| | | | initial | 10 |
| | Statistical Trends | 10 | decreasing | 0 |
| | | | no tread | 5 |
| | | | increasing | 10 |
| | Evidence of Natural Attenuation | 10 | $O_2$, $NO_3$, $NO_2$ consumption | 0 |
| | | | Fe and Mn concentration | 5 |
| | | | $SO_4$ - S | 10 |

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QUANTITATIVE
RISK ASSESSMENT

Used to assess management requirements of residuals

- after source removal
- monitoring
- active remedial action

Three tiered process for “safe” levels

- Tier 1 - where practical
- Tier 2 - background
- Tier 3 - risk based clean-up criteria

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# Three Staged Process

- Problem Formulation
- Risk Characterisation
- Monitoring for Natural Attenuation

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Problem Formulation

- potentially large number of sites
- stream line costs
- document thinking process

Linkages between three levels

- receptors
- C of C
- pathways

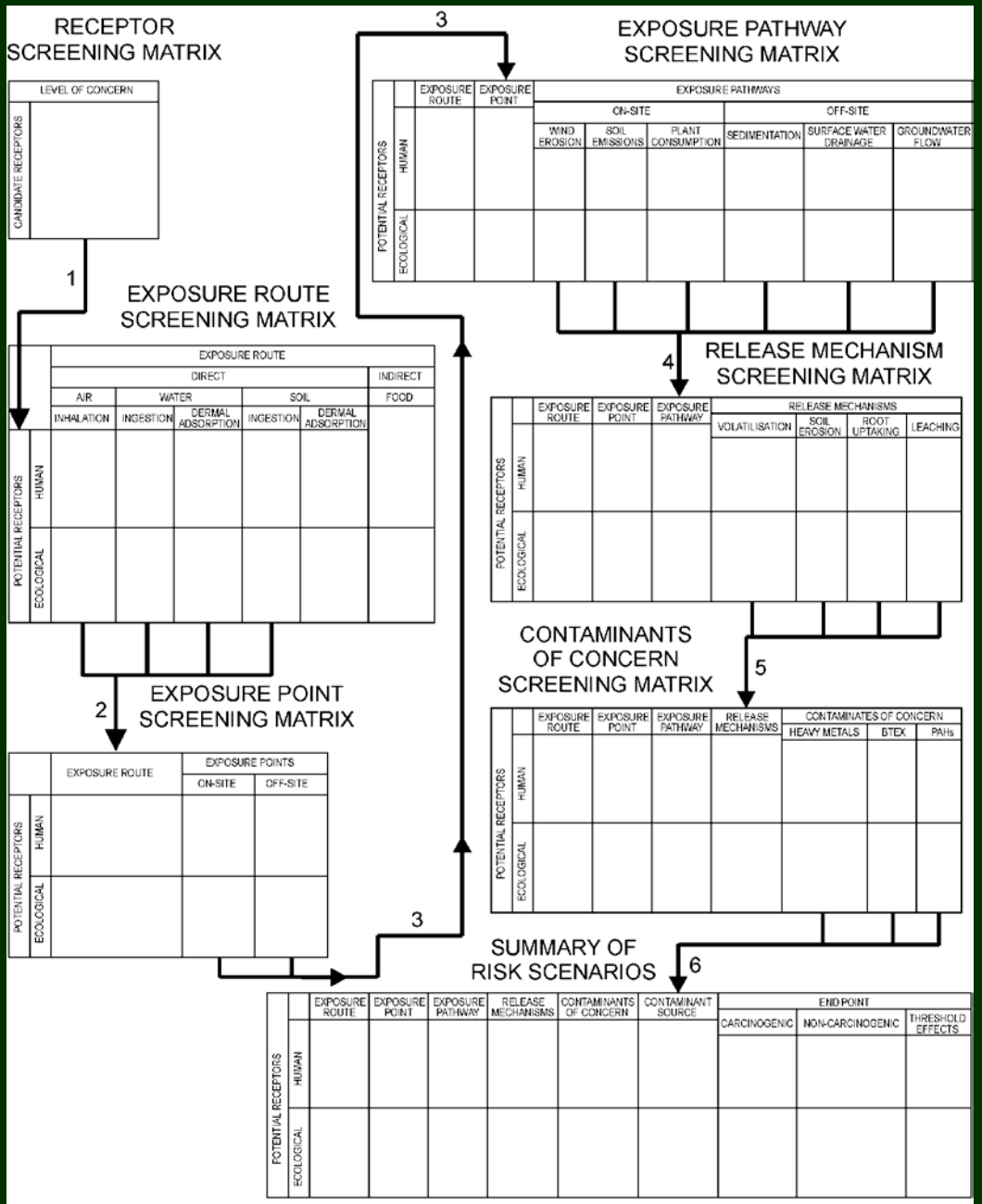


**Figure 5.** Step Matrix Screening Model for Problem Formulation

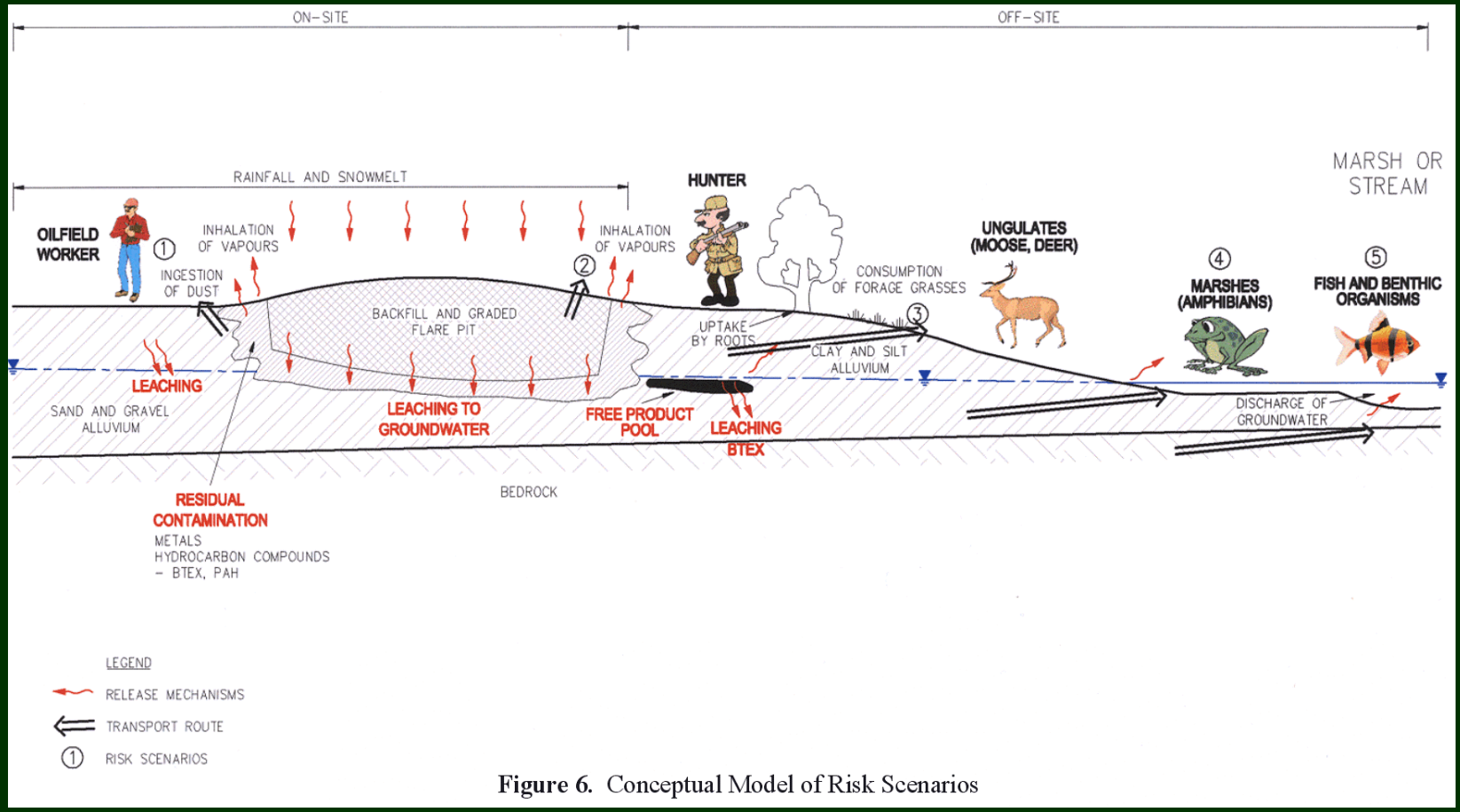


**Figure 6.** Conceptual Model of Risk Scenarios

# Risk Assessment

## Pathways into three sections

- release mechanism
- loading mechanism
- pathway modelling

## Monitoring of Natural Attenuation

- primary indicator
- secondary indicator
- tertiary indicators
  - monitoring trigger points

## Contingency Plans

# Looking Forward

1. Revised Monitoring Plans

2. Characterisation of Habitats

# END

Thank you