

Sampling, planning, and preliminary assessment of contaminated sites

Module 3

Contents

Develop basic understanding of the key steps in planning and conducting an oil-contaminated site assessment including development of **Conceptual Site Models**, sampling design and techniques; understand contaminants of concern, field kits and laboratory analysis, and sample preparation, including brief introduction to standard equipment and procedures associated with Health, Safety & Security (HS&S).

Topics

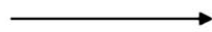
- Overall Objectives of CSA
- Introduction and key steps in site assessment
- Sources and scales of error
- Phase 1 Preliminary Site Assessment
- Preparing the Conceptual Site Model (CSM)
- Preparations for site visit



Reminder: Overall Objectives of a CSA

Traceability – Representativeness – Trust

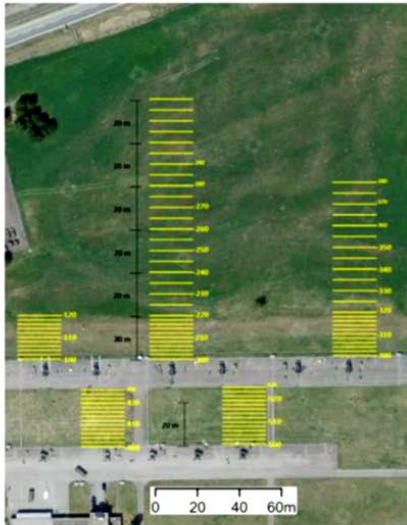
Sampling Plan



Reality



Laboratory / Report

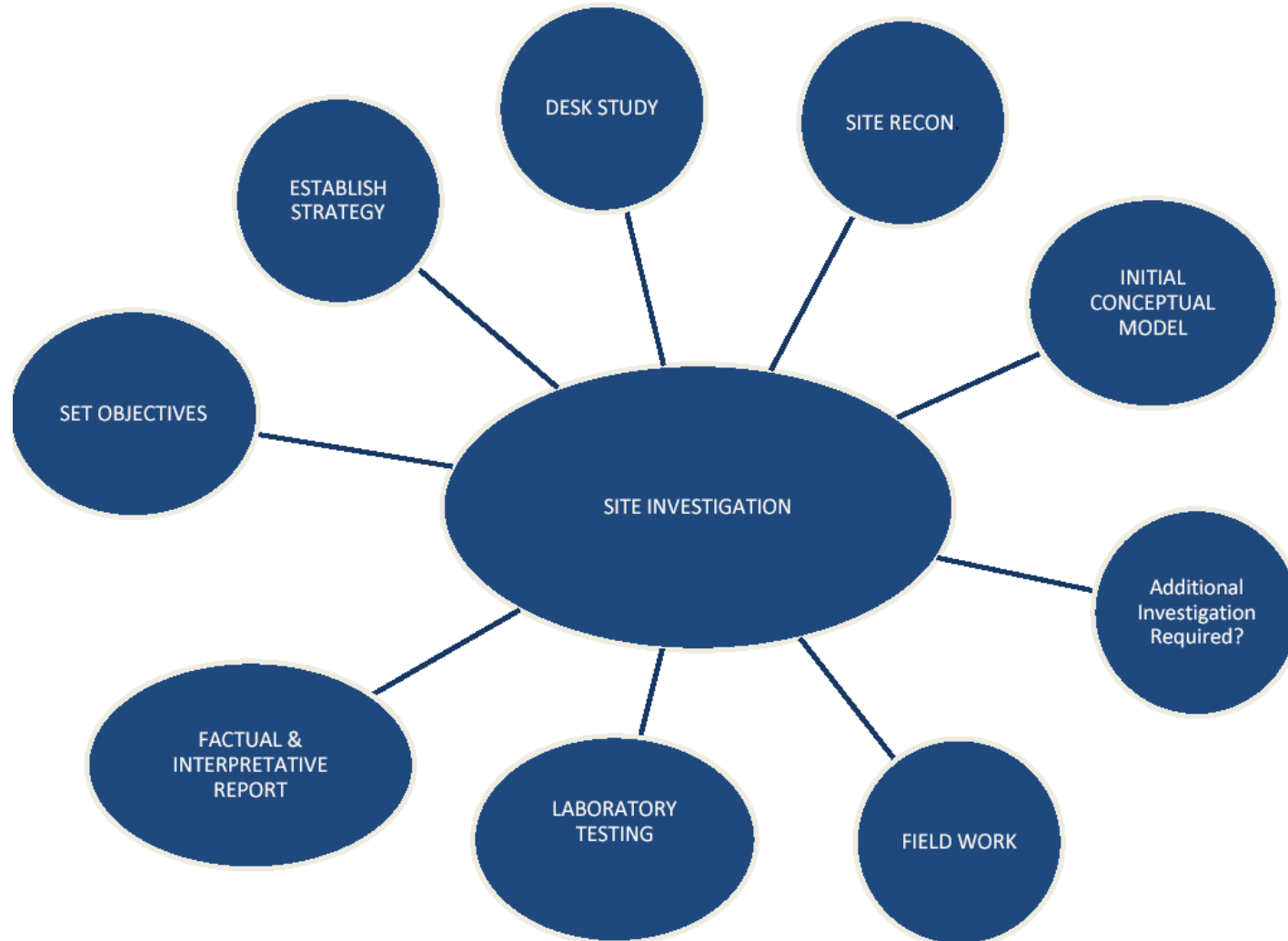


EPA Sampling Guideline

i.e. EPA 6000 series

ISO 17025

Overall: what's involved?



Introduction & key Site Assessment steps

Phased Investigation Approach

Phase 1 - Preliminary Site Assessment to determine the potential for site contamination

- Historical and current land use
- Site reconnaissance, and
- Other information gathering techniques

Phase 2 – To confirm presence/absence of suspected contamination

Phase 3 – To delineate the contamination information (area/depth/types), a requirement for Risk Assessment and Remediation Planning

! Key term:

Risk Assessment

= the combined effort of identifying and analyzing potential events that may have severe negative impacts and making judgements "on the tolerability of the risk on the basis of a risk analysis" while considering influencing factors.

Can include four phases

Contaminated Land Surveys

Phase 1 Contaminated Land Survey (aka Phase 1 Desktop Study) and Site Reconnaissance – identifying potential contamination sources, pathways and receptors, to develop the initial **Conceptual Site Model** (CSM). Phase 1 will determine whether a Phase 2 Intrusive Site Investigation is required.

Phase II Intrusive Site Investigation – Boreholes, sampling, drilling, trial pits, etc. to assess the ground conditions, carry out *in situ* testing and obtain samples for geotechnical and contamination testing.

Phase III Options Appraisal and Remediation Strategy – If Phase II suggests there is a risk to human health, controlled waters, plants, etc. then a Phase III will be required which will be carried out in consultation with the Local Planning Authority and/or the Environment Agency.

Phase IV Verification (Validation) – Site inspections and providing independent Validation of range of remediation technologies & protection measures including gas and vapour barrier membrane installation, engineered topsoil cover systems, contamination hotspot removal, tank removal, soil waste management and re-use, environmental permit surrender, etc.

Sources and scale of errors

1. Sampling

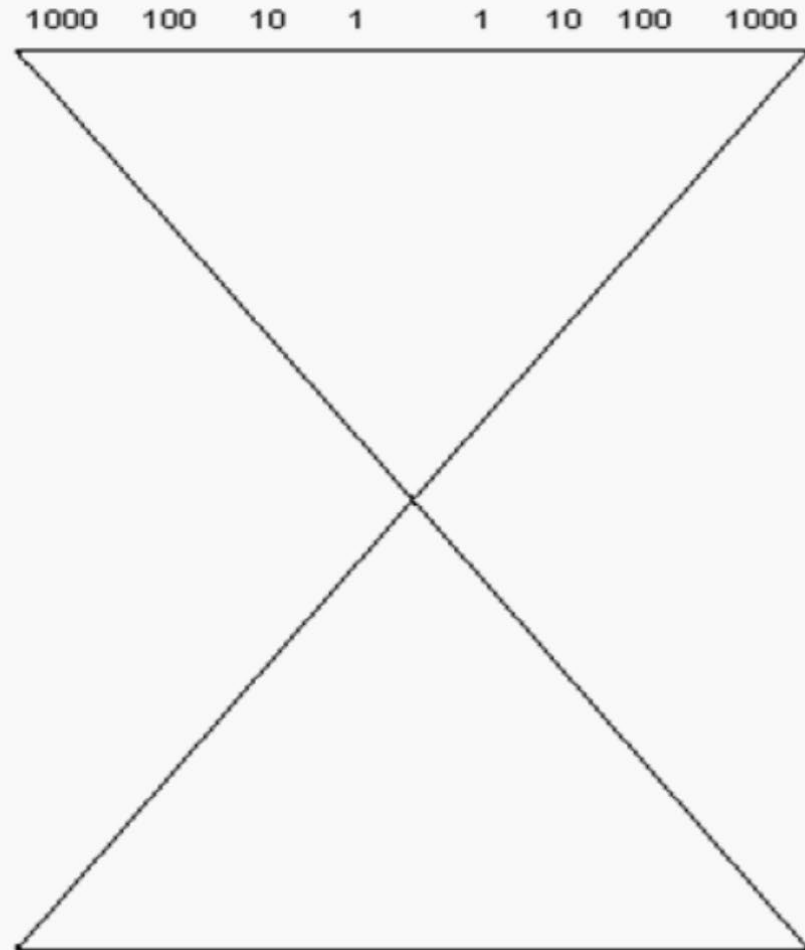
2. Transport/Storage

3. Sample preparation

4. Measuring

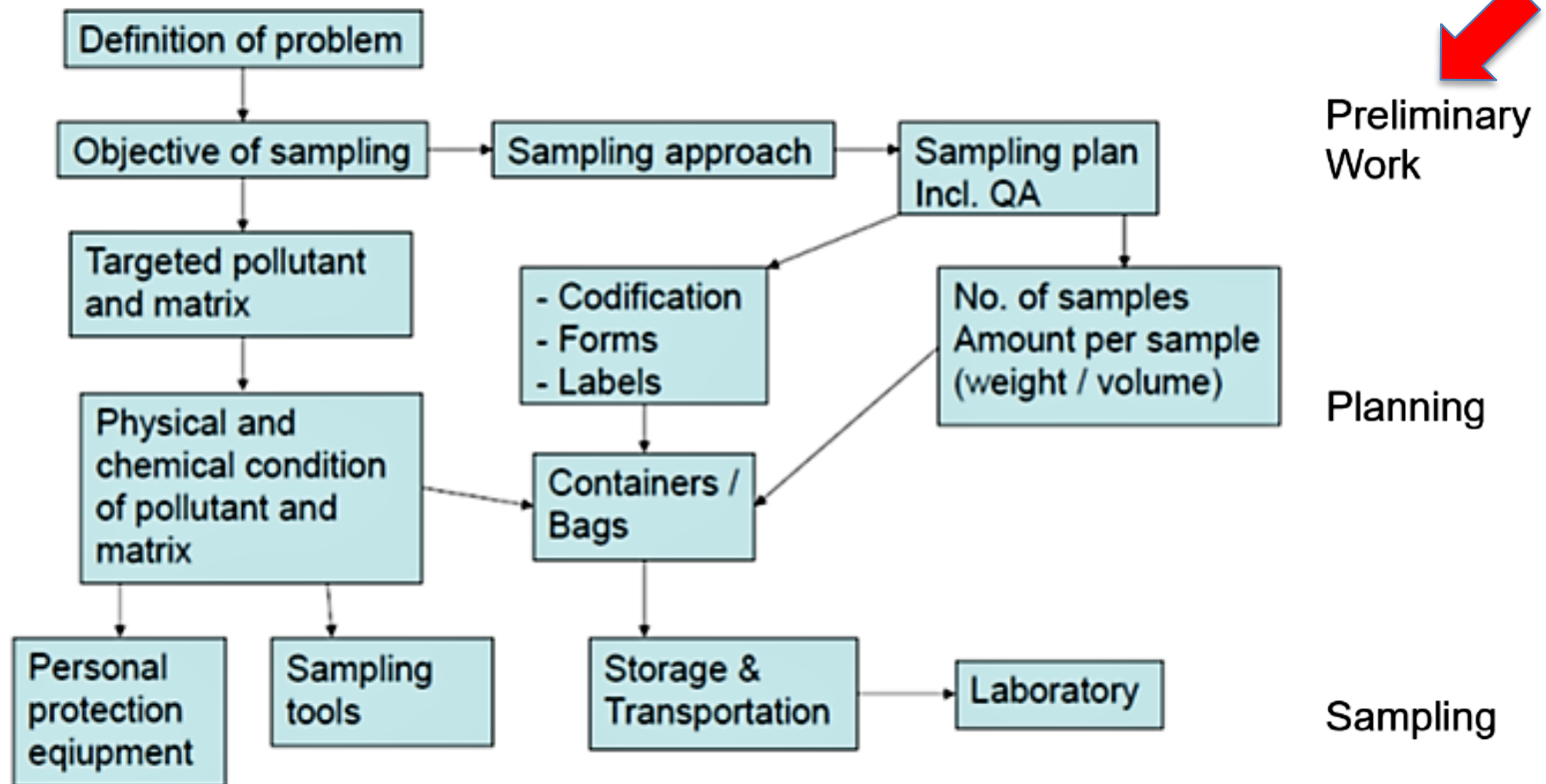
5. Calculate/Report

6. Interpretation



Sampling Planning Overview... reminder

Most important question:
What is the problem and
what is the objective?



Phase 1 Preliminary Site Assessment

The key points of a preliminary site assessment are:

- Identification of the site
- Visual Observation
- Interviews with locals, officials
- Geo-referencing
- Assessment forms as documentation -> Spill Assessment Form
- Handheld or in-situ measurements
- Non-probabilistic grab samples



These points deliver important facts for the subsequent planning process.

-> Usually done by the CSA-Team leader + 1-2 collaborators

Preliminary Site Assessment Form

Main headings

Site specific: Identification, Location (GPS)

Access restriction, Topography

Spill details: Legacy site, Oil spill, Area, Classification of pollution (soils, air, surface and ground water, damage to vegetation, residences, agriculture)

Adjacent areas details:

Affected flora and fauna, Neighboring land use (N/E/S/W), Residential information (size/ water source), Surface hydrology

Oil Spill Preliminary Site Assessment Form	
1. Site specific information	
1.1	Identification
a)	Inspector Name & Organization (Please write in BLOCK LETTERS):- _____
b)	Inspector Name & Organization (Please write in BLOCK LETTERS):- _____
	GPS ID [][][][][][][][][] Map ID [][][][][][][][][]
	Camera ID [][][][][][][][][] Spill ID ___/___ Total No of spills ___
1.2	Location
a)	Date (dd/mm/yyyy) [][][]/[][][]/[][][][][] Time (start) [][][][][]
b)	Identification Code [][][][][][][][][] Time (finish) [][][][][]
c)	Local name of site _____ LGA _____
d)	GPS Coordinates in decimal degrees (GPS-Map-Code: A): Latitude (N): _____ Longitude (E): _____ Precision(+/- ...m) _____
e)	Map coordinates (UTM Zone 32N): [][][][][][][][][]N [][][][][][][][][]E
f)	Weather: Sunny <input type="checkbox"/> Rainy <input type="checkbox"/> Cloudy <input type="checkbox"/> Foggy <input type="checkbox"/> Other : _____ Did heavy rain occur over the past 7 days? Yes <input type="checkbox"/> No <input type="checkbox"/>
g)	If Yes, (please specify date; dd/mm/yyyy) [][][]/[][][]/[][][][][] Did flooding occur over the past 7 days? Yes <input type="checkbox"/> No <input type="checkbox"/>
	If Yes, (please specify date; dd/mm/yyyy) [][][]/[][][]/[][][][][]
1.3	Access restriction

Note: Preparations for field visit include health & safety, PPE, maps, equipment (probes, GPS, camera (charged/batteries), forms, pen/paper (spares), sun protection, spades/digger, sample bags, labels).

Preliminary Site Assessment: Reporting

Table of Contents (based on Headings in Site Assessment Form)

Executive Summary

1. Introduction

1.1. Project Contractual Basis and Personnel Involved

1.2. Background Information

1.3. Project Objectives

1.4. Scope Of Works

2. Source Audit Findings – Production & Operational History

2.1. Current Site Operations

2.2. Previous Site Operations

2.3. Chemicals of Potential Concern

3. Site Environmental Setting

3.1. General Introduction

3.2. Regional Geology and Hydrogeology

3.3. Site Geology and Hydrogeology

3.4. Summary of Previous Site Sampling and Monitoring Data

4. Summary, Conclusions and Recommendations

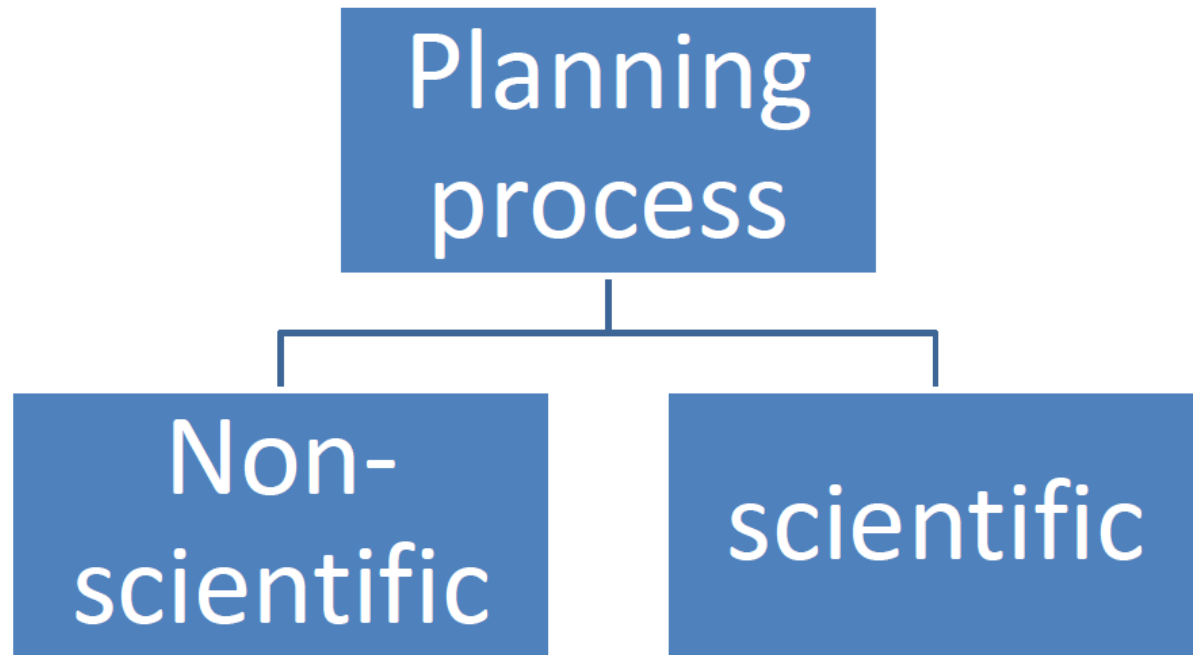
4.1. Summary AND Conclusions

4.2. Recommended Way Forward

5. References

Planning process

The planning process (sampling campaign) can be divided into two parts:



Planning process: Non-scientific part

Non-scientific or “classic project management” part:

- Timeframe
- Budget
- Staff roles and responsibilities
- Stakeholders & connections & communications
- Vehicles and routes
- Sampling equipment, tools and “field office”
- Accommodation
- Food and water
- Security and access

Planning process: Scientific part

Scientific part:

- Site model
- Exposure pathways
- Hypothesis of contamination
- Contaminants & matrices and their physical and chemical properties
- Sampling strategies
- Sampling plan, including quality assurance
- Amount of samples, weight and volumes
- Codification
- Labels and forms

Used to define:

- Containers and bags
 - Tools
 - Personal protection equipment (PPE)
 - Transport and storage
-

Preparing the Conceptual Site Model

The conceptual site model contains the following information:

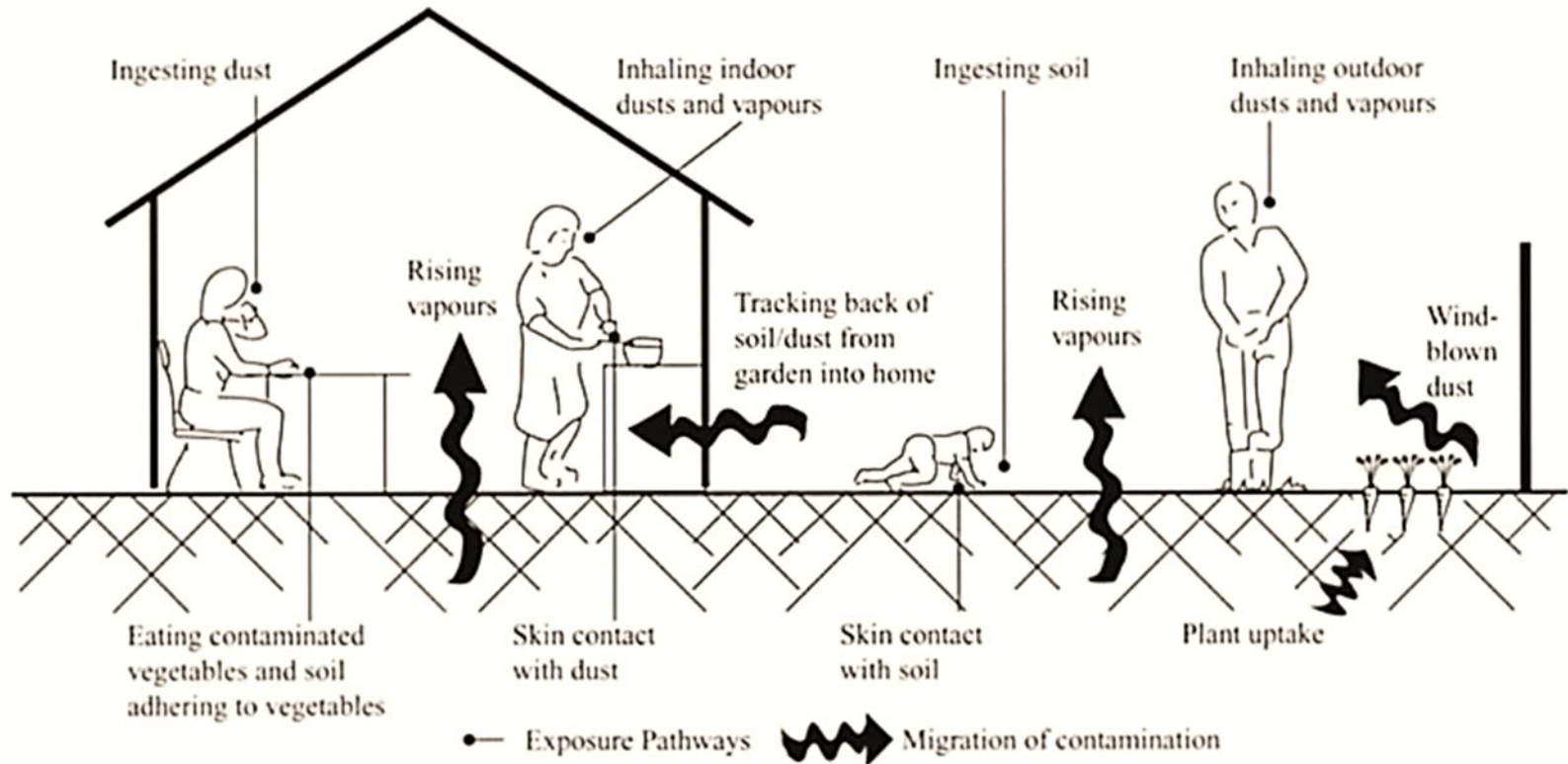
- Plan of the site
- Indication of the known or visually observed contamination and suspected contamination
- Possible exposure pathways

This information is necessary to develop the HYPOTHESIS OF CONTAMINATION

Template for Conceptual Site Model

Which pathways are potentially active?

What are the critical receptors?



Details of migration pathways?

Have we considered all potential pathways?

Definition of a Conceptual Site Model

A CSM, “**should reflect the best interpretation of available information at any point in time**” (US EPA).

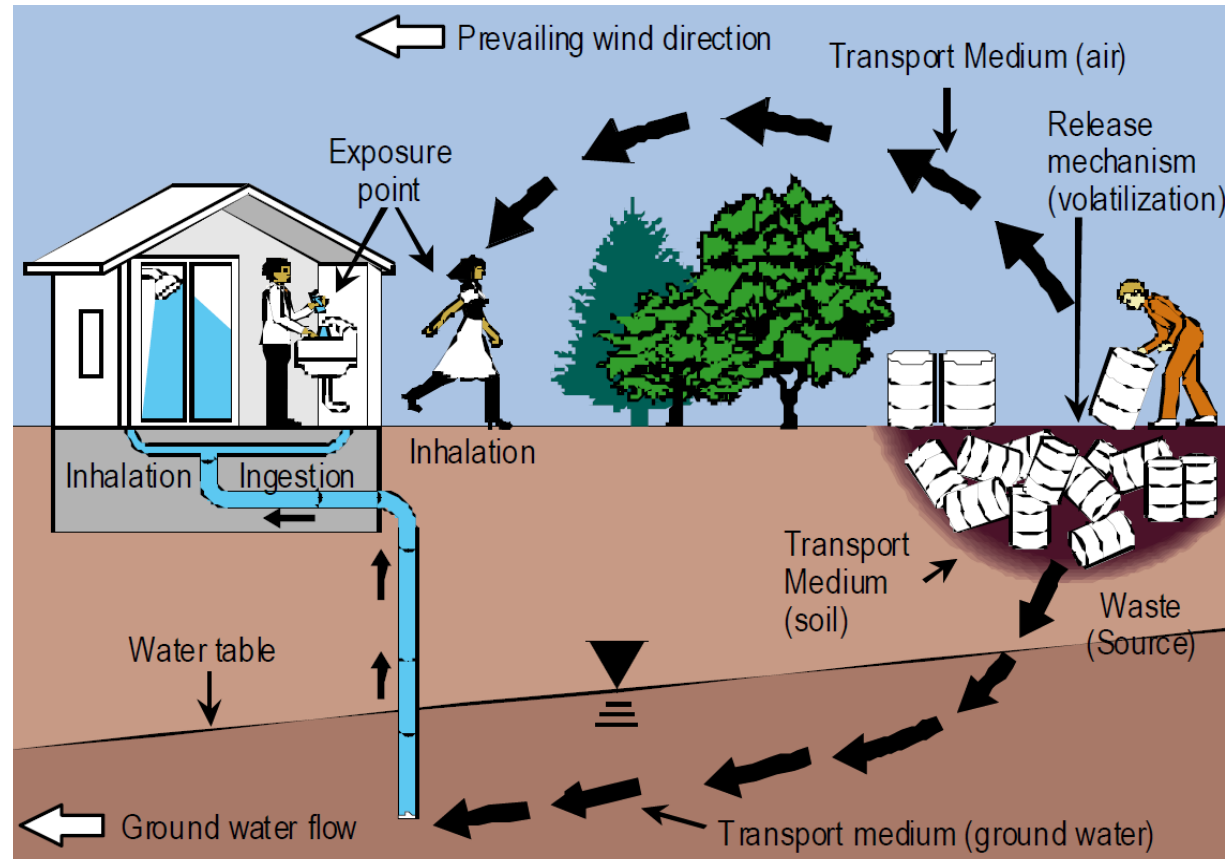
A CSM is defined as, “**an evolving document that will continuously be revised as additional data is collected. The CSM should be maintained and updated as new information is collected throughout the life cycle of the project**” (Interstate Technology & Regulatory Council, 2012).

A CSM **attempts to fit known information together in an organized fashion** to identify data gaps and additional areas of study or concern (Michigan Department of Environmental Quality).

The usefulness of a CSM is in **generating consensus** (involving all stakeholders) and assisting with site-closure decisions by depicting a model representative of all data known about a site.

Simplified Conceptual Site Model

Site investigation and CSM design assess the viability of exposure pathways from contaminant release points to human and environmental receptors.



Shown above are potential exposure concerns from transport mechanisms including air, soil, and ground-water, which may lead to contaminant concerns with indoor air and drinking water.

Draft Outline - Conceptual Site Model

Based on the findings from the Preliminary Site Assessment, a draft outline of the CSM is prepared.

In preparing this draft CSM, the team has identified:

- **source** of pollutant
- exposure **pathways**
- and **receptors**

Now they must conduct the **detailed sampling**.



Some key consideration for CSM

- **Nature of contamination – how does this affect pathways?**
e.g. Any volatiles? Soluble/mobile in groundwater? Non-aqueous phase liquid (NAPL)?
- **Have all plausible s-p-r linkages been identified?**
Not just the ones covered by the generic exposure model e.g. off-site migration of groundwater/vapour, diffusion through pipes
- **Are there any mitigating circumstances?**
e.g. Depth of contamination, vapour barriers
- **What changes might occur in the future?**
e.g. Change in site levels, hard standing removed

Site Characterization & Contaminants of Concern

BDA SITE DESIGNATION	DESCRIPTION OF CONTAMINANTS British Drilling Association (BDA)
GREEN	Substances have little potential to cause significant harm to humans, e.g. sub- and topsoil, hardcore, bricks, stone, concrete, clay, ceramics, wood, paper, plastics, wool, cork, ash, clinker, cement.
YELLOW	Substances not sufficiently harmful to potentially cause death or injury but nevertheless require protection to be worn. E.g. include waste food, vegetable matter, household waste, garden waste, leather, resins, electrical fittings, soaps, cosmetics, tar pitch, solidified wastes, silica dust.
RED	All substances that could subject persons to risk of death, injury or impairment of health. Wide range of chemicals e.g. toxic metals and organic compounds, pharmaceutical and veterinary wastes, phenols, medical products, solvents, micro-organisms, asbestos, thiocyanates, cyanides, hydrocarbons, flammable and explosive materials. Materials that are particularly corrosive or carcinogenic

Site Characterization & PPE

	Item	Green	Yellow	Red
1	Hard hat	X	X	X
2	Gloves and other forms of hand protection	X	X	X
3	Eye Protection (as necessary)	X	X	X
4	Ear Protection	X	X	X
5	Overalls	X	X	X
6	Waterproofs (as necessary)	X	X	X
7	Industrial Boots with Sole and Toe protection	X	X	X
8	High Visibility Clothing	X	X	X
9	Fire Extinguisher	X	X	X
10	Fire Blanket	X	X	X
11	First Aid Kit	X	X	X
12	Mobile Telephone (outside contaminated area)	X	X	X
13	Clean Water Supply	X	X	X
14	Washing Facilities	X	X	X
15	Dust Mask		X	X
16	Gas Mask		X	X
17	Disposable Overalls (as necessary)		X	X
18	Ropes, Cones and Barriers		X	X
19	Safety/Warning Signs		X	X
20	Changing/Washing Facilities		X	X
21	Methane Detector (as necessary)		X	X
22	Carbon Dioxide Detector (as necessary)		X	X
23	Oxygen Deficiency Detector (as necessary)		X	X
24	Other Gas Detectors (as necessary)		X	X
25	Face Shield			X
26	Disposable Waterproofs			X
27	Wellington Boots with Sole and Toe Protection			X
28	Respiratory Equipment (as necessary)			X
29	Decontamination Unit			X

BTEX Considerations

The primary byproduct of manufacturing processes is associated polycyclic aromatic hydrocarbons, or PAHs, and certain volatile organic compounds (VOCs).

At the surface, these chemicals evaporate readily and dissipate, but may remain underground for a long time. Benzene, toluene, ethyl benzene, and xylenes (BTEX) are the primary VOCs, which may remain at old industrial sites.

BTEX describes this group of chemicals that are sweet smelling liquids which rapidly volatilize in the air, can partially dissolve to surface or ground water, or can be bound to soils and sediments.

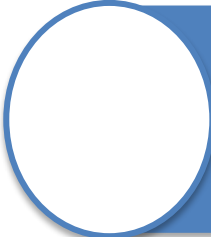
Human Health Effects: Occupational exposure to BTEX can result in adverse health effects e.g. skin and respiratory irritation, central nervous system depression, and maybe cancer. **Whenever possible, exposure to BTEX chemicals should be minimized.**

Planning for Site Visit

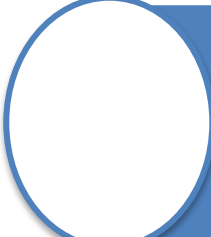
Planning for Field Trip

- Site and objectives
- Departure
- Travel arrangements
- Equipment (all that is needed, plus spares e.g. GPS batteries, or phone chargers, and back-ups)
- Clothing (appropriate for the weather and conditions)
- HSE (appropriate for the site and expected levels of contaminants)
- Food and drink
- Anything else?


Key messages



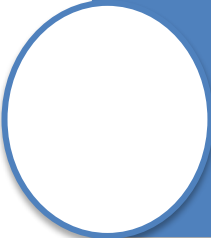
Contamination of land or water, vegetation and air, needs to be determined accurately before restoration or remediation efforts are initiated.



The CSA framework is a structured and accepted approach to understanding and documenting levels of contamination and vital to determining any remediation actions.



The first step or phase of the CSA framework is the Preliminary Site Assessment, which usually does not involve sampling.



Preliminary Site Assessment, together with background data gathering, should provide enough information to develop the first Conceptual Site Model, which is vital for understanding the characteristics of the contamination.

Thank you



(Insert the below information if required)
Name of the presenter / division / unit / office
Address / email / contact information
(Maximum 5 lines of text is permitted)
All in Roboto Regular 9pt..

www.unep.org