ntepa Northern Territory Environment Protection Authority

GUIDELINES ON CONCEPTUAL SITE MODELS

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Version 2.0

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1 Introduction

The objective of these guidelines is to assist industries in developing a conceptual site model (CSM). A CSM may be required in association with the environmental impact assessment process or approvals and licences under the *Water Act* or the *Waste Management and Pollution Control Act*.

This NT EPA guideline is intended to provide a best practice approach to environmental assessment and management and the preparation of a CSM. Included is:

- a definition of a CSM consistent with national policy;
- information on why a CSM is needed;
- essential requirements of a CSM; and
- the Northern Territory Environment Protection Authority's (NT EPA) position on CSMs.

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2 Definition of a conceptual site model (CSM)

A CSM is a representation of the nature, fate and transport of discharges, wastes or contaminants that allows assessment of potential and/or actual exposure to contaminants. A CSM enables the formation of hypotheses that can be tested under a monitoring program. Based on the results of monitoring the CSM can be updated. A CSM can be represented by a plan or diagram that:

- identifies primary sources of discharges or potential discharges from an industrial or commercial activity into the environment (e.g. disposal of wastes to soil or water, airborne releases from an industrial operation, or acid drainage from a mine site);
- shows how discharges or contaminants at the point of release might move in the environment (e.g. chemicals from an above ground storage area may move down into soil or water; petrol from an underground tank may migrate off-site and affect near neighbours; or contaminants from fill material may move into groundwater);
- identifies the different receptors that might come in contact with contaminated media (e.g. birds, mammals, fish, plants, humans); and
- lists the ways different receptors may come into contact with the discharge or contaminants (e.g. potential exposure pathways through ingestion of contaminated surface or groundwater, ingestion of contaminants in soil or food, direct contact with contaminated soil or water).

3 Why is a CSM needed?

A CSM is one of the primary planning tools used to support decision-making processes and environmental risk assessment. It organises available information about an activity or site in an easily understandable format that facilitates the identification of gaps in data and information. It can provide pictorial representation of key features to support communication between stakeholders.

A CSM can be refined as additional data are gathered. This allows for improved understanding of the activity or site characteristics, contamination status, receptor exposure profiles, environmental risk, and re-adjustment of decision-making criteria.

A CSM provides financial benefits by identifying and focussing resources on the most likely environmental risks.

4 What is required in a CSM?

The objective of a CSM is to summarise pertinent information about the history of use and activities on a site and surrounding properties, including potentially contaminating activities and land uses. The complexity of the CSM should correspond to the scale and complexity of the known or potential contamination impacts.

A CSM will be necessary prior to undertaking a preliminary risk assessment. It does not need to encompass all components of a system, but instead, focus on key matters that need to be addressed. A preliminary CSM should support the development of field sampling or monitoring plans focused on defining the problem, or a preliminary risk assessment. A preliminary CSM should include:

- key contaminants and their characteristics;
- inferred sources and pathways;
- mechanisms for transport; and
- potential receptors.

Information collected through sampling and monitoring and incorporated into the CSM will produce a detailed model that:

- further defines the contaminants of concern;
- clarifies the nature and extent of the contamination, including the various environmental media/compartments affected by the contamination;
- identifies the mechanisms for transport and attenuation of the contaminants;
- demonstrates the exposure of identified receptors to the contamination; and
- defines the potential health and environmental risks.

A CSM should include results from validation sampling and monitoring. It can be used to strengthen risk assessment, risk characterisation and performance monitoring designs.

A CSM should be tailored to the activity and site location. For example, if the main contamination migration and exposure issues are related to groundwater, the CSM is primarily a hydrogeological document. If the migration pathway is likely to be through soil and surface waters, then the CSM would be focussed on hydrological information and include soil, surface water, sediment, biota and vapour phase contamination.

5 Types of CSMs

A CSM can be presented in a number of formats. The format of presentation will be dictated by the complexity of the site and the amount and type of data that are available.

The NT EPA recognises the following approaches for presenting a CSM:

- narrative;
- diagrammatic;

- table format;
- pictorial;
- flow charts exposure pathway model;
- fate and transport models; and
- interactive electronic or virtual 3D.

Appendix 1 provides examples of formats. You must satisfy yourself that the format of the CSM and the information it contains is appropriate for your site specific situation.

6 Resources

National policy documents that may assist with the development of a conceptual site model include:

- *Schedule B2, National Environment Protection (Assessment of Site Contamination) Measure 1999*, including variation and updates; and
- National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting, developed by the Australian and New Zealand Environment and Conservation Council and the Agriculture and Resource Management Council of Australia and New Zealand (ANZECC 2000).

7 Further information

Pollution Control

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Appendix: Examples of CSMs

NOTE: These are examples only. Users must ensure that all site specific aspects of their site/activity are considered in the development of a CSM.

1. Narrative CSM

Generic minimal requirements are listed below. A narrative CSM is expected to include:

- a detailed description of:
    - the location and area of the site;
    - site topography;
    - site geology, hydrology and hydrogeology;
    - the history of site usage, ownership and activities; and
    - location of sensitive receptors and distances away from the site;
- nature and location of discharges and what is known about the actual or inferred nature and extent of the discharges and how the contamination moves into the environment (e.g. seeps from landfills, leaks from underground tanks into groundwater, point and non- point source discharges into surface waters);
- a list of the exposure pathways (e.g. ingestion of contaminants in food or water, dermal contact with contaminated soil or water, inhalation of vapours etc.); and
- a list of receptors that might come into contact with contaminated media (e.g. aquatic ecosystems of concern, people, plants or other sensitive areas).

The above narrative outlines generic information required in early phase (preliminary) CSMs. The CSM will be improved using results of investigations. Detailed CSMs are better represented by diagrammatic or pictorial formats.

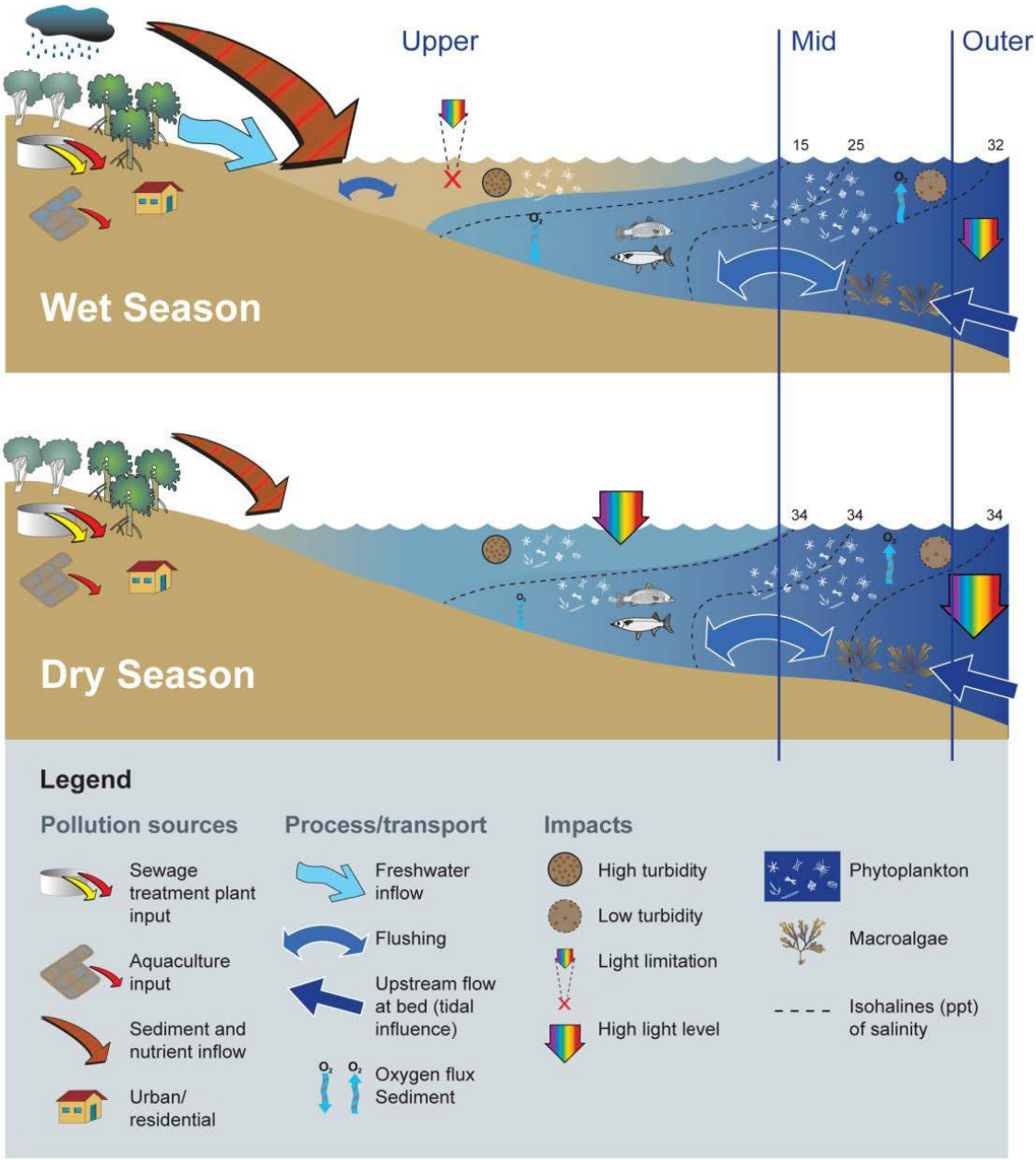
2. Diagrammatic CSM

2a: Catchment

Source: Darwin Harbour Region Report Cards, 2011

A simple diagrammatic presentation of the main processes influencing water quality.

Information from detailed investigation of sediment re-suspension and salinity effects would allow a more detailed CSM to be developed.



2b: Catchment

Source: ANZECC 2000, No.7, Figure 2.3

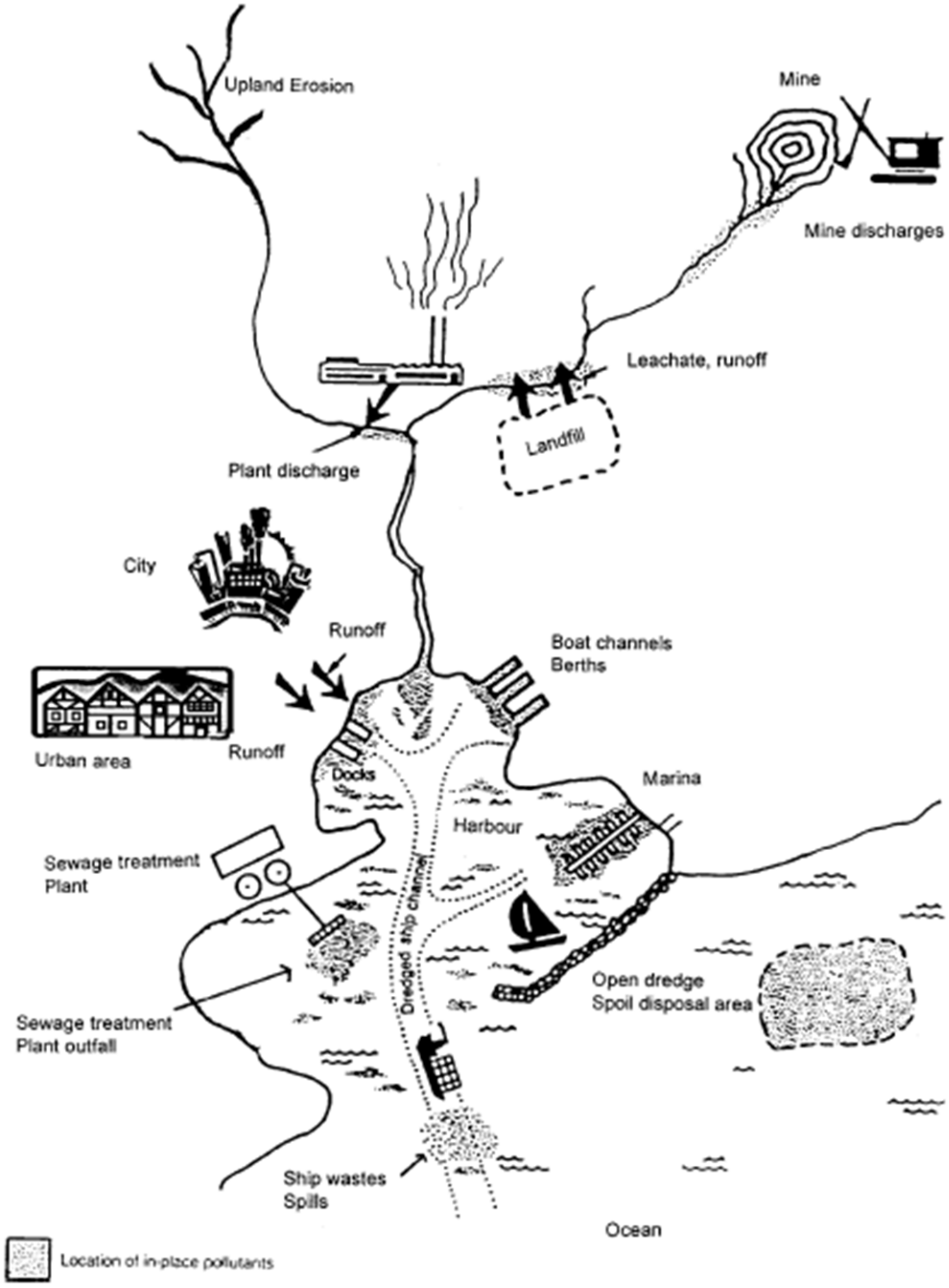


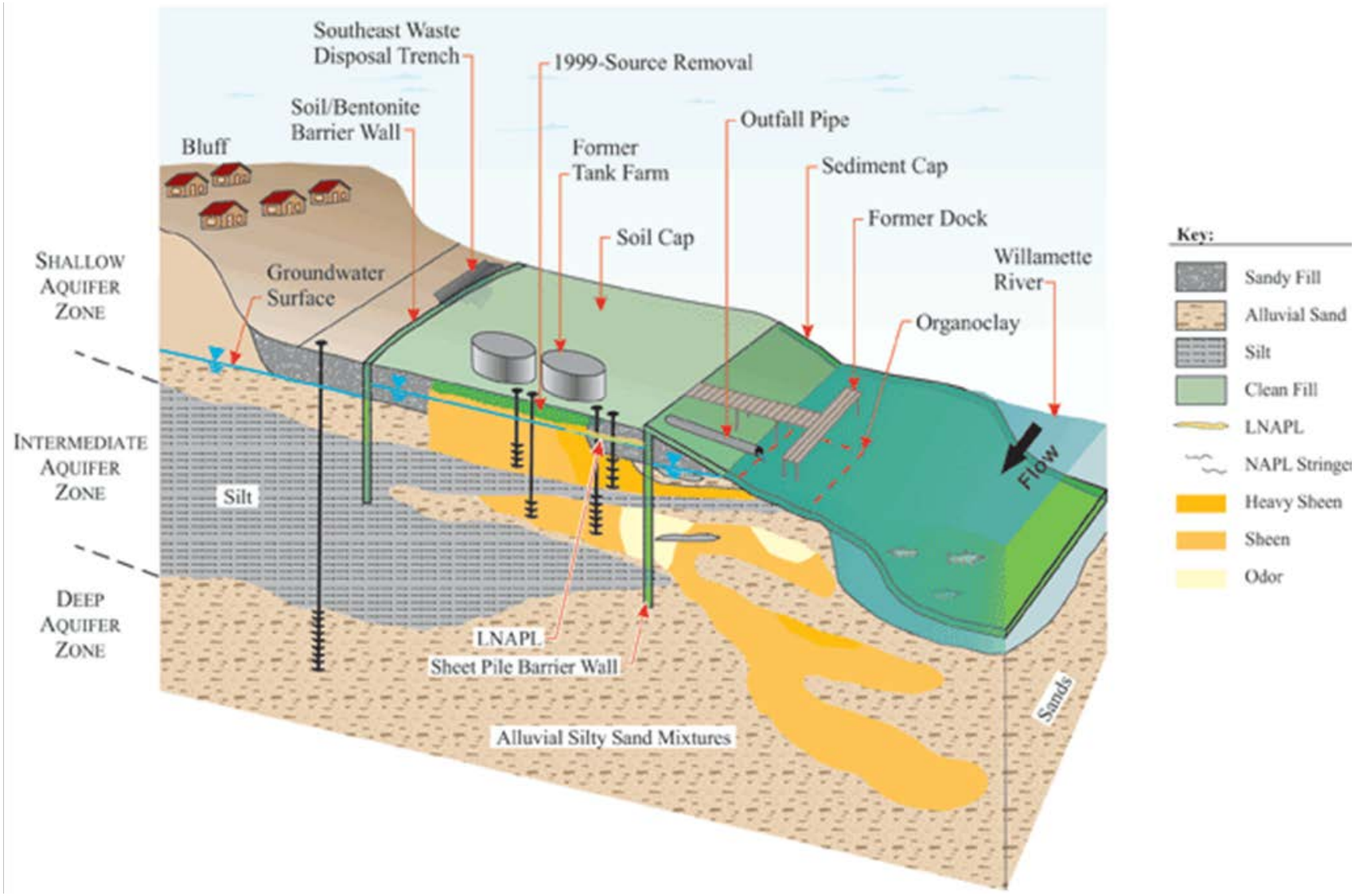
Figure 2.3. Model of sources of metal contaminants to the aquatic environment

3. Table CSM

Source		Pathway *potential or actual*		Exposure Route *potential or actual*		Receptor *potential or actual*
Petrol Tank on site oil water separator oil storage area	⇨	• **How can the contamination at source move into the wider environment and towards a receptor?** For example: o Can the contaminants move off the activity/site through soil, sedimentation or surface flow? o Can the contaminants move from surface soils into deeper soils? o Can the contaminants move from surface soils into groundwater? o Can the contaminants be transported via groundwater into a nearby river or marine environment? o Can the contaminants move into the air phase? o Can the contaminant move off-site into sensitive areas? o Has the contamination migrated into surface water?	⇨	• **How does a contaminant enter a body or organisms after contact or exposure to it/them?** i.e. through ingestion, dermal absorption or inhalation For example: o Can the contaminants move from soil into edible plants? o Can on or off-site workers be exposed to the contamination (dermal or inhalation) during excavation works or while working in service trenches on and off site? o What is the use of groundwater and can contaminated groundwater be used as a potable drinking water supply or used for irrigation?	⇨	• **What body or organisms is/are exposed to the contamination?** i.e. what is adjacent and/or near to the site For example: o Are there residences near the areas of discharges? o Are there service trenches in e.g. grass verges adjacent to the site? o Is the contamination within a buffer zone for a water supply? o Is groundwater used as a potable water supply? o Is groundwater used for crop irrigation? If so, can the contaminants be taken up by the crop? o Has the contamination migrated into surface water in concentration > than the relevant assessment criterion (e.g. ANZECC 2000)? o If contamination is present in waters, do people, swim, fish, canoe in the waters or use the water for some other recreational use?

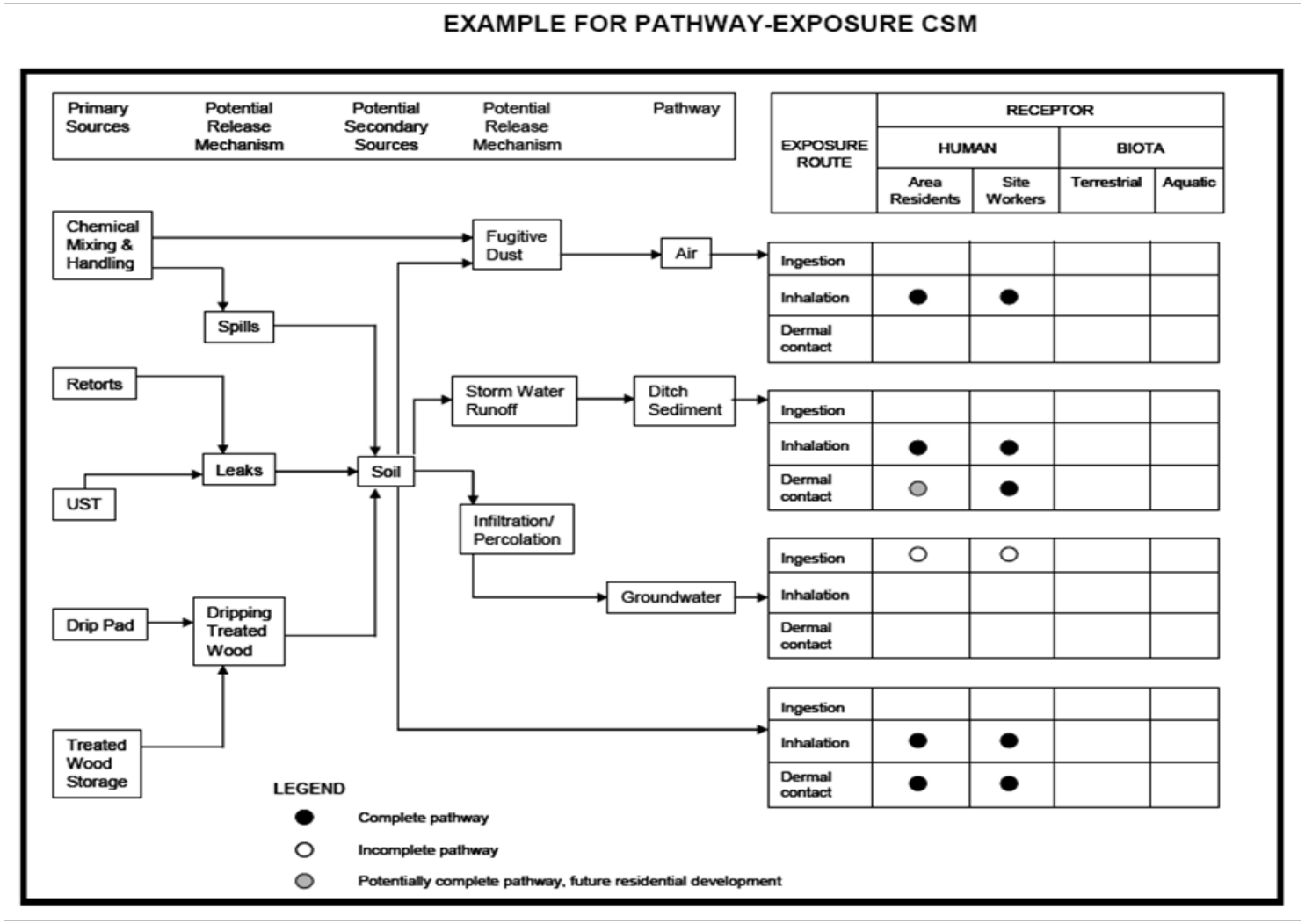
4. Pictorial CSM

Source: http://clu-in.org/contaminantfocus/default.focus/sec/sediments/cat/Conceptual_Site_Models/



5. Flowchart, ecological exposure pathway CSM

Source: http://dtsc.ca.gov/PublicationsForms/upload/Guidance_remediation-Soils.pdf



6. Fate and transport CSM

Source: http://www.urbanhabitats.org/v06n01/fateandtransport_figure1.html