Section 14
Human Health Risk Assessment Summary

This section is a summary of the HHRA (CDM 2002b) portion of the RI/FS for the Calcasieu Estuary in Calcasieu Parish, Louisiana (Figure 1-1). The study area includes Bayou d'Inde, Bayou Verdine, and the Upper Calcasieu and Lower Calcasieu, extending from the saltwater barrier near Lake Charles down to Moss Lake (Figure 2-2). This assessment quantifies potential carcinogenic and noncarcinogenic health risks from exposure to contaminants in the Calcasieu Estuary, following EPA risk assessment policies and guidance. This assessment evaluates both current and future risks to individuals living and working near the estuary based on the assumption of no remediation or institutional controls (i.e., baseline conditions).

The baseline HHRA estimates current and future risks to humans resulting from direct exposure to contaminated sediments, surface water, fish, and shellfish from the Calcasieu Estuary in the absence of any remediation. The baseline risk estimates, developed using conservative or health protective assumptions, are used to determine which contaminants and exposure pathways pose the greatest risk, and whether remediation is likely to be required, and to provide a baseline against which any future remedial action can be evaluated.

14.1 Scope of Risk Assessment

The goal of the HHRA process is to provide a framework for developing the risk information necessary to assist in the determination of possible remedial actions at a site. EPA uses risk assessment as a tool to characterize the contaminants, evaluate the toxicity of the chemicals, assess the potential ways in which an individual may be exposed to the contaminants, and characterize the cancer risks and noncancer health hazards at a site (EPA 1989a). In accordance with EPA guidance, actions at Superfund sites are based on an estimate of the reasonable maximum exposure (RME) expected to occur under both current and future conditions at the site. EPA guidance also recommends estimation of risks based on central tendency (CT), or typical, exposures at a site (EPA 1995).

The following are the components of the HHRA used to evaluate the potential human health risks associated with the site:

Conceptual Site Model

The first step of the risk assessment is development of the conceptual site model. This section identifies current and potential land uses and receptors associated with the site. Based on this information, the site is broken down into several exposure areas for evaluation in the HHRA. The pathways through which chemical contaminants migrate from potential sources to existing receptors were identified. Receptor groups (i.e., human populations) that might potentially be exposed as a result of the presence of one or more chemicals in the environment were also identified.

Data Evaluation And Selection Of Chemicals Of Potential Concern
In this step, chemical concentration data are summarized and evaluated to identify COPCs for further analysis in the HHRA. The primary selection criteria for these chemicals include a comparison of the chemical concentrations to site-specific risk-based screening levels. The frequency of detection and toxicity of the chemicals were also considered.

Exposure Assessment
In the exposure assessment, qualitative or quantitative estimates of the magnitude, frequency, and duration of exposure are made. Exposure point concentrations for COPCs are estimated based on the 95 percent upper confidence level (UCL) on the arithmetic mean or the maximum concentration, whichever is lower. Exposure point concentrations are summarized for COPCs in each exposure area and medium. It should be noted that the risk assessment assumes that no reduction in exposure concentrations occurs due to natural physical/chemical processes, site remediation, or institutional controls.

Daily chemical intakes via the exposure route are quantitatively evaluated based on the concentration and the site-specific, medium-specific, and receptor-specific intake variables. Intake variables are estimated for both an RME scenario and a CT exposure scenario.

Toxicity Assessment
The toxicity assessment provides weight-of-evidence information regarding the potential for a particular chemical contaminant to cause adverse health effects in exposed individuals and provides, where possible, an estimate of the relationship between the extent of exposure to a chemical contaminant and the increased likelihood and/or severity of adverse health effects (EPA 1989a).

EPA has evaluated the toxicity of numerous chemicals and has made available the resulting toxicity information and toxicity values, which have undergone extensive peer review. These established toxicity values are obtained from EPA's Integrated Risk Information System (IRIS) database (EPA 2001) or from the Health Effects Assessment Summary Tables (EPA 1997a), if no value is available in IRIS. The Superfund National Center for Environmental Assessment (NCEA) is consulted for other specific chemical toxicity values, as directed by HEAST, when no value is shown in IRIS or HEAST.

Risk Characterization
The last step of the risk assessment process is risk characterization. This process consists of comparing the chronic daily intake for each chemical to which the receptor group might be exposed with concentrations known or suspected to present some health risk or hazard. Quantitative estimates of the carcinogenic risks and noncarcinogenic health effects associated with each exposure pathway are presented for current and potential future land uses of the site.

Because of the number of assumptions required during the risk assessment process, some degree of uncertainty is inevitably associated with the risk and hazard estimates. These uncertainties are discussed in the risk characterization section of the HHRA (CDM 2002b).

14.2 Overview of Risk Assessment Approach

In the HHRA for the Calcasieu Estuary, contaminants in sediment, surface water, fish tissue, and shellfish tissue at the Calcasieu Estuary site were quantitatively evaluated for potential health threats to human receptors via the ingestion and dermal pathways. Recreational users, commercial fishers, and residential fish and shellfish consumers were evaluated under present and potential future land use conditions. The estimates of risk and hazard and the greatest chemical contributors to these estimates have been presented and discussed.

Chemicals of potential concern were selected based on criteria outlined in RAGS (EPA 1989a), including screening levels that are presented in the HHRA (CDM 2002b). The chemicals of potential concern included SVOCs, pesticides, PCBs, dioxins/furans, and inorganics. The essential nutrients (i.e., calcium, magnesium, potassium, and sodium) were not quantitatively addressed as their potential toxicity is significantly lower than other inorganics at the site, and most existing toxicological data pertain to dietary intake.

Exposure routes and human receptor groups were identified, and quantitative estimates of the magnitude, frequency, and duration of exposure were made. Exposure points were estimated using the minimum of the 95 percent UCL and the maximum concentration. Chronic daily intakes for the ingestion route were calculated for reasonable maximum exposures.

In the toxicity assessment, current toxicological human health data (i.e., reference doses and slope factors) were obtained from various sources and were utilized in the order as specified by Risk Assessment Guidance for Superfund (RAGS) (EPA 1989a). Risk characterization involved integrating the exposure and toxicity assessments into quantitative expressions of risks/health effects. Specifically, chronic daily intakes were compared with concentrations known or suspected to present health risks or hazards. The carcinogenic risks and noncarcinogenic hazard index values calculated for the site are based on the reasonable maximum exposure (the highest exposure reasonably expected to occur at a site). The intent is to estimate a conservative exposure case that is still within the range of possible exposures.

In accordance with NCP Section 300.430 (e)(2) for known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper-bound lifetime cancer risk to an individual of between 10^{-6} and 10^{-4}. Per RAGS Part B: Development of Risk-Based Preliminary Remediation Goals (EPA 1991c), for noncarcinogenic effects, the NCP does not specify a range, but it is generally appropriate to assume a hazard index equal to 1.

In general, the EPA recommends target values or ranges (i.e., risk of 10^{-6} to 10^{-4} or hazard index of one) as threshold values for potential human health impacts (EPA 1989a). These target values aid in determining whether additional response action is necessary at the site. In cases where remedial action is warranted, the values also provide a basis for determining residual chemical levels that are adequately protective of human health, as well as a basis for comparing potential health impacts of various remedial alternatives.

14.3 Summary of Site Risks

In summary, a review of the carcinogenic risks and noncarcinogenic hazards for sediment and surface water exposures in the Calcasieu Estuary showed values that fell within EPA's target risk range of 10^{-4} to 10^{-6} and below a hazard index of 1. However the carcinogenic risks and noncarcinogenic hazards for fish and shellfish consumption exceeded EPA's target risk range and hazard index. A summary of excess lifetime cancer risks and of noncancer hazard indices is presented in Tables 14-1 and 14-2, respectively.

Risk Drivers

Shellfish Tissue
- PCBs
- Dioxin/Furans
- Arsenic
- Pesticides

Fish Tissue
- Dioxin/Furans
- Arsenic

Total excess lifetime cancer risks from consumption of fish and shellfish from the Calcasieu Estuary were above the range of 10^{-6} to 10^{-4}. The cancer risks associated with fish and shellfish ingestion from the areas of Bayou d'Inde, Upper Calcasieu, and Lower Calcasieu were all above 1×10^{-4} (1 in 10,000) for residential exposure and 1×10^{-3} (1 in 1,000) for subsistence exposure. The highest cancer risks were associated with ingestion of fish and shellfish ingestion from Bayou d'Inde. The chemicals that contributed most significantly to risk estimates include PCBs, dioxins/furans, arsenic, and pesticides in shellfish tissue and dioxins/furans and arsenic in fish tissue. Several pesticides, including aldrin, dieldrin, heptachlor epoxide, heptachlor, and BHCs, also contributed to the total cancer risk estimate.

Total excess lifetime cancer risks from ingestion of dioxins/furans in fish and shellfish from Bayou Verdine were also above the range of 10^{-6} to 10^{-4}. The cancer risk estimates were 1×10^{-4} (1 in 10,000) for residential exposure and 6×10^{-4} (6 in 10,000) for subsistence exposure. The estimated risks for residential fish/shellfish consumption were dominated by fish ingestion (1×10^{-4} for fish ingestion, 2×10^{-6} for shellfish ingestion). Similarly, for subsistence fish/shellfish ingestion, the estimated risks were due primarily to fish ingestion (5×10^{-4} for fish ingestion, 7×10^{-5} for shellfish ingestion). Only dioxin/furan concentrations were used to estimate these risks. Risks associated with other chemicals present in fish and shellfish were estimated in ENTRIX (2001). When the risks associated with dioxin/furan are added to the risks from the ENTRIX report, the total cancer risks for all chemicals in fish/shellfish are 4×10^{-4} for residential consumption and 2×10^{-3} for subsistence consumption.

The total hazard indices for both residential and subsistence fish/shellfish consumption from Bayou d'Inde, Upper Calcasieu, and Lower Calcasieu were all

greater than the threshold of one for noncancer effects. These hazard indices indicate that there is a potential for noncancer health effects to occur from ingestion of fish and shellfish from the Calcasieu Estuary. The chemicals that contributed most significantly to the noncancer hazard index include PCBs and manganese in shellfish tissue and PCBs in fish tissue. PCBs may adversely affect the eyes, skin, and nails of individuals consuming fish and shellfish from the Calcasieu Estuary at the rates assumed in this risk assessment. In addition, elevated levels of PCBs may cause immunological and developmental effects. Manganese may impact the nervous system of shellfish consumers.

As in any risk assessment, the estimates of potential health threats (carcinogenic risks and noncarcinogenic health effects) for the Calcasieu Estuary have associated uncertainties. The key uncertainties in this assessment that could influence the risk estimates are the following:

- Chemical concentrations in the estuary are likely to fluctuate and decrease over time. The risk estimates assume long-term (i.e., up to 30 years) exposure to a constant concentration and therefore may overestimate risks.

- Some of the risks noted in the assessment were based on limited data. For example, a limited number of tissue samples were analyzed for dioxins/furans, and an even smaller set were analyzed for barium and manganese. Additional data may need to be collected to provide technical support for any cleanup decisions that are based primarily on these chemicals in fish/shellfish tissue.

- For several COPCs, concentrations measured in reference area samples were similar to or higher than concentrations measured in the Calcasieu Estuary. Cancer risks estimated for dioxins/furans in reference area biota represent 5 to 44 percent of the risks estimated for dioxins/furans in the estuary, depending on the AOC. Cancer risks estimated for arsenic in reference area biota were higher than those estimated for the estuary.

- There is some uncertainty in the toxicity value for dioxin/furans. EPA has proposed a cancer slope factor for dioxins/furans that is seven times higher than the value applied here to 2,3,7,8-TCDD equivalents. Risks associated with these chemicals could be almost an order of magnitude higher.

As a result of these uncertainties, this risk assessment should not be construed as presenting absolute risks or hazards. Rather, it is a conservative analysis intended to indicate the potential for adverse impacts to occur based on a reasonable maximum exposure.