Chapter 4
Development of a Conceptual Site Model for HTRW Projects

4-1. Introduction

This chapter describes the steps in CSM development for an HTRW project addressing environmental contaminants. As with an OE project, CSM development follows the TPP process with establishment of project objectives and DQOs. The primary focus of the HTRW CSM is to illustrate the interaction between contaminant sources and receptors. This is accomplished through development of the profile information (see Paragraph 2-4) and subsequent pathway analysis.

4-2. Profile Information Resources

a. Identifying profile information available for an HTRW site is one of the most critical steps in developing the initial CSM. Historical and current site information may be obtained from maps, aerial photographs, existing reports, cross sections, land surveys, environmental studies, or laboratory analytical data. Procurement contracts or inventory records provide information about what items or materials were purchased and used by various departments. Operational manuals or procedures are also essential resources for information relating to how an activity was performed in the past. Landfill or burial pit disposal records, when available, offer invaluable data on what wastes may be present.

The **quality** of existing data must be evaluated before inclusion in the CSM. Some data may not meet quality standards for all uses. For example, data that are inadequate to evaluate risk may be acceptable to design a remedy. The decision to use the data should be based on their applicability to the project objectives. However, all data sources should be described, copied, and archived for future reference.

b. Interviews with current or former site personnel will provide anecdotal information or process knowledge about the site or specific activity. For military installations, the base historian, real property manager, and range managers should also be contacted. Local officials with the fire or law enforcement offices would typically have information if there have been responses to chemical spills or incidents.

c. Site visits are highly recommended to identify significant features from all profile types for inclusion in the initial CSM. Local archives are often the best resource for information, and a site visit allows the opportunity to verify much of the written information. Visual evidence, such as soil stains or stressed vegetation, can directly indicate that HTRW contaminants are present.

Sources of environmental contaminants should be described in terms of locations where the contamination exists and the types of contaminants present.

4-3. Facility Profiles

a. Facility Profiles provide information to determine the source areas at a site. The source area for an HTRW project should be identified based on the presence of an environmental contaminant. The team should be familiar with the historical operations at a site to recognize potential unauthorized disposal sites or areas with a likelihood for incidental spills or releases. At HTRW sites, source areas typically include landfills, surface impoundments, fire training areas, process buildings, and underground storage tanks. All suspected source areas should be marked clearly on a site map, including the relationship to property boundaries.

A **contaminant** is usually defined as any substance that is potentially hazardous to human health or the environment and is present at concentrations above background levels. Contaminants may also be defined by regulatory concentrations, regardless of background levels.

b. Sampling data are typically the most reliable indicator of contamination sources at a site. In the absence of adequate sampling data, other methods may be used to develop reasonable hypotheses regarding potential sources. Known burial sites, soil stains, or stressed vegetation are signs of potential source areas and should be included in the profile information.

4-4. Physical Profiles

a. The factors that affect the fate and transport of the contaminants are identified in the Physical Profile. This information includes soil type, soil properties, precipitation data, surface and ground water characteristics, and topography.

b. Physical profiles also describe site conditions important in determining exposure potential. Excessive topographic relief, dense vegetation, water bodies, or other physical characteristics may prevent or deter access to some sites, which limits potential for exposure.

c. Physical profiles are also important for identifying constraints to field activities and evaluating potential response actions.

4-5. Release Profiles

a. A contaminant is rarely immobile in the physical system; therefore, pathway analysis for environmental contaminants will usually require identification of a release mechanism. Release mechanisms include those physical processes that contribute to the introduction and distribution of a contaminant in the environment. This often leads to migration from the source area to another exposure medium.

Release mechanisms should be identified for each source present at the site. Multiple release mechanisms may exist for each source area.

b. Multiple release mechanisms may exist for the same source. A drum of liquid contaminant may leak to soil as a

primary release, then create a secondary release through percolation or infiltration. Volatilization of that contaminant from the soil may also occur, which adds another release mechanism from the primary source. Contaminated soil or sediment may become airborne or migrate through erosional processes to contaminate another medium. All potential release mechanisms and resulting contaminated media must be carefully evaluated.

c. Exposure media contain the source or become contaminated through migration of the contaminant from the source area. Examples of exposure media are surface soil, subsurface soil, ground water, sediments, surface water, and air. The biotic medium can exist through uptake, accumulation, or concentration of contaminants by organisms and subsequent transport of that contaminant through the food chain.

4-6. Land Use and Exposure Profiles

a. The Land Use and Exposure Profiles are used to identify on-site and surrounding off-site land use and associated receptors. These profiles should also include locations of natural resources and how they are used.

b. The team should determine current use of the property and surrounding land. Demographic as well as sensitive subpopulation information is included in this profile. Any beneficial resources at the site must also be identified. This will aid in determining the appropriate receptors to be evaluated in the pathway analysis.

c. The exposure profile identifies the available receptors at and near a site. A receptor is a person or population that is or may be exposed to a release. Both current and potential future receptors must be identified.

4-7. Ecological Profiles

The Ecological Profile for an HTRW project includes a description and use of the natural habitats at and surrounding the site. Identification of receptors is usually enhanced by use of maps that show the ecological profile and land use surrounding the facility and contaminant migration routes from the source. Ecological receptors may include individual organisms, populations, communities, or habitats and ecosystems. Threatened and endangered species, as well as migratory species, must be identified if they are present.

4-8. Pathway Analysis

Careful analysis of the profile information should allow the team to identify all source–receptor interactions for an HTRW project, for both current and reasonably anticipated future land use. The CSM will illustrate all potential exposure pathways (see Paragraph 2-6 for various CSM representations). An exposure pathway is the

An HTRW **exposure pathway** requires a source, an exposure medium, an exposure route, and a receptor. If any one of these is absent, that pathway is incomplete and no risk can be assigned. This effort must be documented to demonstrate that the potential for risk from this pathway has been evaluated.

course a physical or chemical agent takes to contact a receptor. Each pathway must include a **source**, an **exposure medium**, an **exposure route**, and a **receptor**. The pathway may also include a release mechanism (e.g., volatilization) and a transport medium (e.g., air), if the point of exposure is not at the same location as the source. It is important to remember that certain activities, such as soil excavation, can create a complete exposure pathway where one does not currently exist.

a. Sources. Source areas are identified when the Facility, Physical, and Release Profiles are generated, and will be used for the pathway analysis.

b. Interaction. For HTRW sites, the source–receptor interaction requires that exposure media and exposure routes be evaluated. Information from all profiles will assist in identifying these interactions.

(1) *Exposure Media*. Exposure media are those that contain the source, or those media that become contaminated through migration of the contaminant from the source area.

(*a*) Exposure to soil (surface and subsurface) is important where there is potential for receptor contact with contamination or for contaminant migration into another medium. The team must determine the depth of contamination, the potential for human or biotic contact with the contamination, and the migration potential of the contaminant.

(*b*) Exposure to ground water is important when contaminated ground water is used for domestic purposes. Contaminants are rarely released directly into ground water. Typically, ground water is contaminated by migration from another medium. The team must consider factors that affect the likelihood of a contaminant reaching ground water, such as depth to the aquifer and permeability of the overlying strata. Contaminant migration within the aquifer must consider transmissivity of the water-bearing unit as well as fate and transport properties of the contaminant.

(*c*) Exposure to sediments is most important to ecological receptors, as sediment-dwelling organisms typically serve as a food source for higher trophic level organisms. Human receptors can be exposed under certain conditions, such as through wading or swimming.

(*d*) Exposure to surface water is important when contamination is released directly to the surface water body, or through contaminant migration from another medium (e.g., surface soil or ground water). Human receptors can be exposed through recreational activities (e.g., swimming, wading, or fishing) or domestic uses of the surface water.

(*e*) Exposure to air is important when particulate dispersion of contaminated soils or sediments, release of volatile compounds from soils or sediments, or volatilization of contaminants from surface water is possible. Prevailing wind directions should be determined to measure potential for receptor exposure to this medium.

(*f*) The biotic medium is important when considering the potential for transfer of contaminants through the food chain. Additionally, bioaccumulation and bioconcentration of some contaminants in plants or animals can result in exposure of other receptors to harmful contaminant concentrations.

(2) *Exposure Routes*. Exposure routes are those processes by which a contaminant or physical agent comes in contact with a receptor. For most environmental contaminants, these processes include ingestion, inhalation, and dermal contact. More than one exposure route may exist for any single pathway. For example, a receptor may be exposed to contaminants in surface water through dermal contact and incidental ingestion while swimming. Inhalation of volatile compounds released from water is a third potential exposure route in this scenario, depending on the properties of the contaminant. Multiple receptors may be, and typically are, exposed through a single exposure route. Ingestion of contaminated surface water is as much a concern for terrestrial or aquatic wildlife as for humans.

c. Receptors. The receptors evaluated in the HTRW CSM were identified in the Land Use and Exposure Profile, as well as the Ecological Profile. The team must consider both human and ecological receptors. Evaluation of actual and potential receptors will consider both current and reasonably anticipated future land use. In addition, human receptors are typically subdivided into several categories to represent varying degrees of potential exposure. These may include residents, site workers, construction workers, recreational users, and trespassers. The probability, frequency, and duration of each receptor's exposure to the contaminant are assessed in this manner.