Sustainable management of contaminated sites

Presentation 3.1
Phase 3 - Remediation Assessment

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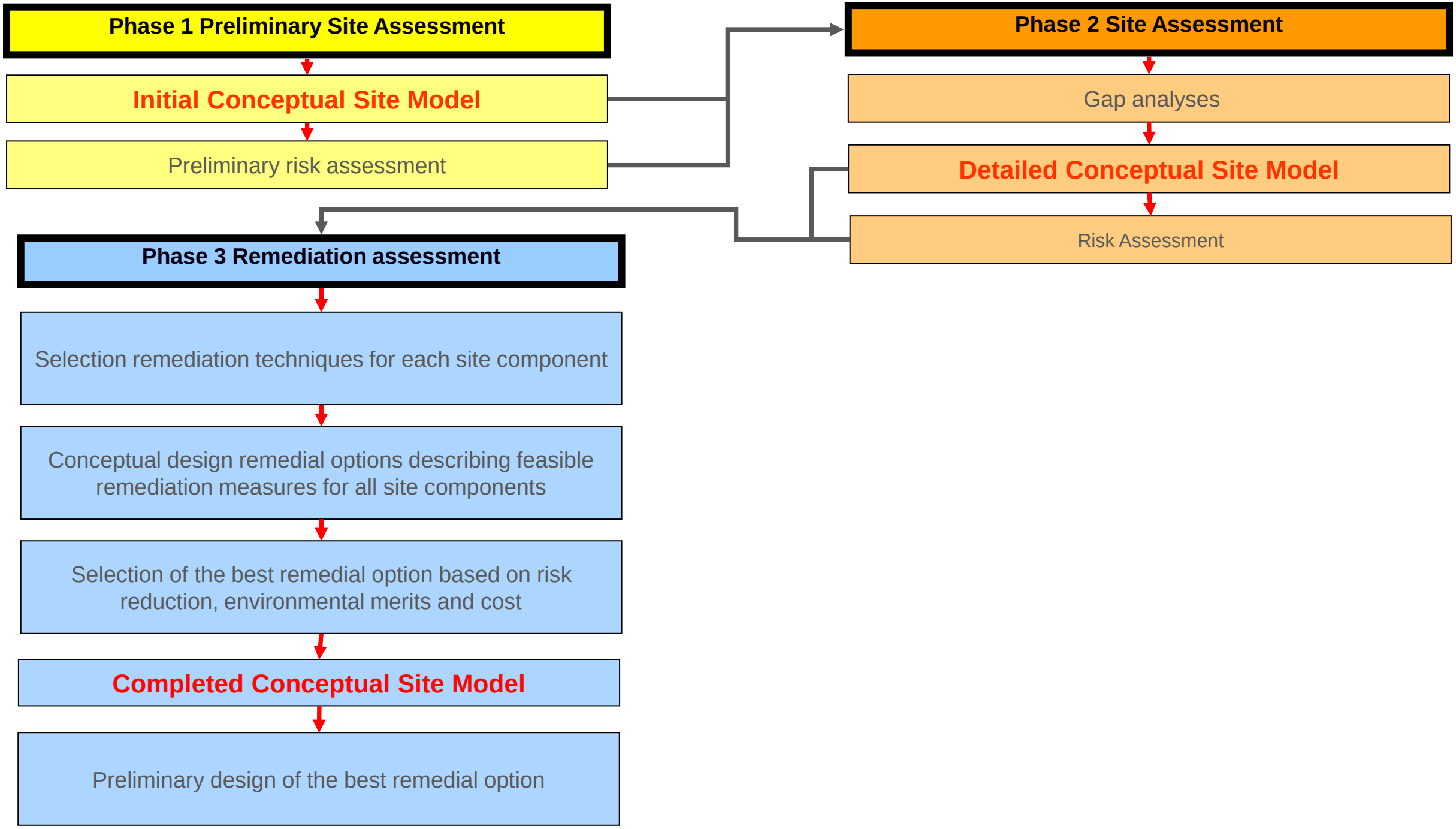
Content

- Introduction
- Remediation Assessment objectives
- Remediation Assessment tasks
- Remediation design steps
- Selection process
- Preliminary Design
- Implement project risk management
- Implement stakeholder involvement
- Remediation Assessment reporting
- Remediation Assessment Process


Phase 1 Preliminary Site Assessment
Initial Conceptual Site Model
Preliminary risk assessment
Phase 2 Site Assessment
Gap analyses
Detailed Conceptual Site Model
Risk Assessment
Phase 3 Remediation assessment
Selection remediation techniques for each site component
Conceptual design remedial options describing feasible remediation measures for all site components
Selection of the best remedial option based on risk reduction, environmental merits and cost
Completed Conceptual Site Model
Preliminary design of the best remedial option

The site components of contaminated site

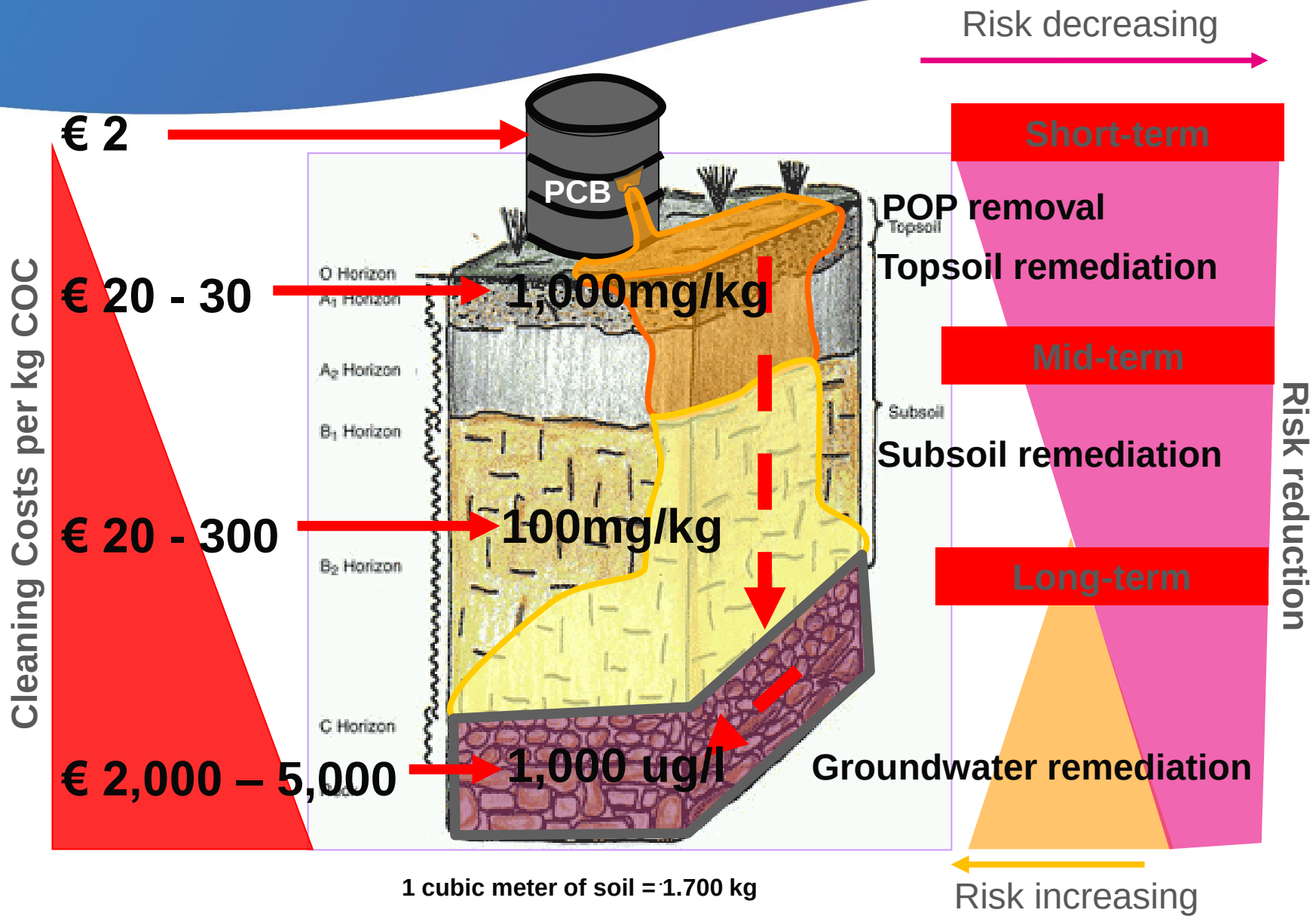
Stock of hazardous waste

Bunker or building with hazardous waste

Buried or pit hazardous waste

Contaminated soil & groundwater

Why focus on hazardous waste/source removal?



1 cubic meter of soil = 1.700 kg

Remediation Assessment objectives

Selection technique	Select feasible remediation techniques
Conceptual Design	Sketch remedial options
Select Best Option	Select preferred remedial option using Multi-Criteria Decision Analysis (MCDA)
Preliminary Design	Preliminary design preferred remedial options
Project Risk Management	Implement proper project risk management
Design of Stakeholder Involvement	Involve stakeholders
Reporting	Summarize results in correct format

Remediation Assessment tasks

- Select risk reduction techniques for each site component
- Conceptual design at least three different site remediation options
  - ✓ One maximum risk reduction highest cost
  - ✓ One minimum risk reduction lowest costs
  - ✓ At least one Intermediate
- Select best option with a Multi Criteria Decision Analyses
  - ✓ The most risk reduction
  - ✓ With the best environmental merits
  - ✓ Not entailing excessive cost
- Preliminary design best option
- Estimate cost best option

Selection remediation techniques

Hazardous waste

- Repackaging and removing hazardous substances from contaminated site

Contaminated building

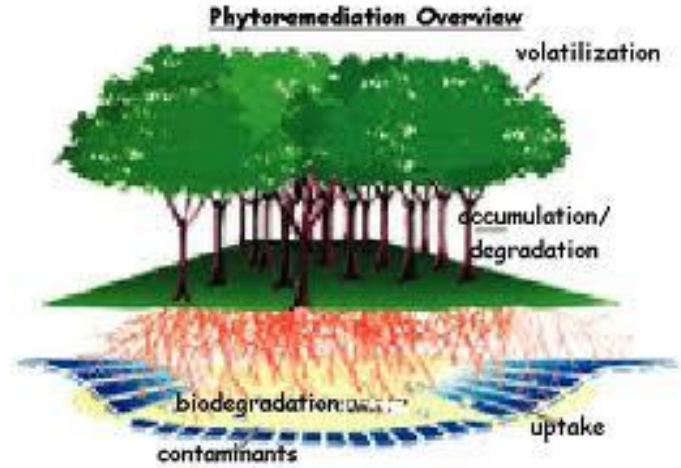
- Decontaminating/demolition buildings and infrastructures

Buried hazardous waste

- Removing buried hazardous waste

Soil and groundwater

- Remediating soil
  - ✓ Excavation and removal
  - ✓ Excavation and on-site treatment
  - ✓ In-situ remediation
- Remediating groundwater
  - ✓ Pump and treat
  - ✓ In-situ remediation



Remediation design steps

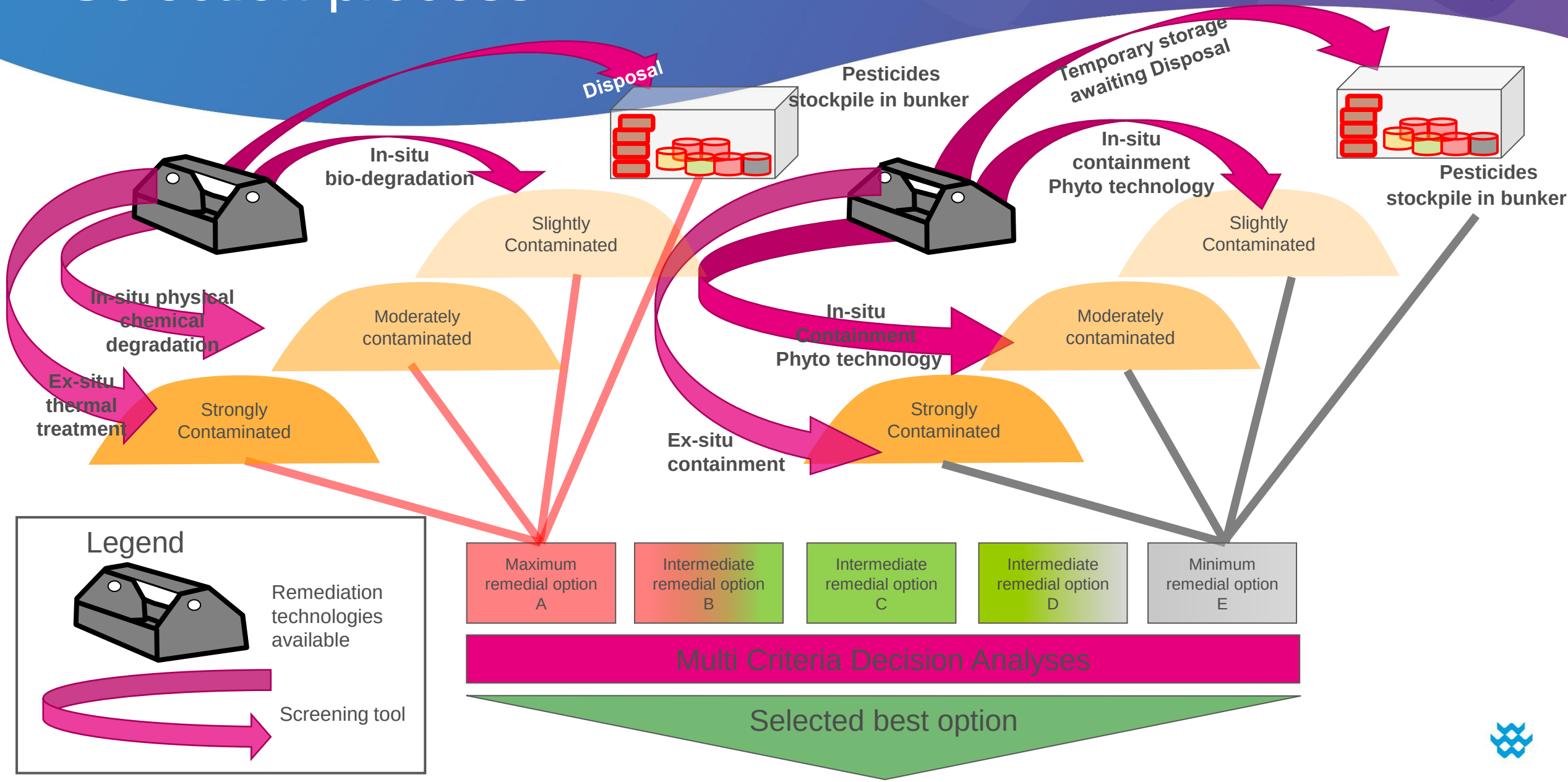
Phase 3

- Selection remediation techniques for each site component
- Conceptual design remedial options describing feasible remediation measures for all site components
- Selection of the best remedial option based on risk reduction, environmental merits and cost
- Preliminary design of the best remedial option

Phase 4

- Detailed design of the best remedial option

Selection process



Hazardous waste

Risk reduction / remediation techniques

Destruction

- Removal
- Repackaging
- Transport
- Interim storage
- Transport
- Destruction

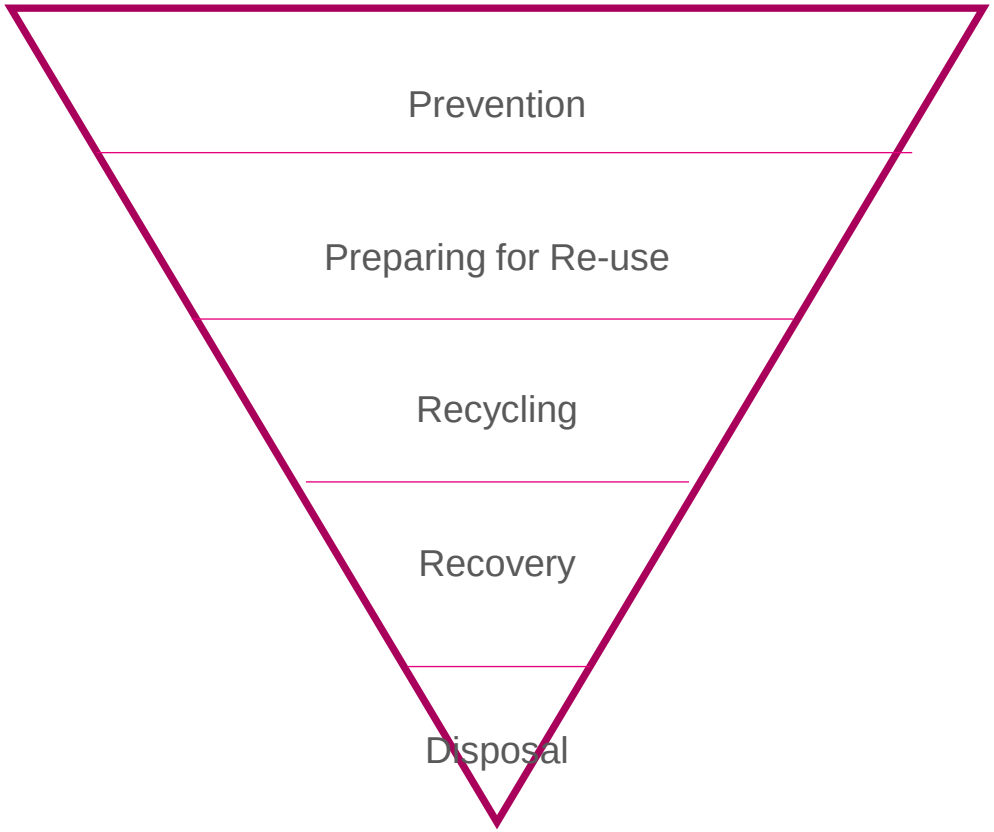
Containment

- Removal
- Repackaging
- Transport
- Final storage
  - ✓ Bunker
  - ✓ Sarcophagi
  - ✓ Storage
  - ✓ Controlled hazardous landfilling

Hazardous waste

Treatment or landfill

1. Treatment is compulsory when
   - ✓ Reusable product
   - ✓ Technically feasible
   - ✓ Cost efficient
2. Based on
   - ✓ Reuse standards
   - ✓ Validated treatment efficiencies
   - ✓ Measured degree of contamination
3. Landfilling of soil is taxed in EU



Pit
Remediation techniques

Excavation

- Excavated top cover
  - ✓If clean store for re-use
  - ✓If not clean remediate
- If necessary, lower the groundwater table by drainage
- Excavate buried hazardous waste
- Pre-treat and/or repack buried hazardous waste
- Excavate contaminated pit bottom and wall
- If visibly contaminated with hazardous waste treat as hazardous waste
- Sample the bottom and the sites when all waste and visibly contaminated soil is removed
- If clean backfill excavation with clean soil
- If soil contaminated remediate

Pit
Remediation techniques

Excavation buried Hazardous waste

Excavation

Sampling

Obtaining clean back fill material

Back filling

Contaminated soil & groundwater
Remediate in-situ or ex-situ

To consider

1. **Cost**
   - Actual costs of installation and running
   - Time and ability (project development)
2. **Technical / Environmental factors**
   - Biodegradability of contaminants
   - Depth / spreading / position of the plume
   - Combination of in/ex-situ technologies
   - In or excluding groundwater remediation
3. **Results**
   - Project risks
   - Uncertainties
   - Residual contamination
   - Needed monitoring and aftercare

Contaminated soil & groundwater

Remediate in-situ or ex-situ

EX-SITU TREATMENT TECHNOLOGIES

THERMAL

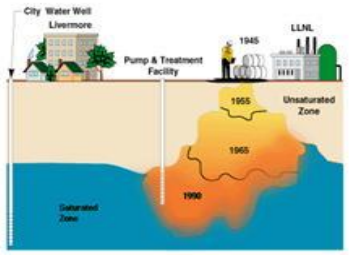
WASHING

LANDFARMING

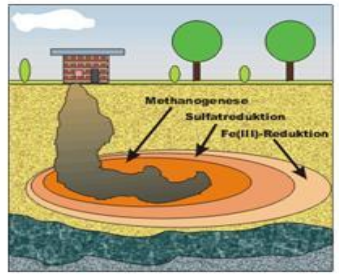
- Thermal: all soil types
- Washing: preferably coarse textured-sandy soils
- Land-farming: only degradable organic components
- Immobilization: preferably coarse textured-sandy soils

OPERATIONAL IN-SITU TECHNOLOGIES

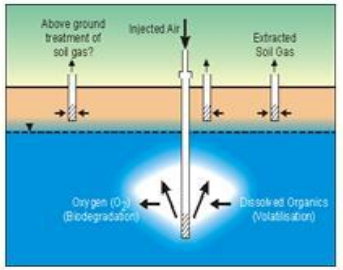
PHYSICAL



BIOLOGICAL



CHEMICAL



- Preferably coarse textured-sandy soils
- Biological: only degradable organic components
- Physical and chemical: difficult to control
- In-situ immobilization

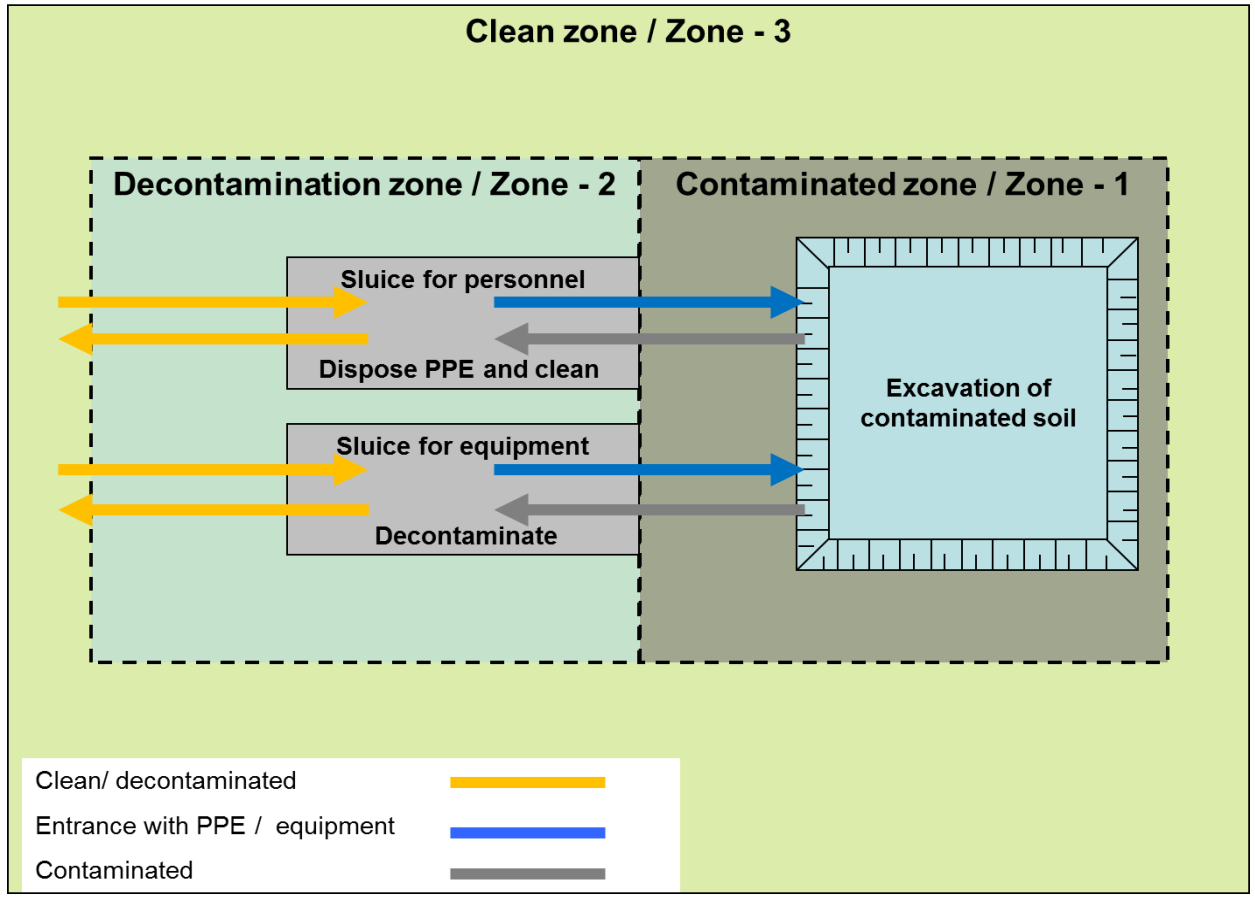
Preliminary Design
Selected Remedial Option

- Carry out additional technical survey
- Update CSM
- Preliminary technical design
- Write supervision plan
- Write Health And Safety Plan (HASP)
- Estimate the cost

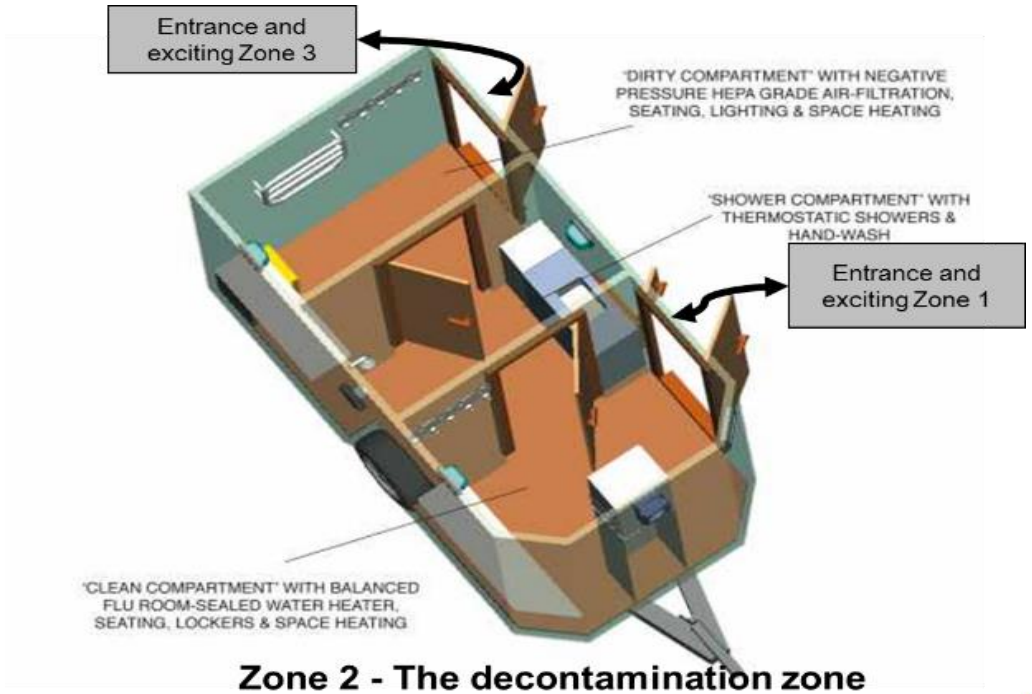
Preliminary Design
Health & Safety measures

- Personal protective equipment (PPE)
- Start work analysis
- Toolbox meetings

Preliminary Design
Health & Safety site zoning



- Contaminated zone
- Decontamination zone
- Clean zone

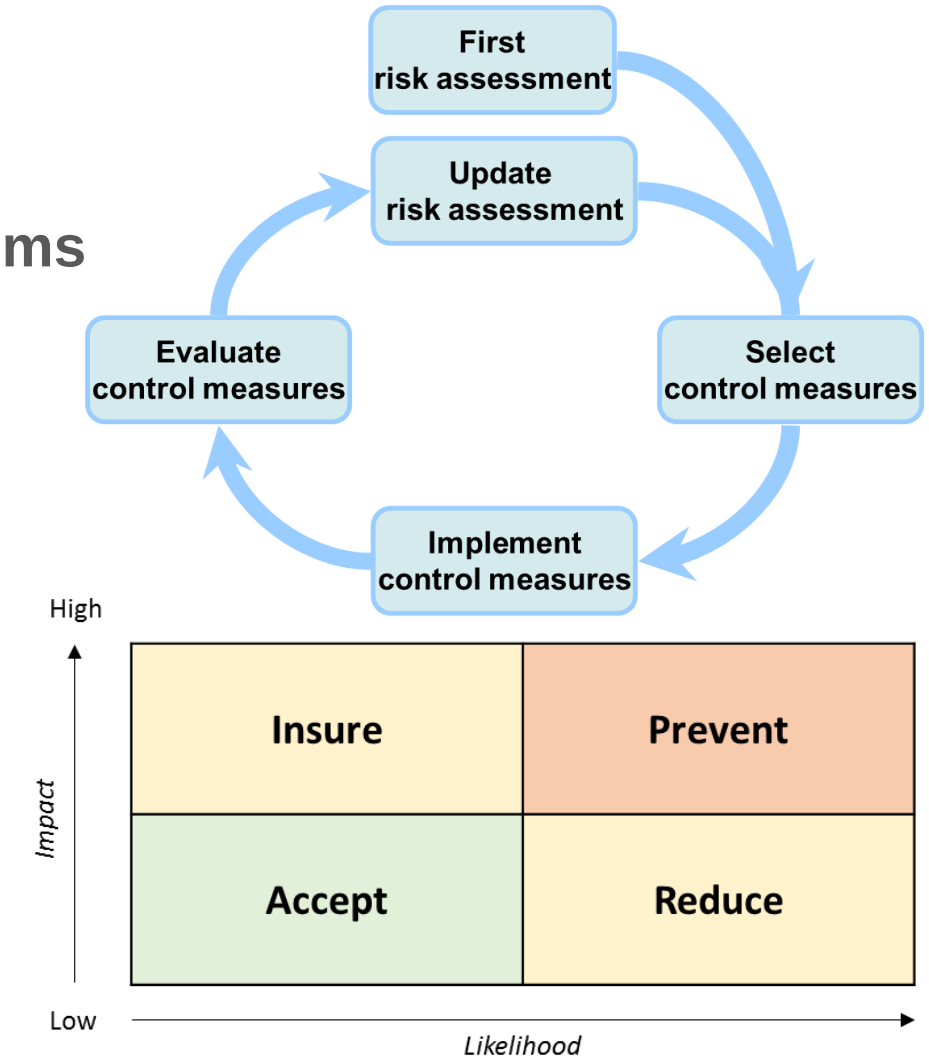


Zone 2 - The decontamination zone

Implement
Project risk management

Risk is an event that, if triggered, causes problems

- The origin of a risks can be
  1. Technical
  2. Organizational
  3. Legal
  4. Environmental
  5. Financial
  6. Social
  7. Political



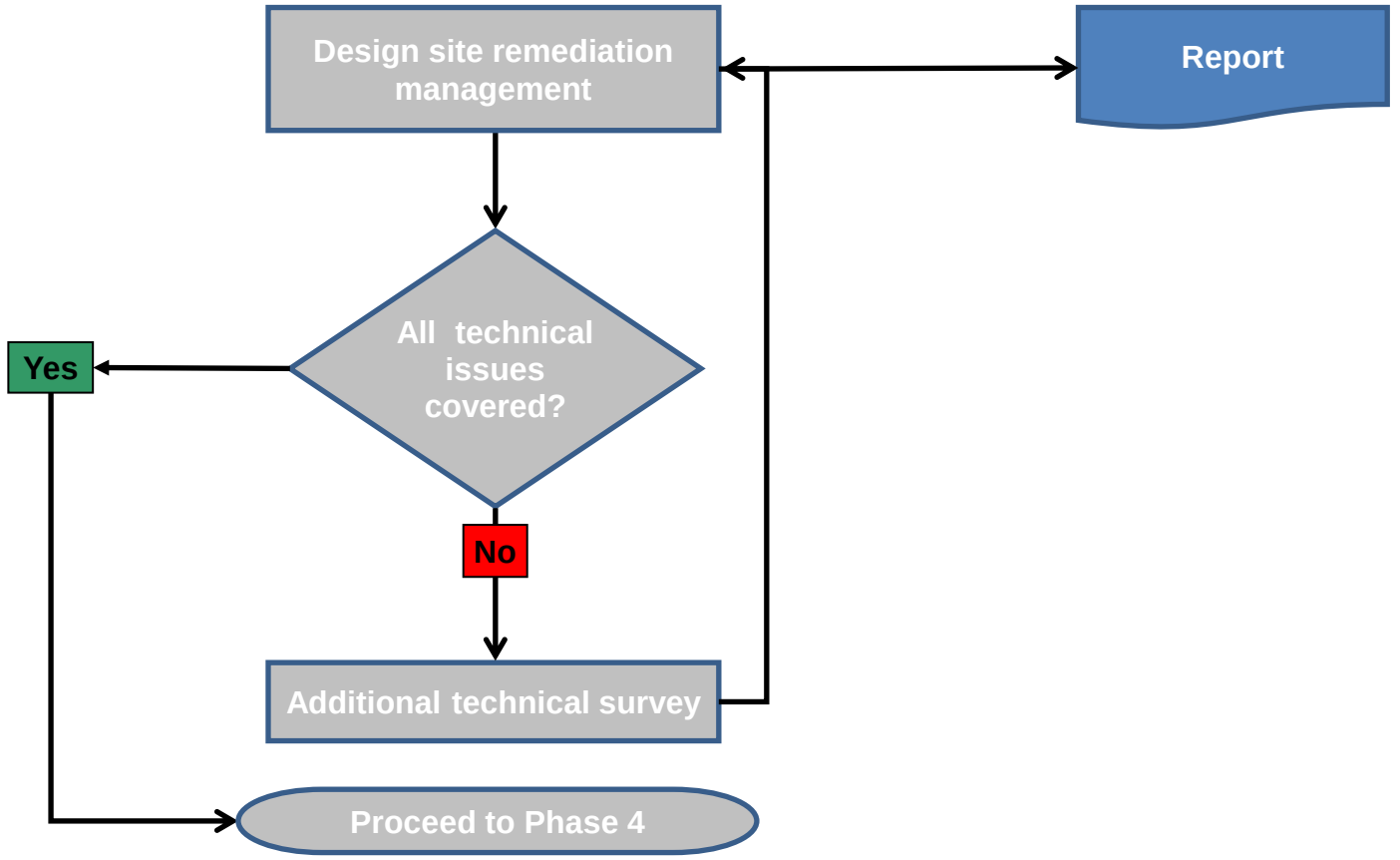
Implement
Stakeholder involvement

- Making sure that all stakeholders are informed before a remediation project starts
- Proper stakeholder involvement avoids health risks, accidents and protests
- Good stakeholder involvement planning
  - ✓ Provides overview of activities needed for each stakeholder group
  - ✓ Creates involvement
  - ✓ Creates common project ownership
  - ✓ Provides opportunity to share inspiration

Remediation Assessment
Reporting

- General information
- CSM Site Assessment results (Phase 2)
- Remediation Assessment
  - ✓ Conceptual design of at least three remedial options
  - ✓ Selection of the remedial option
  - ✓ Points of concern: uncertainties and how to reduce them
- Remediation Plan
  - ✓ Technical measures selected option / Preliminary design
  - ✓ Planning selected option
  - ✓ Estimated costs selected option
- Appendices

Remediation Assessment
The Process



Contact

Questions?

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