

Remedial Investigation San Jacinto River Waste Pits Superfund Site – May 2013

by Jennifer Ronk and Birnur Guven, Houston Advanced Research Center

What is the Purpose of the Remedial Investigation Report?

The Remedial Investigation (RI) report describes the work that has been done at the site, describes what contaminants have been detected, where they are located, and how those contaminants might move through, or be transformed in the environment. It also describes what kind of effects these contaminants might have on people or the ecosystem and describes possible methods of addressing the contamination.

What is the Time Critical Removal Action (TCRA)

A cap was installed to isolate the wastes in the impoundments north of I-10 in July 2011. The purpose of the cap was to stop the release of contaminants from the north impoundment waste pits while the investigation was being completed and long term solutions are selected.

What are the Chemicals of Potential Concern (COPCs)

Chemicals of Potential Concern (COPCs) for Human health

- Dioxins and furans
- Polychlorinated biphenyls (PCBs)
- Mercury

Chemicals of Potential Concern (COPCs) for the environment and animals in the area

- Dioxins and furans

Dioxins and furans were higher than risk-based screening levels, and are described the most important risk driver in the risk assessments summarized [here](#) (in the HARC Technical Review of the Baseline Human Health Risk Assessment) and [here](#) (in the HARC Technical Review of the Baseline Ecological Assessment Report).

What are the baseline conditions?

The RI includes evaluation of baseline risks to human and ecological receptors. Receptors are species, populations, communities, or habitats that might be exposed to contaminants (e.g. humans such as recreational or subsistence fishermen and recreational visitors; and fish and wildlife such as river bottom-dwelling invertebrates, fish, reptiles, birds, mammals). Baseline conditions are the conditions within the Site before any remediation takes place. For the area north of I-10 and aquatic environment,

baseline means environmental conditions that existed immediately prior to installation of the cap. For the area of investigation on the peninsula south of I-10, baseline refers to the current condition.

Baseline conditions provide a point of reference for evaluation of the “no-action alternative” in the feasibility study (FS). Superfund regulations require that sites evaluate the risks and costs of doing nothing as a baseline that can be used for comparison with the other possible methods of cleaning up the site. This comparison is done as part of the FS.

What kind of investigations were conducted for the RI?

Samples were collected from sediment, soil, tissue, and groundwater. Background samples were also collected for soil, sediment, and tissue, so that it would be possible to identify contamination that was related to the site.

Data collection for the RI began in April 2010 and was completed in July 2012. Surface sediment samples (0 to 6 inches) were collected from 59 locations in a grid within the Site, including 3 samples at the same location within the original impoundments north of I-10. Ninety-nine sediment core samples were collected from 14 locations within the Site. Samples to be used in the exposure assessments for human and ecological receptors were collected from beaches in five discrete areas within the Site. Samples to be used in the engineering design evaluation were collected within and in the vicinity of the original impoundments north of I-10.

Tissue sampling was conducted from September 30 to October 12, 2010. Additional sampling was conducted in background areas in October 2011 to get additional information on background for dioxins and furans in edible blue crab and catfish fillet. Tissue sampling was conducted for the exposure assessment. Hardhead catfish, Gulf Killfish, and Blue crab samples were collected within the site perimeter and the upstream background locations.

The soil investigations conducted within the Site and for the background study were conducted during seven individual sampling events.

Groundwater sampling has been conducted in the area of the impoundments north of I-10, with samples collected in late December 2010 and early January 2011; and in the area of investigation on the peninsula south of I-10, with samples collected in May 2012 to monitor shallow and deep wells. Regional groundwater is directed down southeast towards the Gulf of Mexico. The fine grained Beaumont Formation separates shallow soils from the underlying Chicot Aquifer and limits any recharge from the surface waters, making it unlikely that the shallow groundwater or any site related contaminants would affect local wells. In order to do that, groundwater from the site alluvial sediments would have to overcome significant surface water/groundwater interactive forces, penetrate up to 20 ft of Beaumont Formation clay and silt, and flow under the river to reach these wells, which is very unlikely. Moreover, dioxins/furans strongly adsorb to soil particles and very immobile in the subsurface.

Finally, samples were collected from the armored cap to evaluate the effectiveness of the cap in containing COPCs and controlling any releases from the northern impoundments to the environment.

Background Concentrations of COPCs

Background information and samples were collected for soil, sediment, and tissue for this RI. Comparisons of COPC concentrations in surface sediment, surface soils, and edible blue crab and hardhead catfish fillet indicate that dioxins, furans, and several metals are higher in samples collected within the Site than in background areas, indicating that this contamination is related to chemicals that had been released from the waste pits before the cap was installed. Contaminants with similar concentrations in samples collected from the site and from background locations, however, are less likely to be related to releases from the waste pits site.

The results of the investigations in the Area North of I-10

Dioxins and Furans, PCBs, and Mercury in Sediments

The northern impoundments in their pre-cap condition were located on a partially submerged 20-acre parcel on the western bank of the San Jacinto River, immediately north of the I-10 Bridge.

Impoundments were constructed in 1965 and Champion Paper Inc. transported pulp and paper waste by barge by to the site. There were dioxins, furans, and some metals in the pulp and paper waste. The pits were filled in 1966.

Large scale groundwater pumping in 1970s and 1980s caused regional subsidence (sinking) of land. This subsidence caused the formerly dry impoundments to become partially submerged. This meant that waste material came in contact with the surface water. The site is located in a dynamic tidal section of the river, causing sediment and waste material move.

Dredging activities in the area may have also affected the movement. In addition to dredging in the vicinity of the northern impoundments, Southwest Shipyards, a barge maintenance and cleaning facility located on the eastern half of the peninsula south of I-10, leased part of the upland sand separation area in 1996. The Southwest Shipyards cleans and repairs of barges that carry petrochemical products.

In mid-2011, the San Jacinto River Fleet established a barging operation in the waters and at the shoreline surrounding the upland sand separation area. The San Jacinto River Fleet use tugboats to move barges around the upland sand separation area, including directly in the area where the sediments with the highest dioxin and furan concentrations outside of the original impoundments north of I-10 are located. These activities may have moved surface and subsurface sediments in this area.

The movement of contaminated sediment appears to have been limited to areas within close proximity to the waste pits. In general, surface and subsurface sediment concentrations drop rapidly from inside the impoundment area to outside the original impoundment. Sediments surrounding the impoundments north of I-10 and elsewhere within the Site contain dioxins and furans. The relative concentrations of the dioxin/furan mixture (called the "fingerprint") in the proximity of the impoundments was different from the fingerprint of those compounds found in sediments collected elsewhere in Ship Channel.

Elevated dioxin and furan concentrations were reported in the subsurface sediment samples collected in some, but not all, of the cores collected from within the impoundment perimeter. Outside of the impoundment perimeter, concentrations are significantly lower, in both surface and subsurface samples. Outside of the impoundments, the maximum concentration in sediments at depth occurs in a core to the north (upstream) of the northern impoundments; these dioxins and furans are not clearly attributable to the waste material from the northern impoundments. Elsewhere, concentrations in sediments at depth are lower except for one sample collected at 15 to 17 feet southwest of the peninsula south of I-10.

Concentrations of PCBs and mercury in samples collected from within the northern impoundments are higher than in nearby sediments. However, both PCBs and mercury are common contaminants in urban environments, and these contaminants may be attributable to other sources. The PCB congeners in sediment are similar compounds to the dioxins that are the risk drivers at the site; therefore, methods that address dioxins will also address PCBs in sediment. Mercury concentrations in four soil samples on the upland sand separation area are higher than those in any sample from within the northern impoundments, suggesting that the elevated mercury in soils on the upland sand separation area is not a result of influence of wastes from the impoundments north of I-10. The actual source of these elevated mercury concentrations is unknown.

Dioxins and Furans, PCBs, and Mercury in Tissue

Tissue samples are not very useful in describing distribution and extent of COCs, especially for species that move a lot, such as the crab and catfish. These species can take up and retain dioxins and furans, PCBs, and mercury from locations other than the Site. Also, dioxins and furans can be digested and excreted by both fish and invertebrates at different rates. It is known that there are sources of PCBs, dioxins and furans in areas outside the Site Perimeter.

Two of the species collected for this investigation, the common Rangia (clam) and the Gulf killifish, do not move much. These show a more clear linkage between the concentrations of dioxins and furans in their tissues and their proximity to the impoundments north of I-10 under baseline conditions.

Results of Source Evaluation

The RI identified and evaluated sources of all four COCs (dioxins, furans PCBs and mercury). In addition to the paper mill wastes, these sources include upland soils, stormwater runoff, wastewater effluents on and directly upstream from the Site Perimeter, and atmospheric inputs. Patterns of COCs in tissue of species with limited movement (Rangia clam and Gulf killifish) suggest that the paper mill wastes under baseline conditions are a source of dioxins and furans to tissues of these species when they are sampled directly next to the northern impoundments.

Chemical Fate, Transport, and Bioaccumulation

The chemical fate and transport model was developed for dioxin and furans and simulates the key processes affecting these chemicals. The model provides a good representation of concentrations of these chemicals in the river at the Site. The model also represents the locally increased concentrations observed in the area surrounding the northern impoundments. Predictions by the fate model suggest

reductions in concentrations of dioxins and furans in surface sediments within the area surrounding the Site over the period from 2005 to 2010. As part of the feasibility study, the model will be used to assess how the system would respond to different potential methods of cleaning up the site.

Bioaccumulation of Dioxins and Furans

Although there are data gaps, and dioxin and furan bioaccumulation is not fully understood, some conclusions are supported by the results of the sampling and analysis:

- Dioxin and furan mixtures in tissue samples are the type that is most readily absorbed.
- For the majority of dioxin and furan types in the mixtures, there are no statistically significant correlations between concentrations in environmental media (sediment, soils, etc.) and in whole or edible tissues.
- Risk managers should not expect to predict the precise reduction in tissue concentrations due to specific reductions in the concentrations of dioxins and furans in sediment.

Risk Assessments

The findings of the baseline human health and ecological risk assessments are consistent: risk scenarios involving humans or ecological receptors which assumed extensive direct contact with the wastes from the impoundments north of I-10 result in risks that are higher than the acceptable levels, and the risk driver is the dioxins and furans associated with the waste materials.

For humans, hypothetical fishing and recreational scenarios that assume human use of the area within the original 1966 perimeter of the impoundments north of I-10 (referred to in the reports as Beach Area E), make assumptions regarding the extent and frequency of contact with sediments within the original 1966 perimeter of the impoundments under baseline conditions prior to implementation of the cap. For spotted sandpiper and marsh rice rat, close contact with and potential ingestion of these same materials results in risks that are higher than the acceptable levels. Direct contact pathways are the most important driver of risks calculated as part of the risk assessment process that are higher than the acceptable levels.

Installing the cap removed the direct contact pathway and resulted in substantially reduced risks from dioxins and furans. However, it did not eliminate all potential dioxin and furan risks to people. For those hypothetical scenarios assuming levels of consumption of fish and shellfish from within USEPA's Preliminary Site Perimeter, there remains some uncertainty about the actual level of risk reduction achieved by the cap, because of the absence of empirical data for post-cap concentrations of dioxins and furans in fish and crab edible tissues.

Conceptual Site Model

Dioxins and furans are the indicator chemical group for the area north of I-10 and the aquatic environment. The wastes in the northern impoundments are a source of dioxin and furan toxicity in sediments within this area, but they are not the only source. The dioxins and furans in the paper mill wastes have a distinctive fingerprint. This distinctive fingerprint provides a means to target remedial

action on those sediments and soils that can be identified as having been impacted by the paper mill wastes from the northern impoundments.

Dioxins and furans have extremely low water solubility and strong affinity for sediments and lipids within tissue. Although some dioxins deposited on or near the water surface will be broken down by sunlight the vast majority will stick to particulate matter, eventually settle to sediment bed, they will then be subject to sediment transport processes. After they are attached to the sediment, they show little potential for leaching (releasing to the water) or volatilization (releasing to the air). They are highly stable in the environment, persistence in decades.

Some certain dioxin and furans are associated with the paper mill wastes in the northern impoundments. Other dioxins and furans are likely originated from other sources including nearby public treatment works and industries, and urban runoff both within and outside the Site. Physical proximity to the site provides a basis for associating a possible source of the observed tissue concentrations of dioxins and furans.

- The area within the original impoundments north of I-10 contains the highest concentrations of dioxins and furans under baseline conditions. This area is associated with the greatest risk identified by the risk assessment process, particularly from assumed direct contact exposures (by people) and direct sediment ingestion (by shorebirds and small mammals) under the hypothetical conditions assumed for risk assessment purposes. Proximity to the wastes in the impoundments is also an important risk driver for clams; tissue concentrations of dioxins in clam samples collected directly adjacent to the wastes reached and exceeded levels associated with adverse reproductive effects. As a result, implementation of the cap eliminated much of the baseline risk.

Area of investigation south of I-10

The peninsula has been a busy industrial area for several decades. The peninsula south of I-10 houses shipping and marine industrial services, serves as a transport hub, and is the site of barge or ship maintenance, cleaning and painting facility.

The subsurface concentrations of dioxins and furans in some areas are elevated; however based on the reported concentration in samples collected from the area, there are no elevated ecological risks from dioxins and furans. For hypothetical future construction workers, hypothetical exposure scenarios that assumed a potential for direct contact exposure via eating and skin contact to soils at three locations resulted in non-cancer and dioxin cancer hazard indices greater than 1. For all three exposure units with non-cancer and dioxin cancer hazards greater than 1, over 99 percent of the risks were attributable to assumed exposure to dioxins and furans. There are no increased risks to workers and trespassers from any chemical in surface soil, and there are no increased risks to ecological receptors including reptiles, mammals, and birds, except a possible risk to terrestrial bird populations from lead and zinc.

Three dioxin and furan source types have been identified in soils of the area of investigation south of I-10.

1. General urban background sources such as fuel combustion and other common municipal activities, or specific local sources like the Baytown Wastewater Treatment Plant outfall and a major stormwater outfall, both of which discharge into the aquatic environment within the Site.
2. The paper mill wastes from the Champion Paper mill.
3. An unknown third source that has a fingerprint that is distinct from the other two sources, and affects only soils in the area of investigation on the peninsula south of I-10, not sediments. The nature and origin of this source are unknown. Its spatial distribution in subsurface soils suggests that it was deposited earlier than the paper mill wastes.

Although several metals were identified within the area of investigation on the peninsula south of I-10, there is no evidence that these metals or other chemicals in soils have adverse effects on the aquatic environment. Since risks associated with any paper mill wastes are limited to those for the hypothetical future construction worker in three locations, and since such wastes are not mobile, available information is adequate for risk management decision-making. Since there are no further data gaps for this area, the RI for this area is considered to be complete.

Remedial Action Objectives (RAOs)

RAOs explain the accomplishments to be expected from the proposed site cleanup. They should be linked to the conceptual site model, address the significant exposure pathways and site-specific risks to human health and the environment, and provide the basis for more specific cleanup goals.

RAO 1: Stop the release of dioxins and furans from the former paper mill waste impoundments north of I-10 to sediments and surface waters of the San Jacinto River by transport and dispersal of wastes, processing of dredged material, and sediment resuspension due to storms.

Transport and dispersal of wastes is no longer an issue because no disposal is occurring at the northern impoundments. The cap has eliminated the transport from erosion and sediment resuspension in the northern impoundments.

For the Southern Impoundments, runoff of soil particles and migration of dissolved dioxins and furans with groundwater are potential pathways for dioxin and furan loading to surface water and sediment.

RAO 2: Reduce human exposures to paper mill waste-derived dioxins and furans from consumption of fish and shellfish by cleaning up sediments affected by paper mill wastes to appropriate levels. Dioxins and furans originating in the wastes deposited in the impoundments have been identified as COCs, and are considered a risk driver for hypothetical human groups who could visit the area within the Site and collect fish and shellfish for consumption.

RAO 3: Reduce human exposure to paper mill waste-derived dioxins and furans from direct contact with sediments by remediating sediments affected by paper mill wastes to appropriate cleanup levels. People may become exposed to COCs from the northern impoundments when visiting the area within the Site and wading or having direct contact with sediments in the intertidal zone. The construction of the cap achieved part of this RAO by eliminating exposures to paper mill wastes from direct contact within the

original impoundments north of I-10. However, more sediment remedial actions may be required to reduce or eliminate these exposures.

RAO 4: Reduce human exposures to paper mill waste-originated dioxins and furans from direct contact with upland soils through the skin or eating to appropriate cleanup levels. Dioxin and furan concentrations in surface and near-surface soils are below the EPA's temporary Preliminary Remediation Goals (PRG) for *industrial* soil but soil remediation actions may still be required depending on EPA's conclusions of the risk assessment process.

RAO 5: Reduce exposures of fish, shellfish, reptiles, birds, and mammals to paper mill waste by remediating sediment affected by paper mill wastes to appropriate cleanup levels. Animals may become exposed to COCs from the waste from the impoundments north of I-10 through direct contact with sediments and through ingestion. Remediation of sediments is expected to reduce COC concentrations in sediments, water, and soils, that animals may have contact with, and will thus reduce or eliminate the pathways linking animals to chemicals from the impoundments.