RECORD OF DECISION

SAN JACINTO RIVER WASTE PITS

HARRIS COUNTY, TEXAS

EPA ID: TXN000606611

U.S. ENVIRONMENTAL PROTECTION AGENCY

REGION 6

DALLAS, TEXAS

OCTOBER 2017

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LIST OF ACRONYMS AND ABBREVIATIONS

95UCL	95 percent upper confidence limit
°F	degrees Fahrenheit
Anchor	Anchor QEA, LLC
ARAR	applicable or relevant and appropriate requirement
BERA	baseline ecological risk assessment
BHHRA	baseline human health risk assessment
BMP	best management practice
CDI	chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
COC	chemical of concern
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CWA	Clean Water Act
cy	cubic yard(s)
Dioxins	polychlorinated dibenzo-p-dioxins
EPA	U.S. Environmental Protection Agency
FCA	fish collection area
FS	feasibility study
furans	polychlorinated dibenzofurans
HI	hazard index
HpCDD	heptachlorodibenzo-p-dioxin
HQ	hazard quotient
HxCDF	hexachlorodibenzofuran
I-10	Interstate Highway 10
IC	institutional control
Integral	Integral Consulting Inc.
IRIS	Integrated Risk Information System
Mg/kg	milligram(s) per kilogram
MNR	monitored natural recovery
MSL	mean sea level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

ng/kg	nanogram(s) per kilogram
NOAEL	no observed adverse effects level
NPL	National Priorities List
OCDD	octachlorinated dibenzo-p-dioxin
PCB	polychlorinated biphenyl
pg/kg	picogram(s) per kilogram
pg/L	picogram(s) per liter
PRG	preliminary remediation goal
RAO	remedial action objective
RfD	reference dose
RI	remedial investigation
ROD	Record of Decision
SF	slope factor
Site	San Jacinto River Waste Pits
SLERA	screening level ecological risk assessment
SPME	solid-phase micro extraction
S/S	solidification and stabilization
SVOC	semivolatile organic compound
TCEQ	Texas Commission on Environmental Quality
TCRA	Time Critical Removal Action
TCDD	tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofuran
TDSHS	Texas Department of State Health Services
TEQ	2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalents
$TEQ_{P, M}$	dioxin-like PCB congeners toxicity equivalents calculated using toxicity equivalency factors for mammals
TMDL	total maximum daily load
TOC	total organic carbon
TPWD	Texas Parks and Wildlife Department
TxDOT	Texas Department of Transportation
UAO	Unilateral Administrative Order
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Society
VOC	volatile organic compound

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PART 1: THE DECLARATION

1.1 SITE NAME AND LOCATION

The San Jacinto River Waste Pits Superfund Site is located in Channelview, Harris County, Texas (Site). The U.S. Environmental Protection Agency (EPA) Superfund Database Identification Number is TXN000606611. This Site remedial response is a single operable unit, and all areas and media within the site are addressed in this Record of Decision (ROD) document.

1.2 STATEMENT OF BASIS AND PURPOSE

This decision document presents the Selected Remedy for the San Jacinto River Waste Pits Site in Harris County, Texas. The Selected Remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 U.S. Code §9601 et seq., as amended by the Superfund Amendments and Reauthorization Act of 1986; and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300, as amended. This decision is based on the administrative record for the site, which has been developed in accordance with Section 133(k) of CERCLA, 42 U.S. Code §9613(k).

The State of Texas, acting through the Texas Commission on Environmental Quality (TCEQ), was provided the opportunity to review and comment on the Selected Remedy.

1.3 ASSESSMENT OF THE SITE

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment and pollutants or contaminants which may present an imminent and substantial endangerment to the public health or welfare.

1.4 DESCRIPTION OF THE SELECTED REMEDY

The Selected Remedy is a final action for the San Jacinto River Waste Pits Site. It addresses unacceptable human health risks associated with consumption of fish and direct contact (skin contact and incidental ingestion) with the waste material from the Site. It also addresses Site-related ecological risks to bottom-dwelling organisms (benthic invertebrates) from exposure to sediment and waste material.

The overall strategy for addressing contamination at the Site includes excavation and off-site disposal of source materials and contaminated soils from impoundments in and adjacent to the San Jacinto River. There are impoundments located both north and south of Interstate 10. Institutional Controls (ICs) will be used to prevent disturbance of the certain areas (e.g., dredging and anchoring in the Sand Separation Area, and construction, and excavation in the Southern Impoundment). Monitored natural recovery (MNR) will be used for sediment in the nearby sand separation area to ensure remedy protectiveness in the aquatic environment. The Selected Remedy includes the following major components:

- Removal of a portion of the existing temporary armored cap installed under the time-critical removal action (TCRA).

- Removal of approximately 162,000 cubic yards (cy) of waste material exceeding the paper mill waste material cleanup goal of 30 nanograms per kilogram (ng/kg) 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) toxicity equivalent (TEQ) that is located beneath the armored cap in the northern impoundment. The waste material will be stabilized as necessary to meet the appropriate requirements at a permitted disposal facility.

- Excavation of approximately 50,000 cy of waste material exceeding the paper mill waste material and soil cleanup goal for the Southern Impoundment of 240 ng/kg TEQ to a depth of 10 feet below grade in the peninsula south of I-10.

1.5 STATUTORY DETERMINATIONS

The selected remedy meets the requirements for remedial actions set forth in Section 121 of CERCLA, 42 U.S.C. § 9621, because it meets the following requirements: 1) it is protective of human health and the environment; 2) it meets a level or standard of control of the hazardous substances, pollutants and contaminants that at least attains the legally applicable or relevant and appropriate requirements under federal and state laws (unless a statutory waiver is justified); 3) it is cost-effective; and 4) it utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.

In addition, Section 121 of CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity or mobility of hazardous substances as a principal element (or justify not satisfying the preference). Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during the remediation will be tested to comply with the applicable requirements.

This remedy will result in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure. Pursuant to Section 121(c) of CERCLA, statutory reviews will be conducted no less often than once every five years after the initiation of construction to ensure that the remedy is, or will be, protective of human health and environment. If justified by the review, additional remedial actions may be implemented to remove, treat, or contain the contaminants.

1.6 ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record file for this site.

- A discussion of the nature and extent of contamination is included in the "Summary of Site Characteristics" section (Section 2.5).
- Chemicals of concern (COCs) and their respective concentrations (Sections 2.5)
- Baseline risks for human health and the environment represented by the COCs (Section 2.7)
- Cleanup levels established for COCs and the basis for these levels (Section 2.8)
- How source materials or highly toxic materials constituting Principal Threat Wastes are addressed (Section 2.11).
- Current and reasonably anticipated land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and the ROD (Section 2.6)
- Potential land and groundwater use that will be available at the site as a result of the Selected Remedy (Section 2.6)
- Estimated capital; annual operation and maintenance; and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Section 2.12)
- Key factors that led to selecting the remedy (i.e., describe how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (Section 2.10).

1.7 AUTHORIZING SIGNATURE

This ROD documents the Selected Remedy for the San Jacinto River Waste Pits Site. This remedy was selected by the EPA after consultation with the TCEQ.

By: [signature] Date: 10/11/17

E. Scott Pruitt
Administrator
U.S. Environmental Protection Agency

CONCURRENCE PAGE FOR RECORD OF DECISION

San Jacinto River Waste Pits Site

Gary Miller, Remedial Project Manager Arkansas/Texas Section	10/2/17 Date
Carlos A. Sanchez, Chief Arkansas/Texas Section	10/2/17 Date
John C. Meyer, Chief Superfund Remedial Branch	10/2/17 Date
Anne Foster, Assistant Regional Counsel Regional Counsel Superfund Branch	10/5/17 Date
Mark A. Peycke, Chief Regional Counsel Superfund Branch	10/05/17 Date
Carl E. Edlund, P.E., Director Superfund Division	10/02/17 Date

PART 2: THE DECISION SUMMARY

This Decision Summary provides a description of the site-specific factors and analyses that led to the Selected Remedy. It includes background information, the nature and extent of contamination, assessment of human health and environmental risks posed by contamination, and identification and evaluation of remedial action alternatives for the site.

2.1 SITE NAME, LOCATION AND DESCRIPTION

The San Jacinto River Waste Pits Site is located in Harris County Texas (Figure 1) east of the City of Houston, between two unincorporated areas known as Channelview and Highlands. The National EPA Superfund Database Identification Number is TXN000606611. The EPA is the lead agency and the TCEQ is the support agency.

The site consists of a set of impoundments built in the mid-1960s for the disposal of solid and liquid pulp and paper mill wastes, and the surrounding areas containing sediments and soils impacted by waste materials disposed of in the impoundments. In 1965 and 1966, pulp and paper mill wastes (both solid and liquid) were transported by barge from the Champion Papers, Inc. paper mill in Pasadena, Texas, and deposited in the impoundments. The northern set of impoundments, approximately 14 acres in size, are located on a partially submerged 20-acre parcel on the western bank of the San Jacinto River, immediately north of the I-10 bridge over the San Jacinto River (Figure 2). Currently, approximately half of the northern 20-acre parcel, including the abandoned waste disposal ponds, is now submerged below the adjacent San Jacinto River's water surface. The Southern Impoundment, less than 20 acres in size, is located on a small peninsula that extends south of I-10.

The area receives an average of 54-inches of rain annually. The Site may be affected by tides, winds, waves, and currents resulting from extreme weather conditions such as strong storm winds, flooding, tornadoes, and hurricanes, which may cause a potential release or migration of dioxin and furan contaminated materials.

The primary hazardous substances documented at the Site are polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans. Physical changes at the site during the 1970s and 1980s, including regional subsidence of land in the area due to large scale groundwater extraction, resulted in partial submergence of the northern impoundments and exposure of the hazardous substances in the impoundments to surface water of the San Jacinto River.

A Time Critical Removal Action (TCRA) to address temporarily the hazardous substances associated with the impoundments north of I-10 was completed in July 2011. The TCRA included the installation of geotextile and geomembrane underlayments in certain areas and a temporary armored cap. The purpose of the temporary cap was to prevent hazardous substances from washing into the river during the site characterization and remedy selection process and to prevent the recreational use of the northern impoundments that had been occurring.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

This section provides background information on past activities that have led to the current contamination at the Site, and federal and state investigations and cleanup actions conducted to date under CERCLA.

2.2.1 *Historical Activities*

In the 1960s, McGinnes Industrial Management Corporation transported liquid and solid pulp and paper mill wastes by barge from the Champion Papers, Inc. paper mill in Pasadena, Texas to impoundments located north of I-10, adjacent to the San Jacinto River, where the waste was disposed of. Champion Papers, Inc. business records indicate the paper mill produced pulp and paper using chlorine as a bleaching agent (EPA 2009). The pulp bleaching process forms dioxins and furans as a by-product. Historical activities for each area are discussed below.

Northern Impoundments

Impoundments were built by constructing berms prior to 1965 within the estuarine marsh to the west of the main channel of the San Jacinto River, just north of what was then Texas State Highway 73 and is now 1-10. The impoundments were divided by a central berm running lengthwise (north to south) through the middle, and were connected with a drain line to allow flow of excess water (including rain water) from the impoundment located to the west of the central berm into the impoundment located to the east of the central berm. The excess water collected in the impoundment located to the east of the central berm was supposed to be pumped back into barges and taken off-site (Anchor and Integral 2010).

On December 27, 1965, the Harris County Health Department observed pumping of liquid waste out of one of the ponds directly into the San Jacinto River (EPA 2009). The Harris County Health Department instructed McGinnes Industrial Management Corporation and Champion Papers by letter to stop discharging to the San Jacinto River and demanded that the levees surrounding the impoundments be repaired (EPA 2009). An internal memo, dated 30 December 30, 1965, from Champion Papers, Inc. confirmed water seepage along the levees and that portions of the levees required reinforcement (EPA 2009).

In May 1966, the Texas Department of Health investigated Champion Papers, Inc. waste disposal practices. Seepage was noted on the western waste pond and deteriorating levees on the eastern waste pond. The Texas Department of Health also noted that storm events had the potential to cover the disposal area with water and wash out the levees.

On July 29, 1966, the Texas Water Pollution Control Board granted McGinnes Industrial Management Corporation permission to release a combination of stabilized waste water and rain water from waste ponds into the San Jacinto River. It was also noted that the waste ponds would no longer be used for the storage of waste material (EPA 2009).

Physical changes at the site in the 1970s and 1980s, including regional subsidence of land in the area due to large scale groundwater extraction and sand mining within the river and marsh to the west of the northern impoundments, have resulted in partial submergence of the impoundments north of I-10 and exposure of the contents of the impoundments to surface waters. During the mid- to late 1990s, third-party dredging likely occurred in the vicinity of the perimeter berm at the northwest corner of the northern impoundments.

A release of the hazardous substances from the northern impoundments was identified through site assessment activities conducted by EPA and TCEQ in 2006. Site assessment activities included surface water and sediment sampling for the presence of dioxins and furans. People and animals coming on to the site could be exposed to these contaminants through ingestion, skin contact and inhalation pathways. Further, during a site visit by EPA conducted on March 1, 2010, releases of hazardous substances were observed entering the San Jacinto River from the northern impoundments.

A temporary cap constructed over the northern waste pits in 2010 and 2011 (pursuant to an Administrative Settlement Agreement and Order on Consent for Removal Action) experienced repeated damage and repairs during the six years since construction. A discussion of this history of repeated damage is included below under the section titled “Administrative Settlement Agreement and Order on Consent for Removal Action”.

Southern Peninsula

The peninsula south of I-10 has a complicated history that includes evidence of disposal of paper mill waste, disposal of anthropogenic waste, and subsequent industrial activities. An impoundment located on the southern peninsula and used for disposal of paper mill waste was likely constructed sometime between 1962 and 1964, based on evidence of berms visible in historical photos. The oldest aerial photo that contains evidence of the construction of berms is from 1964. The berms that seem to define an impoundment appear to have been formed in the same manner as the impoundments north of I-10, with sidecast from trenching providing the berms of the impoundment that ultimately contained the waste. The extent of the area potentially affected by waste disposal in the Southern Impoundment is uncertain, but is most likely within the area enclosed by the berms.

Disposal of paper mill waste from Champion Papers, Inc. was performed by Ole Peterson Construction Co., Inc. at the Southern Impoundment. An April 29, 1965 agreement between Champion Papers and Ole Peterson Construction provides for the removal and barge transportation of pulp and paper mill waste from the Champion plant for disposal; this agreement was assigned to McGinnes Industrial Maintenance Corporation in September 1965. A Texas State Department of Health interoffice memorandum dated May 6, 1966, states that disposal of Champion waste at the site began in June 1965 by Ole Peterson, with McGinnes taking over the operation in September 1965. The memorandum describes the older site for disposal as being on the south side of Highway 73 (now Interstate 10) and consisting of a pond between 15 and 20 acres. The memorandum states that the older pond on the south side was used prior to McGinnes taking over the waste disposal activities.

The impoundment on the southern peninsula was also used for dumping of various anthropogenic wastes (e.g., wood, plastic sheeting, paint chips, ceramic shards) since at least the early 1970s. Aerial photographs and anecdotal information indicate that the impoundment berms were still visible in 1972, when the current landowner's family purchased the property on which they were located. Soon after 1972, the impoundment berms were graded down. The entire peninsula south of I-10 was subject to continuous and significant modification from the early 1970s through the 1980s. From 1985 to 1998, Southwest Shipyards leased a portion of the western shoreline of the southern peninsula, immediately to the south of the present-day location of Glendale Boat Works operations on property owned by New Lost River, LLC. This area includes the shoreline area that appears to be flooded in the 1973 aerial photograph and that was filled in by 1984. Southwest Shipyards conducted sandblasting and painting of barges in this area, and spent blast sand was stockpiled along an unknown portion of the shoreline. Aerial photographs provide evidence of deposition and transport of large volumes of material, significant changes in the form of the landscape, and continuous physical change from at least 1972 to the present.

2.2.2 *Pre-CERCLA Investigations*

Between 1993 and 1995, the City of Houston conducted a toxicity study of the Houston Ship Channel that included the San Jacinto River in accordance with a Consent Decree between EPA and the City of Houston. Sediment, fish, and crab samples were collected in August 1993 and May 1994. Sediment, fish, and crab samples collected near the site indicated elevated dioxin and furan levels (ENSR Consulting and Engineering and Espey, Huston and Associates 1995). Between 2002 and 2004, the TCEQ conducted a study of total maximum daily loads (TMDLs) for dioxins and furans in the Houston Ship Channel (University of Houston, Parsons Engineering, and PBS&J 2004). Sediment, fish, and crab samples were collected in the summer of 2002, fall 2002, spring 2003, and spring 2004. The data indicated the continued presence of elevated dioxin and furan contamination in the San Jacinto River surrounding the site. Results indicated that the human health-based standard was exceeded by 97 percent of fish samples and 95 percent of crab samples (Anchor and Integral 2010).

In April 2005, the Texas Parks and Wildlife Department (TPWD) sent a letter notifying TCEQ of the existence of former waste pits in a sandbar in the San Jacinto River north of I-10. The letter included discussion of anecdotal evidence, data collected during the Houston Ship Channel Toxicity Study (ENSR Consulting and Engineering and Espey, Huston and Associates 1995) and TMDL study (University of Houston, Parsons Engineering, and PBS&J 2004), documentation of U.S. Army Corps of Engineers (USACE) dredge and fill permits in the area, and requested that TCEQ further investigate the site (TPWD 2005).

A preliminary assessment and screening site inspection was conducted between 2005 and 2006 to determine if the site was eligible for proposal to the National Priorities List (NPL) (TCEQ 2005). Site reconnaissance identified the surface water pathway as the primary pathway of concern. Seventeen sediment samples were collected from the San Jacinto River to evaluate background, potential source areas, and possible releases. Samples were analyzed for semivolatile organic compounds (SVOCs), pesticides, PCBs, dioxins and furans, and metals. Sediment sample results indicated elevated concentrations of dioxin congeners. The former surface impoundments were identified as the source of hazardous substances at the site (TCEQ 2006).

The Hazard Ranking System is the principal mechanism the EPA uses to place sites on the NPL. The Hazard Ranking System Documentation Record for the site was published by TCEQ in 2007. The site score was 50 because of components of the surface water overland/flood migration pathway (TCEQ 2007). Any site scoring 28.5 or greater is eligible for the NPL (EPA 1992).

2.2.3 *National Priorities List*

The site was proposed for listing on the NPL List on September 19, 2007 (72 FR 53509), and was placed on the list effective April 18, 2008 (73 FR 14719).

2.2.4 *Unilateral Administrative Order for Remedial Investigation/Feasibility Study*

On July 17, 2009, EPA sent Special Notice Letters to the International Paper Company, Inc. and McGinnes Industrial Management Corporation offering them an opportunity to negotiate and enter into an Administrative Order on Consent covering the performance of a Remedial Investigation (RI)/Feasibility Study (FS) for the site. EPA did not receive a Good Faith Offer from either company to begin negotiations for a RI/FS for the site (EPA 2009).

On November 20, 2009, EPA issued Unilateral Administrative Order (UAO), CERCLA Docket No. 06-03-10, to the International Paper Company, Inc. and McGinnes Industrial Management Corporation. The International Paper Company, Inc. is the successor to Champion Papers, Inc., which arranged for the disposal or treatment of materials containing hazardous substances that were disposed of at the site (EPA 2009). McGinnes Industrial Maintenance Corporation operated the waste disposal facility at the time of disposal of hazardous substances at the site (EPA 2009). The UAO directed International Paper Company, Inc. and McGinnes Industrial Management Corporation to conduct a RI/FS in accordance with provisions of the order, CERCLA, the NCP, and EPA guidance. EPA also required the investigation of the impoundment located south of I-10 because historical documents indicate that waste disposal activities occurred in this area (Integral and Anchor 2013a).

2.2.5 *Administrative Settlement Agreement and Order on Consent for Removal Action*

The EPA's April 2, 2010 Request for a Time-Critical Removal Action at the San Jacinto River Waste Pits Site (April 2010 Action Memorandum) documented the hazardous conditions at the San Jacinto River Waste Pits prior to the removal action (Figure 9), finding that should a removal action be delayed, the potential threats to human health and the environment would increase; a substantial amount of dibenzo-p-dioxins and polychlorinated dibenzofurans would continue to be released and spread into the San Jacinto River; and unrestricted access to the site would continue to threaten nearby populations. Following the April 2010 Action Memorandum, McGinnes Industrial Maintenance Corporation and International Paper voluntarily entered into the Administrative Settlement Agreement and Order on Consent for Removal Action, CERCLA

Docket No. 06-12-10, dated May 11, 2010. The administrative agreement provided for the performance of the site removal action and the reimbursement of EPA oversight costs.

Pursuant to the April 2010 Action Memo and the administrative order, the PRPs prepared and submitted a technical memorandum to evaluate all removal option alternatives for the design and construction of a physical protective barrier surrounding the waste ponds in order to temporarily address the releases or threat of release from the Site. Based on the analysis of alternatives in the PRPs' technical memorandum, the EPA Decision Document for the Time-Critical Removal Action, dated July 28, 2010, selected the cap currently in place at the Site to temporarily abate the releases and threats of releases of dioxin until a permanent remedy could be evaluated and selected. The July 2010 Action Memorandum required that the time critical removal action stabilize the impoundments to withstand forces sustained by the river, including a cover design that considered storm events with a return period of 100 years.

Northern Waste Pits Cap

Elements of the selected TCRA included construction of a perimeter fence on the uplands to prevent unauthorized access, placement of warning signs around the perimeter of the impoundments and on the perimeter fence, design and implementation of an operations, monitoring, and maintenance plan, and installation of the following items as part of the temporary cap:

- A stabilizing geotextile underlayment over the eastern and western cells;
- An impervious geomembrane underlayment in the western cell;
- A granular cover over the northwestern area of the western cell;
- A granular cover above the geotextile and geomembrane in the western cell; and
- A granular cover above the geotextile in the eastern cell.

Additionally, the western cell received treatment through stabilization and solidification of approximately 6,000 cy of material in the upper 3 feet of paper mill waste material.
From December 2010 through July 2011, TCRA construction activities were completed at the site. On 1 August 2011, EPA conducted a final site walk through accompanied by International Paper Company, Inc., McGinnes Industrial Management Corporation, Anchor, and USA Environment, LP. The *Revised Final Removal Action Completion Report*, which documents the TCRA construction activities, was completed in May 2012 (EPA 2012).

The *Operations, Monitoring, and Maintenance Plan, Time-Critical Removal Action, San Jacinto River Waste Pits Superfund Site* identifies continuing obligations, including monitoring and maintenance, with respect to the TCRA (Anchor 2011). Inspections of fencing, signage, and the protective armored cap are required quarterly for the first 2 years following completion of the TCRA (January 2012 through December 2013), semiannually for years three to five (April 2014 through October 2016), and annually starting at year six (July 2017 and beyond). However, the current inspection frequency is quarterly in response to the repeated instances of cap repair required following completion of the cap. Inspections of the armored cap are also required following the first 25-year flow event and after each 100-year flow event. TCRA inspection events include:

- Visual inspection of the security fence and signage surrounding the site;
- Visual inspection of the armored cap located above the water surface;
- Visual observation that waste materials are not actively eroded into the river;
- Collection of topographic survey data for the portions of the armored cap that are located above the water surface or at a water depth too shallow to access by boat;
- Collection of bathymetric survey data for the portions of the armored cap that are below the water surface and accessible by boat; and
- Manual probing of armored cap thickness at areas identified by the topographic or bathymetry surveys as more than 6 inches lower in elevation than during the prior survey.

If the visual inspection identifies a breach in the security fence or damaged or missing signs, repairs or replacement will be made as soon as practicable, but not to exceed two weeks following the inspection. Repair activities to the armored cap are required if (1) the thickness of the armored cap is less than 6 inches than the thickness specified by the TCRA design over a contiguous area greater than 30 feet by 30 feet in size, (2) the armored cap has any area of complete absence, or (3) visual observation indicates that waste materials are being actively eroded into the river. Inspection and repair reports, as needed, are submitted to EPA.
Since its completion in July 2011, the temporary armored cap has generally isolated and contained impacted material, with the known exceptions noted below. The following events have been documented since the time of armored cap installation:

- In July 2012, an area along the western berm slope was noted to have areas where cap armor materials had moved down the slope, uncovering an area of the geotextile layer (approximately 200 square feet, or 0.03 percent of the armored cap footprint). There was no exposure of underlying materials or release of hazardous substances associated with this temporary condition. Maintenance measures were completed that involved grading specific locations to an overall flatter condition by placing additional armor rock over the cap surface in those locations.

- In January 2013, five areas in the eastern cell of the cap with less than the required armor cover thickness and/or exposed geotextile were identified. In one of those areas there was a need for placement of geotextile fabric in addition to armor stone (Figure 3). The cause of these areas of deficient cap cover is unknown. These areas were repaired in January 2013 with the addition of additional stone and geotextile.

- In response to USACE recommendations following their post-construction evaluation (USACE 2013) of the armored cap, additional cap enhancement work was completed in January 2014. In order to address the factor of safety, slope of the face of the berm, and uniformity of cap material, additional stone was placed on the armored cap.

- On December 9 and 10, 2015, EPA performed an underwater inspection that identified an area of missing armor cover resulting in exposure of the underlying paper mill waste material to the San Jacinto River. The damaged area, approximately 400 to 500 square-feet, was located on the northwestern section of the armored cap where no geotextile was installed (Figure 4). Armored rock cover was intermittent with gaps where the rock had sunk into the paper mill waste leaving the waste material openly exposed to the San Jacinto River. This failure appeared to be caused by a bearing capacity failure from a poor filter layer and soft underlying waste materials. Sediment sampling completed in December 2015 identified dioxins and furans in the exposed sediment as high as 43,700 ng/kg TEQ. Repair activities to place geotextile and additional rock cover in the damaged area were completed on January 4, 2016.

- On February 2016, during an extremely low tide, a visual inspection of the cap was performed. A large majority of the eastern cell was exposed during this low tide event. Five small areas (approximately 1 foot by 3 feet at the largest areas) of exposed geotextile with no rock cover were observed in the central part of the eastern cell where the cap should have had a 1-foot thickness minimum. The cause of these deficient rock areas is unknown. During March 2016, probing of the entire eastern cell of the cap to check thickness was completed and identified numerous additional areas of deficient armor cover thickness and/or exposed geotextile from apparent shifting or movement of the armor cap (Figure 5). Rock was added to all of these areas in the eastern cell in March 2016 to achieve a minimum thickness of 1 foot.

- Flooding in the Spring of 2016 resulted in several areas of riverbed erosion/scour adjacent to the eastern edge of the armored cap. The erosion into the riverbed reached a depth of approximately 8-feet (Figure 6) in an area of approximately 120-feet by 60-feet. Following a review by the U.S. Army Corps of Engineers, approximately 1300 tons of rock were delivered and placed to stabilize the edge of the cap and prevent any further erosion that could undermine the cap.

- Flooding in September 2017 resulting from Hurricane Harvey eroded armor rock from the cap. Armor stone as well as the underlying geotextile was completely eroded from portions of the southern berms (Figure 7). In addition, approximately 36 areas within the cap ranging in size from1-square foot to 50-square feet were found with either a reduced cap thickness, intermittent rock cover, or no cap rock present (Figure 8). These areas were located in the eastern cell, the western cell, and the northwest part of the waste pits. In some areas the underlying geotextile was exposed, and in other areas the underlying soft material was exposed to the San Jacinto River. This soft material was, or could have been, paper mill waste. Samples of the exposed soft material were collected by the EPA Dive Team, however, the validated results are not available at this time. Approximately 1000-tons of rock were delivered to repair these 36 areas of damaged cap.

- Previous samples (collected December 2015) from the surface of the northwest part of the waste pits, where there is no geotextile present now, showed dioxin/furan ranging from 383 ng/kg TEQ to over 43,000 ng/kg TEQ. Because the northwest area does not have a geotextile liner, material containing up to 43,000 ng/kg TEQ dioxin/furan may have been exposed to the San Jacinto River during Hurricane Harvey.

- The flooding as a result of Hurricane Harvey also eroded a section of the riverbed immediately adjacent to the east side of the cap. This erosion next to the cap is a concern because it may have undercut and caused a loss of part of the cap. The exact dimensions and depth of the erosion area are not available at this time. A plan to stabilize the cap in this area is currently being prepared by the PRPs for EPA approval.

The EPA notes that the recent flooding from Hurricane Harvey resulted in a 500-year flood in the San Jacinto River as indicated by the Harris County Flood Warning System. This flooding resulted from excessive rainfall associated with the hurricane and did not include the erosion effects of hurricane wind driven waves, which would be expected to increase the amount of cap damage that occurred.

The above history of continuing damage to the cap, the exposure of high concentration (43,000 ng/kg TEQ) dioxin and furan wastes to the environment, the instances of erosion of the riverbed next to the cap, and the need for repeated repairs illustrate the lack of effectiveness that has been documented for the relatively short time, 6 years, since the cap was completed. The repairs to the temporary cap over the last six years have not been routine and within the scope of what was contemplated at the time the cap was completed in 2011. The 2011 Operations, Maintenance, and Monitoring Plan provided that inspections of the cap would be "performed quarterly for the first two years following completion of the TCRA construction, semiannually from years three to five, and annually starting at year six," with provision for additional inspections after 25-year or 100-year flow events (*Operations, Monitoring, and Maintenance Plan, San Jacinto River Waste Pits Superfund Site, October 2011, Section 2.1, p. 5*). This provision envisions that the cap would require significantly less inspection and resulting maintenance after its first two years of operations, which has not in fact been the case. While cap inspections were at one point decreased from quarterly to semiannually, in February 2016 the frequency of the inspections had to be increased again to every quarter, due to the issues discovered by the EPA dive team in December 2015 as part of a sampling effort. The expectation that extensive maintenance to the cap would be limited to its first two years is also found in the cost estimates provided by Anchor QEA in its draft of the Feasibility Study, as resubmitted in April 2014. The cost for "Armored Cap Maintenance" was assumed only as "$100,000 cap maintenance in Year 1 and 2." (*Draft Final Interim Feasibility Study, March 2014, Appendix C: Remedial Alternative Cost Development, Table 1*). The total estimated costs for cap maintenance as a net present value for Alternative 2N (the TCRA cap) and 3N (an enhanced cap) were both estimated as a net present value as only $181,000. The significant repairs in December 2015 and early 2016, the repair of the area with scour in November 2016, and the current efforts to repair the cap in 2017 demonstrate that the maintenance of the cap has not been routine and expected, but instead indicates an ongoing problem.

Further, the impacts of a strong hurricane with its storm surge and wind driven waves has not yet occurred at the Site; however, one or more strong hurricanes are likely over the long term that the dioxin, a persistent waste, would remain toxic. Finally, modeling conducted by the U.S. Army Corps of engineers has determined that a Category 2 hurricane in conjunction with flooding would result in erosion over most of a cap that is significantly upgraded over the current cap. Stronger Category 3, 4, or 5 hurricanes are possible and may have even greater impacts to the cap.

2.3 COMMUNITY PARTICIPATION

This section of the ROD describes the EPA's community involvement and participation activities. EPA has been actively engaged with stakeholders and has encouraged community participation during EPA's remedial and removal activities. These community participation activities during the remedy selection process meet the public participation requirements in CERCLA 300.430(f)(3) and the NCP.

2.3.1 *Community Involvement Plan*

The Community Involvement Plan is central to Superfund community involvement. It specifies the outreach activities that the EPA undertakes to address community concerns and expectations. The Community Involvement Plan included background information on the community, community issues and concerns, community involvement activities, communication strategy, official contact list, and local media contacts. The Community Involvement Plan was last updated in June 2016.

2.3.2 *Community Meetings and Fact Sheets*

The EPA and TCEQ have conducted community meetings during the course of the Superfund process. In addition, factsheets detailing site activities have been published periodically since the site was listed on the NPL and are available in the Administrative Record.

The Proposed Plan presented the EPA's rationale for the Preferred Remedy. A public comment period for the Proposed Plan was held from September 29, 2016, until January 12, 2017. The public comment period was originally slated to last 60-days until November 28, 2016. However, in response to requests for an extension, the public comment period was extended an additional 45 days until January 12, 2017. As part of the public comment period, a community meeting was held at the Highlands Community Center in Highlands, Texas, on October 20, 2016. A public notice of the community meeting and public comment period was published in the Baytown Sun newspaper on September 30, 2016, and in the Houston Chronicle newspaper on October 1, 2016. Additionally, a fact sheet announcing the comment period and meeting was mailed to the contacts included on the Site's mailing list.

At the community meeting, representatives from the EPA provided a presentation on the Proposed Plan and received questions about EPA's Preferred Alternative. Representatives from the TCEQ were also present at the meeting. Oral and written comments were accepted at the meeting and a court reporter transcribed the discussions held during the meeting. This transcript is included in the Administrative Record file for the site. The EPA's responses to the comments received during the public comment period are included in "Part 3: Responsiveness Summary."

EPA, in cooperation with elected officials and state, county, and local agencies, has been providing community outreach and public participation for the site since it was added to the National Priorities List in 2008. EPA's community involvement began with a community meeting in 2010 to provide the public with information regarding the site and share information on the Superfund process, the next steps, and how the community could get involved in the process.

In early outreach efforts, some community members voiced concern that they were not receiving sufficient information from EPA. As a result, EPA increased its outreach and community involvement efforts. EPA deemed the site a Community Engagement Initiative Site and in 2010 performed additional outreach planning, such as informational meetings and mail outs to a large site mailing list. Later that year, EPA initiated a Community Advisory Group for the site known as the Community Awareness Committee. The 16-member group, which includes representatives from the community as well as state agencies, local governments, environmental organizations, and the PRPs, began a series of quarterly meetings at the Harris County Attorney's Office.

Other outreach and community involvement efforts include coordinated outreach with the Texas Department of State Health Services to survey nearby communities (door to door) to better understand their health concerns and to provide site information and an Environmental Justice survey. In 2012, EPA provided a Technical Assistance Grant to the Galveston Bay Foundation to hire a technical advisor to provide assistance. In addition, a number of local internet websites are being utilized to keep area citizens updated on site events.

EPA will continue to provide community meetings, open houses, elected officials briefings, media interviews, public notices, and fact sheets to inform the public and keep residents updated on all site developments that affect cleanup actions.

2.3.3 *Information Repositories*

The Administrative Record file is available for review at:

Highlands Public Library
Stratford Branch Library
509 Stratford Street
Highlands, Texas 77562
(281) 426-3521

U.S. Environmental Protection Agency, Region 6
7th Floor Reception Area
1445 Ross Avenue, Suite 12D13
Dallas, Texas 75202-2733

Texas Commission on Environmental Quality
Building E, Records Management
12100 Park 35 Circle
Austin, Texas 78753
(800) 633-9363

2.4 SCOPE AND ROLE OF RESPONSE ACTION

The NCP, 40 CFR Section 300.5, defines an operable unit as a discrete action that comprises an incremental step toward comprehensively addressing a site's contamination problems. The cleanup of a site may be divided into one or more operable units, depending on the complexity of the problems associated with the site. The EPA has chosen to address the site as a whole without division into operable units. The selected remedy addresses the contaminated environmental media at the Site with the primary objectives of preventing human exposure to contaminants, and preventing or minimizing further migration of contaminants. The remedial action objectives (RAOs) are described in more detail in Section 2.8.

2.5 SUMMARY OF SITE CHARACTERISTICS

This section presents a brief, comprehensive overview of the site. This section has been divided into three subsections that include physical characteristics, conceptual site model, and the nature and extent of contamination.

2.5.1 *Physical Characteristics*

This subsection provides a summary of site surface features, climate, surface water hydrology, geology, ecology, and habitats. Detailed information on these topics can be found in the Administrative Record, including the *Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site* (Integral and Anchor 2013a).

Surface Features

The site is located in the estuarine portion of the lower San Jacinto River where the river begins to transition from a fluvial system to a deltaic plain. The northern impoundments cover an area approximately 15.7 acres in size including the berms. Pre-TCRA ground surface elevations ranged from 0 feet above mean sea level (MSL) at the shoreline, to nearly 10 feet above MSL. South of I-10, ground surface elevations range from 0 feet above MSL at the shoreline to nearly 13 feet above MSL. Both areas are generally flat with very little noticeable topographic relief. Relief south of I-10 is the likely result of building foundations and leftover cut material from grading.

Climate

The climate along the Gulf Coast of Texas and the area surrounding Houston is humid subtropical. The average annual precipitation is 54 inches. The warmest month is July, with an average temperature of 85 degrees Fahrenheit (°F), and the coldest month is January, with an average temperature of 54°F. During the spring season, large thunderstorms are common and are capable of producing tornados. The transition to the summer months is characterized by mild temperatures, but relative humidity of up to 90 percent results in a higher heat index.

The monthly average precipitation varies from approximately 2.5 inches in February to over 7 inches in June. It is not uncommon to have precipitation events that exceed 2 inches per day, and rain events bringing 10 inches of precipitation or higher in a day occur on a decadal scale. These types of precipitation events produce wide variations in the volume of discharge into and out of the San Jacinto River and may significantly affect variations in flow velocities, sediment transport, and suspended sediment loads.

The Texas Gulf coast was recently struck by Hurricane Harvey, which made landfall near Rockport, Texas about 170 miles southwest of the site. While Hurricane Harvey did not make landfall in the Houston area, the hurricane pushed moisture inland, which stalled over Houston causing historic rainfall, runoff, and flooding. The highest rainfall amount totaled 48.20 inches at a rain gauge on Clear Creek and I-45 near Houston Texas. It was the highest rainfall amount in a single storm for any place in the continental United States (NOAA, 2017).

Surface Water Hydrology

The frequency of hurricanes along any 50-mile segment of the Texas coast is about 1 every 6 years; the annual average occurrence of a tropical storm or hurricane is about 1 per year (Roth, 1997). Between 1851 and 2004, 25 hurricanes have made landfall along the north Texas Gulf Coast, seven of which were major (Category 3 to 5) storms. Tropical Storm Allison, which hit the Texas Gulf Coast in June 2001, resulted in 5-day and 24-hour rainfall totals of 20 and 13 inches, respectively, in the Houston area, resulting in significant flooding. More recently, Hurricane Rita made landfall in September 2005 as a Category 3 storm with winds at 115 miles per hour. The storm surge caused extensive damage along the Louisiana and extreme southeastern Texas coasts. In September 2008, the eye of Hurricane Ike made landfall at the east end of Galveston Island. Ike made its landfall as a strong Category 2 hurricane, with Category 5 equivalent storm surge, and hurricane-force winds that extended 120 miles from the storm's center. Climate models (Knutson and others, 2010) predict an increase in the intensity of tropical cyclones and hurricanes in the Gulf, meaning greater risk of flooding and storm surges over the long time frame that the dioxin waste at the Site would remain hazardous.

The San Jacinto River Waste Pits Site is located in a Federal Emergency Management Agency (FEMA) designated "VE" Floodway Zone, meaning that it is prone to inundation by the 1 percent annual chance flood event with additional hazards due to storm induced waves (Brody and others, 2014). As noted in "A Flood Risk Assessment of the San Jacinto River Waste Pit Superfund Site" (Brody and others, 2014):

> "National Oceanic and Atmospheric Administration (NOAA) surge models for a category 3 storm striking Galveston Bay during high tide show surge levels at the waste pit site reaching 23 feet. A category 5 storm hitting the Bay during similar conditions would produce a storm tide of up to 33 feet. Keim, Muller & Stone, (2007) also derived an average return period of 3 years for tropical storms, 8 years for all Hurricanes, and 26 years for hurricanes category 3-5 for Galveston, Texas. Researchers at NOAAs National Hurricane Center corroborate this estimate, predicting the return period for a major hurricane (category 3) striking Galveston Bay at 25 years".

The river in the vicinity of the northern impoundments is affected by diurnal tides, with a typical tidal range of about 2 feet. Tidal range varies over a 14-day cycle, with neap and spring tide conditions corresponding to minimum and maximum tidal ranges, respectively. A tidal river is an inherently more dynamic environment than would be a more stable inland location not subject to currents, changes in stage, and the more focused effects due to flooding, storm surges, and hurricanes to which the current location is subject.

Salinity in the vicinity of the site ranges between 10 and 20 parts per trillion during low to moderate flow conditions in the river. During floods, salinity values will approach freshwater conditions.

Flow rates in the San Jacinto River at the site are partially controlled by the Lake Houston dam, which is located about 16 river miles upstream of the northern impoundments. The average flow in the river is 2,200 cubic feet per second (cfs). Floods in the river occur primarily during tropical storms (e.g., hurricanes) or intense thunder-storms. Extreme flood events have flow rates of 200,000 cfs or greater. Floods can cause water surface elevations to increase by 10 to 20 feet or more (relative to average flow conditions).

The San Jacinto River has experienced actual short-term alterations in the past. The most substantial and dramatic changes to river or estuarine environments occur as a result of extreme events, the effects of which are more difficult to predict. For example, in October 1994, heavy rainfall occurred in southeast Texas resulting in the San Jacinto River Basin receiving 15 to 20 inches of rain during a week-long period. One of the largest measurements of stream flow ever obtained in Texas, 356,000 cubic feet per second (cfs), was made on the San Jacinto River near Sheldon on October 19, 1994, at a stage of 27 feet. During the measurement, velocities of water that exceeded 15 feet per second (about 10 miles per hour) were observed. The 100-year flood, which is defined as the peak stream flow having a one percent chance of being equaled or exceeded in any given year, was exceeded at 18 of 43 stations monitoring the area. For those stations where the 100-year-flood was exceeded, the flood was from 1.1 to 2.9 times the 100 year-flood. The flood waters scoured the riverbed and banks, destabilized roads and bridges, and inundated area homes." (NTSB, 1996). The railroad and highway roadbeds and bridges sustained major damage during the 1994 flood (USGS, 1995).

The 1994 flooding caused major soil erosion and created water channels outside of the San Jacinto River bed. This flooding caused eight pipelines to rupture and 29 others were undermined at river crossings and in new channels created in the flood plain outside of the San Jacinto River boundaries. The largest new channel was cut through the Banana Bend oxbow just west of the Rio Villa Park subdivision, about 2½ miles northwest of the Site. This new channel was approximately 510-feet wide and 15-feet deep. A second major channel cut through Banana Bend just north of the channel through the oxbow. Both of these new channels were cut through areas where sand mining had been done before, as is the case in the vicinity of the Site. Sonar tests in a 130-foot section south of the I-10 Bridge located adjacent to the Site found about 10 to 12-feet of erosion from the bottom of the river bed. Two other recorded floods in the San Jacinto River actually exceeded the 1994 flood, including during 1929 (32.90-feet) and during 1940 (31.50-feet).

More recently, river bed scour, approximately 8-feet deep, was identified in 2016 adjacent to the temporary cap. Additional river bed scour occurred in 2017 during the flooding associated with Hurricane Harvey, immediately adjacent to the east side of the cap, although the magnitude of this scour is unknown at this time. These scour events point to the potential for change in the San Jacinto River bed and the dynamic nature of the river.

The San Jacinto Superfund Site was effected by the historic flooding caused by Hurricane Harvey, but the area didn't receive high winds or storm surge typical of a hurricane. If a hurricane hit directly in this area in the future, one would expect to have waves driven by high winds, flooding, and storm surge adding additional energy to the river system, which could cause additional erosion to the stream bed and flood plain in the area.

The USGS performed a review of the geomorphic characteristics of the San Jacinto River based on review of historic documents in response to comments submitted during the public comment period. This review noted that geomorphic evaluations based on the behavior of upland river systems may not accurately simulate scenarios in a river downstream of a reservoir and in immediate contact with a tidal estuary, as is the case in the vicinity of the site. Also, the review stated that what cannot be accurately predicted are the conditions that the impoundments and channels at the Site will be subjected to, given the need to secure the impoundments for the long term that the dioxin would remain hazardous. A variety of models could be used to test potential effects to specific areas of the stream channel or impoundments with the application of specific stress conditions. However, the complex way in which the effects of these individual stresses interact and propagate through the river system in the area of the impoundments cannot be reliably simulated with existing models. Several models suggested as candidates by commenters on the Proposed Plan (HEC RAS 5.0 with BSTEM and the morphodynamic meander models of Langendoen and others (2015 and 2016)) were designed to model upland river systems. Specifically, classification schemes such as those by Lagasse and others (2004), which can be used to establish channel stability, were designed to classify upland river systems. The San Jacinto River in this reach is downstream of a dam and is part of a coastal-plain estuary. As such, there are additional forces acting on the river as mentioned before, such as downriver releases from the dam and upriver/onshore forces such as hurricanes and storm surges, which can affect the morphology of the area in ways not accounted for in an upland river classification scheme.

The USGS concluded that the need to simulate scenarios in a river downstream of a reservoir and in immediate contact with a tidal estuary introduces factors into the analysis not accounted for in these models. The USGS also stated that accurately evaluating the uncertainty of model predictions would be problematic given uncertainties in long-term future conditions for the San Jacinto River.

Hayter and others (2016) refer to “the dynamic nature of the flow regime in the San Jacinto River estuary” in their assessment of the hydrology and hydrodynamics of the river, referencing the location of the Waste Pits within the FEMA designated 100-year floodplain, susceptibility to flooding from storm surges, and vulnerability of the Site due to sea level rise. While it is possible to evaluate a river as dynamic in terms of its tendency towards lateral channel migration and channel avulsion, a “dynamic system” also could be considered a system subject to a wide range of flooding and storm surges, and this type of activity will continue irrespective of the additional impacts of subsidence or dredging that might occur in the area. Warner and Tissot (2012) conservatively estimate a sea level rise at Galveston Bay of 2.1 feet over the 21st Century, and continuously increasing risks of flooding from storm surges as the century progresses. By this definition, the river should be considered dynamic, especially in comparison to low energy river environments, protected harbors and low flow streams, with the river likely becoming increasingly more dynamic over time.

The San Jacinto River has been prone to severe flooding with major floods occurring prior to the 1994 flood in 1907, 1929, 1932, 1935, 1940, 1941, 1942, 1943, 1945, 1946, 1949, 1950, 1959, 1960, 1961, 1972, and 1978 (NTSB, 1996). The actual history of the San Jacinto River and the uncertain impacts of future storms are sufficient to raise concerns about the stability of structures constructed in the river over the long time frame that the dioxin waste would remain hazardous.

Regional Geology and Hydrogeology

Sediments of the Texas Gulf Coast are generally Cenozoic fluvial-deltaic to shallow-marine deposits of a coastal plain environment (U.S. Geological Society [USGS] 2002). Sea-level transgression-regression cycles and natural basin subsidence have produced beds of clay, silt, sand, and gravel that gently dip southeast towards the Gulf of Mexico. This complex depositional process created both a continental assemblage of sediments that now make up the aquifers within the area and a marine sequence of sediments that contains clay layers and confining units. This process resulted in a regional aquifer system with a high degree of heterogeneity in both lateral and vertical extent (USGS 2002) commonly referred to as the Gulf Coast Aquifer System (Texas Natural Resource Conservation Commission 1999).

The Gulf Coast Aquifer System is located along the coast of the Gulf of Mexico and has been divided into four units: the Chicot, Evangeline, and Jasper aquifers, and the Burkeville confining unit. The Site is above the Evangeline (deeper) and Chicot (shallower) aquifers. Groundwater elevation maps for the Evangeline and Chicot aquifers show that regional groundwater flow is directed approximately southeast towards the Gulf of Mexico (USGS 2002). On a localized net flow basis, shallow groundwater may discharge to the San Jacinto River, providing a portion of base flow. Under high tide and river flow conditions, a temporary gradient reversal may cause the San Jacinto River to temporarily recharge the shallow alluvium adjacent to the river.

The Chicot Aquifer is used as a drinking water source within the greater Houston area, but water used from this source is pumped from wells screened far below the Beaumont Formation, a confining clay. Although there are some privately owned upper Chicot Aquifer wells near the Site, the infiltration of surface waters or shallow groundwater would likely be prevented in most cases by the thick sequence of the clay and silt deposits of the Beaumont Formation, effectively isolating the lower portion of the Chicot Aquifer from shallower groundwater and surface water in the vicinity (USGS 2002).

Local Geology and Hydrogeology

At the site, the surface and underlying local soils include Holocene alluvial deposits and the Beaumont Formation, which is the youngest and uppermost of the series of coast-parallel Pleistocene deposits that make up the Gulf Coast Aquifer System The soils of the Beaumont Formation are dominated by clays and silts that thicken seaward and that were deposited in a fluvial-deltaic environment (Van Siclen 1991). The Beaumont formation and overlying recent alluvial soils make up the uppermost units of the Chicot Aquifer (Figure 10) (USGS 2002).

The local water table (i.e., shallow groundwater) is found near land surface in the shallow alluvium sediments, generally at the approximate elevation of the San Jacinto River water surface. Groundwater movement in the shallow alluvium in the area is dominated by surface water and groundwater interactions with the river, which surrounds the former impoundments north of I-10 and the area to the south. This reach of the San Jacinto River watershed is characterized by extremely flat groundwater gradients indicating that the area surrounding the site is an area of minimal recharge to the aquifers. The Beaumont Formation is a confining unit that isolates shallow groundwater in the Holocene alluvium and in the San Jacinto River sediments from the underlying formations of the Chicot Aquifer.

Habitats Overview

The site is located in a low-gradient, tidal estuary near the confluence of the San Jacinto River and the Houston Ship Channel. Upland, riparian, and aquatic habitats are present.

Upland natural habitat adjacent to the San Jacinto River at and near the site is generally low-lying, with little topographic variation, and consists primarily of clay and sand that supports forest communities of loblolly pine-sweetgum, loblolly pine-shortleaf pine, water oak-elm, pecan-elm, and willow oak-blackgum (Texas State Historical Association 2009). Upland natural habitat occurs along narrow sections of land on either side of the river, as well as on several small islands, to the north and south of I-10 and east of the northern impoundments. Most of these islands are vegetated with a mixture of shrubs and trees, with fringing shallow waters.

Habitats on the northern portion of the site include shallow and deep estuarine waters, and shoreline areas occupied by estuarine riparian vegetation. The in-water portion of the site is unvegetated, with a deep (20- to 30-foot) central channel and shallow (3 feet or less) sides (National Oceanic and Atmospheric Administration 1995; Clark et al. 1999). Except in the northern impoundments, sediments have a high sand content and are characterized by low organic matter content (0.5 and 2 percent TOC). By contrast, most surface sediment samples collected within the northern impoundments ranged between 1 and 5 percent TOC, with the fraction consisting of sand ranging from 4 to 98 percent, and an average of about 50 percent sands.

A sandy intertidal zone is present along the shoreline throughout much of the Site. Minimal habitat is present in the upland sand separation area located adjacent to the northern impoundments, because demolition and closure of this former industrial area created a denuded upland with a covering of crushed cement and sand. The sandy shoreline of this area is littered with riprap, other metal debris, and piles of cement fragments. Prior to implementation of the TCRA, estuarine riparian vegetation lined the upland area that runs parallel to and north of I-10. As a result of the TCRA, that area now includes a dirt road. The western cell of the impoundments north of I-10 had been occupied by estuarine riparian vegetation to the west of the central berm until the recent implementation of the TCRA, when the vegetation was removed. The eastern cell, also completely covered as a result of the TCRA, lies within intertidal and subtidal habitats.

Throughout the broader surrounding area, there are approximately 55 additional acres of freshwater, estuarine, and marine wetlands (Figure 11). The vegetation associated with the estuarine intertidal wetland documented on the northern impoundments is no longer present as a result of the TCRA, but could return over time. Major vegetation associated with fringe wetland areas included broadleaf cattail, saltmeadow cordgrass, saltmarsh aster, and marsh elder. Wetland habitats to the south of I-10 along the eastern side of the channel include a narrow stretch of vegetation along the shoreline and the shoreline habitats of three small islands south of I-10. The vegetation on the islands mainly consists of shrubs and small trees.

2.5.2 *Conceptual Site Model*

A conceptual site model is a written description and a visual representation of the predicted relationship between a stressor and a potential receptor that describes the potential sources, release mechanisms, transport pathways, and environmental exposure media of chemicals to receptors. The conceptual site model provides a framework that facilitates application of the risk assessment process to the conditions and use of a site. Separate conceptual site models have been developed for the area north of I-10 and aquatic environment, and the area south of I-10.

North of I-10 and Aquatic Environment Conceptual Site Model

The conceptual site model for the area north of I-10 and aquatic environment is shown in Figure 12. Figure 13 identifies the potential routes of human exposure in detail and indicates whether they are considered significant or minor. For this area, hypothetical recreational and subsistence fishers, recreational visitors, and trespassers were identified as groups that may have contact with impacted media under baseline conditions.

Fishing activity within the waters surrounding the site has been observed, and fishers in this area have been reported to collect whatever they catch. However, little information is available about the type and amount of fishing that occurs. Fishers may potentially be exposed to chemicals of potential concern (COPCs) via direct contact with sediments and soils, and by ingesting fish or shellfish that have been exposed to impacted media. They may also potentially be exposed to COPCs through direct contact with surface water (ingestion and dermal contact) or porewater (dermal contact), and through inhalation of COPCs as particulates or vapors in air; however, exposures via these media and routes are considered to be minor (Figure 13).

Although the lands at and near the site are largely privately owned, points of access were available to the public along and within this area under baseline conditions. Such access allowed for a variety of recreational activities other than fishing, including picnicking, walking, bird watching, wading, and boating. Shoreline use and wading at the site has been reported prior to construction of the temporary cap; recreational visitors could have potentially been exposed via the same direct contact exposure routes as fishers (i.e., incidental ingestion of and dermal contact with soils and sediments). However, these individuals are not exposed via ingestion of fish or shellfish.

Signs of trespassing have been reported in some areas at the site, particularly under the I-10 Bridge. The hypothetical trespasser is the receptor used to represent a very low level of possible exposure. Therefore, although a hypothetical trespasser could be exposed via the same pathways as the recreational visitor (i.e., direct contact pathways) and recreational fisher (i.e., ingestion of fish and shellfish), the concept of the trespasser is that of a person whose exposure would likely be intermittent and of a shorter term than the exposures being evaluated for either of those scenarios. Thus, for the area north of I-10, the estimated risks and hazards presented for the hypothetical fishers and hypothetical recreational visitors are higher than and would overstate potential risks for hypothetical trespassers. Therefore, the hypothetical trespasser scenario was not evaluated quantitatively for the area north of I-10 and aquatic environment.

South of I-10 Conceptual Site Model

The conceptual site model for the area of investigation on the peninsula south of I-10 is shown in Figure 14. Figure 15 describes the specific routes of potential exposure in detail. For this area, trespassers, commercial workers, and construction workers were identified as groups that may potentially come into contact with impacted media.

With signs of trespassing in areas along the western bank of the river at this site, it is possible that trespassers might walk around or spend time in the area of investigation on the peninsula south of I-10. Because such activities might result in direct contact with surface soil, potentially complete exposure pathways for the trespasser are incidental ingestion and dermal contact with soil. Because fencing and active management and use of industrial properties south of I-10 make this area largely inaccessible, however, it is anticipated that the trespasser's exposure would be infrequent. Also it is likely that trespassing activities by any given individual would be limited to a relatively short time frame (i.e., no more than a few years).

Land use on the peninsula south of I-10 is commercial/industrial. Commercial workers, who perform maintenance or other work-related outdoor activities, might have potential direct contact with surface and shallow subsurface soil. Potentially complete exposure pathways for the commercial worker are incidental ingestion and dermal contact with surface and shallow subsurface soil.

In the future, construction work could occur in the area of investigation on the peninsula south of I-10. Under this future scenario, construction workers may have direct contact with surface and subsurface soil. Potentially complete exposure pathways for the construction worker are incidental ingestion and dermal contact with surface and subsurface soils.

2.5.3 *Nature and Extent of Contamination*

The RI Report (Integral and Anchor 2013a) contains a detailed discussion of the process involved to identify COCs and the nature and extent of contamination (RI Report, Section 5.2 for the area north of I-10 and Section 6.2 for the area south of I-10). Results of the baseline human health risk assessment (BHHRA) and baseline ecological risk assessment (BERA), indicate COCs include dioxins and furans, and polychlorinated biphenyls (PCBs) (discussed in Section 2.7 of this ROD). This section discusses the nature and extent of contamination focusing on these COCs. The information is from the RI report (Integral and Anchor 2013a), unless otherwise noted.

Between 2010 and 2013, site-specific data were collected for the remedial investigation. The remedial investigation included the collection of paper mill waste, sediment, tissue (i.e., hardhead catfish, Gulf killifish, rangia clam, and blue crabs), soil, and groundwater samples for analyses including dioxins and furans, PCBs as Aroclors, metals, semivolatile organic compounds, volatile organic compounds, and pesticides. Physical data collected during the remedial investigation included: a bathymetric survey, current velocity, material, geotechnical, riverbed properties, sediment loading, erosion rates of cohesive sediment, and net sedimentation rates. Solid-phase micro extraction (SPME) porewater samplers were also evaluated as part of the RI. The RI did not include surface water sampling of the San Jacinto River.

Three hundred and fifty-seven sediment samples were collected during the RI to evaluate the nature and extent of contamination, exposure, and determine an appropriate background tissue location. Sediment samples were collected from 0 to 6 inches, 6 to 12 inches, or in 1-foot intervals at depths ranging from 3 to 10 feet. Sediment samples were analyzed for a combination of the following analyses: dioxins and furans, PCBs, metals, SVOCs, volatile organic compounds (VOC), grain size, and total organic carbon (TOC).

One hundred eighty-three tissue samples were collected during the RI to provide sufficient data to complete the baseline human health and ecological risk assessments and to evaluate biota-sediment relationships. Skin off fillets were collected from 50 hardhead catfish. The remainders of 18 hardhead catfish fillets from the fillet samples were also collected for analysis. Eighteen whole-body Gulf killifish were collected. The edible tissue from 35 common rangia clams was collected. The edible tissue from 50 blue crabs was collected. The remainders of crab after edible tissue was removed was analyzed for 12 blue crab samples. These tissue and remainder samples were analyzed for dioxins and furans and a subset were analyzed for PCBs, metals, and SVOCs.

Three hundred ninety-two soil samples were collected during the RI to evaluate the nature and extent of contamination, exposure, fate and transport, and document right-of-way conditions. Soil samples were analyzed for a combination of the following analyses: dioxins and furans, PCBs, metals, SVOCs, VOCs, grain size, and TOC. An even smaller subset of samples was analyzed for pesticides, PCBs as Aroclors, and asbestos.

A total of twenty-one monitoring wells were installed during the RI. Initially, three well pairs were located on the berms of the northern impoundments and one well within the wastes of the western cell of the northern impoundment. These wells were plugged and abandoned prior to construction of the temporary cap. More recently, four monitoring wells were installed in the northern impoundment on the berms and these wells still remain. Ten monitoring wells in the area of investigation south of I-10 were installed and still remain. Groundwater samples were collected from the monitoring wells and analyzed for dioxins and furans, PCBs, metals, SVOCs, VOCs in some cases, and total suspended solids to evaluate the nature and extent of contamination and the fate and transport of contaminants.

Physical data collected during the RI included: a bathymetric survey, current velocity (included surface water elevation and salinity), material, geotechnical, and riverbed properties, sediment load, erosion rates of cohesive sediment, and net sedimentation rates (through profiling vertical distribution of radioisotopes) (Integral and Anchor 2013a).

In addition to requirements of the *Operations, Monitoring, and Maintenance Plan* (Anchor 2011), discussed in Section 2.2.5, a porewater assessment was performed to evaluate the effectiveness of the TCRA armored cap. Porewater SPME samplers were deployed at 14 locations within the northern waste pits cap, and retrieved. The sampling objective was to collect data on dioxins and furans in porewater in order to determine if vertical gradients in concentrations of dioxins and furans in cap porewater exist and to determine if porewater concentrations in the cap differ from concentrations in surface water above the cap.

The results of the RI are documented in other sections of this ROD, where relevant.

Surface Water

The following discussion describes the spatial extent of dioxin and furan concentrations in surface water upstream and downstream the Site, including samples taken directly above the eastern cell of the waste pits north of I-10.

Prior to the TCRA, the Texas Commission on Environmental Quality (TCEQ) Total Daily Maximum Loads (TMDL) Program collected surface water samples throughout the San Jacinto River. Samples were collected between 2002 and 2009. Upstream and downstream samples in the vicinity of the Site were generally well above the Texas Surface Water Quality Standard (TSWQS) for dioxins/furans of 0.0797 pg/L TEQ. [30 Texas Administrative Code §307.6(d)(a)(A) and (B) and §307.10]. This TSWQS was developed for the protection of human health from the consumption of fish and other aquatic life potentially exposed to surface waters contaminated with dioxins/furans.

TMDL results for dioxins TEQ over the eastern cell were higher than samples collected upstream of the site. The highest average concentration was observed directly above the eastern cell (8.61 pg/L TEQ in 2009). Tables 1 and 2 summarize the results from previous TMDL samples as well as the 2016 sampling. Average concentrations downstream of the Site ranged between 3.51 pg/L TEQ in 2003 and 0.418 pg/L TEQ in 2002, generally trending downward with distance (Integral, 2016).

In July, 2016, surface water samples were collected at seven locations (Figure 16) once per week during each of three consecutive weeks. Sampling stations were at five locations previously sampled by the TCEQ's TMDL program from 2002 to 2004, and two new stations. The same methods used by the TMDL program were used in 2016 to enable direct comparisons of current and past conditions. The study was designed to allow this comparison, and to provide information on trends across a large area, including the presence of dioxins and furans in surface waters upstream and downstream of USEPA's preliminary Site perimeter.

Results of the 2016 surface water quality study showed that average TEQ in the vicinity of the site remained above the TSWQS (Table 3). The highest average concentration of 0.681 pg/L TEQ remained directly above the eastern cell, and the lowest average downstream concentration was 0.319 pg/L TEQ (Integral, 2016). Although the greatest change (>90% decrease) in TEQ between past and current conditions occurred at the station located directly above the eastern cell of the waste impoundments north of I-10 (Integral, 2016), the average concentration of TCDD (0.386 pg/L) above the waste impoundments remained 3.5 times on average higher than the upstream concentration (0.118 pg/L). The average concentration of TCDF (1.169 pg/L) directly above the eastern cell of the waste pits remained 3.9 times average higher than upstream levels. TCDD and TCDF are forms of dioxin and furan specifically associated with the site waste. The second greatest change (85% decrease) was at the station just downstream of the northern impoundments, under the I-10 bridge.

North of I-10 Soil Dioxin

The following discussion describes the spatial extent of dioxin and furan concentrations in soils north of I-10, including the samples collected underneath I-10 in the Texas Department of Transportation (TxDOT) Right-of-Way.

The highest averages of dioxin and furan concentrations in surface soils north of I-10 occur in Soil Investigation Area 3 (Figure 17 and Table 4), which encompasses the northern impoundments. In Soil Investigation Area 3, the maximum TEQ concentration in surface soils (11,200 ng/kg) occurs in the southern portion of the western cell of the impoundments. Within Soil Investigation Area 3, the congener with the highest average concentration was 2,3,7,8-tetrachlorodibenzofuran (TCDF), at 6,680 ng/kg (Table 4). Average and maximum TEQ concentrations in surface soils in Soil Investigation Areas 1 (upland sand separation area) and 2 (TXDOT ROW beneath the I-10 bridge) are much lower than those within the Soil Investigation Area 3 (the northern impoundments).

In subsurface soils north of I-10, the highest average concentration of dioxins and furans also occurs in Soil Investigation Area 3 (Table 5). In Soil Investigation Area 3, the highest TEQ value in subsurface soils (16,200 ng/kg) occurs in the southern portion of the western cell (Figure 17). Consistent with surface soils within Soil Investigation Area 3, the highest average concentration for an individual congener was for 2,3,7,8-TCDF at 17,000 ng/kg (Table 5).

As with the surface soils, subsurface soil TEQ concentrations in Soil Investigation Areas 1 and 2 are lower than those within Area 3, the northern impoundments. The maximum TEQ concentration in subsurface soils of Soil Investigation Area 1 was 195 ng/kg and occurs in the 12- to 24-inch interval, in the northeastern corner of the upland sand separation area. The maximum TEQ concentration in subsurface soils of Soil Investigation Area 2 was 1.2 ng/kg

North of I-10 Soil PCBs

Outside of the northern impoundment perimeter and within soils north of I-10, Aroclors were detected in five samples from Soil Investigation Area 2, and were estimated (J-qualified) in four of those. Aroclor 1254 was detected in soil from Station TxDOT002 at 130 μg/kg. Aroclors were not detected in surface and shallow subsurface soils of the upland sand separation area.

Because Aroclors were generally not detected in soils of Soil Investigation Area 1 and were rarely detected in Area 2 soils, only the dioxin-like PCB congener data (as $TEQ_{P,M}$) are used in figures, tables, and text supporting descriptions of the nature and extent of PCBs in soils. The data for dioxin-like PCB congeners provide a description over the widest possible geographical area. Aroclors 1242, 1248, 1254, and 1260 have at least one dioxin-like PCB present at greater than 0.5 percent (Frame et al. 1996); the dioxin-like congeners are therefore a reasonable surrogate for the presence of these Aroclors.

Two of the TxDOT stations in Soil Investigation Area 2 fall within the original perimeter of the impoundments north of I-10. The sample from one of these (TxDOT005) has the highest $TEQ_{P,M}$ of all 14 soil samples (2.83 ng/kg; Figure 18), The second highest $TEQ_{P,M}$ concentration (2.23 ng/kg) was found at the location in Soil Investigation Area 2 furthest west of the northern impoundments, Station TxDOT007. There is no evident spatial pattern in the data for $TEQ_{P,M}$ in soils that would suggest that the impoundments north of I-10 are an important source of dioxin-like PCBs in soils. The result for Station TxDOT007 suggests that the distribution of these dioxin-like PCBs in soils north of I-10 and in the TxDOT ROW is random, and likely reflects background conditions. There are no site-specific background data for PCB congeners.

North of I-10 Groundwater Dioxin

In five of the seven initial monitoring wells installed north of I-10 (Figure 19), no dioxin and furan congeners were detected. These five wells include two of the shallow wells in GWBU-A (the alluvial groundwater) and all three deep wells in GWBU-B (the unit below the Beaumont clay). One dioxin and one furan congener were detected in a well screened in GWBU-A (SJMWS02) at estimated concentrations of 3.6 picograms per liter (pg/L) (octachlorinated dibenzo-p-dioxin [OCDD]) and 1.89 pg/L (2,3,7,8-TCDF).

In the shallow perched groundwater sample within the waste in the northern impoundments, SJMWS04, all but 4 of the 17 dioxin and furan congeners were detected or estimated at concentrations ranging from 14 pg/L to 9,100 pg/L (Table 6). This well was screened within the upper 2.5 feet of waste material in the impoundment. 2,3,7,8-TCDD was detected at a concentration of 2,700 pg/L. This is the only detection (estimated or otherwise) of 2,3,7,8-TCDD in any well north of I-10.

North of I-10 Groundwater PCBs

PCBs were analyzed as Aroclors only in the groundwater samples from locations within the perimeter of the impoundments north of I-10. Aroclors were not detected in any groundwater samples (Table 6). Matrix interferences in sample SJMWS04 likely resulted in elevated detection limits for Aroclors (Table 6).

Sediment and Waste Material Dioxin/Furan

The spatial distribution of dioxin/furan in surface and subsurface waste material in the impoundments and sediments is shown in Figures 20 and 21. Summary statistics for results of dioxin/furan as well as the individual dioxin and furan congeners on a dry-weight basis for surface and subsurface sediments are provided in Tables 7 and 8.

In the baseline dataset, the spatial extent of dioxins and furans in sediment is well-defined. Dioxin and furan concentrations in sediments, expressed as TEQ results, are higher within the perimeter of the impoundments north of I-10 than elsewhere at the site. Within the perimeter of the impoundments north of I-10, dioxin/furan results in sediments are highest in the western cell. Dioxin/furan results in sediment outside of the northern impoundments are typically 3 to 4 orders of magnitude lower than those within the impoundments, even in areas directly adjacent to the impoundment perimeter.

The highest dioxin/furan result (43,000 ng/kg TEQ) occurs in surface waste material in the northwest portion of the impoundments, and the second highest (31,600 ng/kg TEQ) occurs in the uppermost 2-foot interval of the core the boring located in the north-central portion of the northern impoundments (Figure 20); cores surrounding it to the north, east, and southeast show much lower concentrations at all intervals, even within the impoundment perimeter. Cores within the western cell tend to show higher dioxin/furan results throughout the upper core increments. Dioxin/furan results generally decrease from their maximum with depth within a given core indicating that the peak concentrations have been located in the vertical dimension.

The highest dioxin levels outside of the waste pits are in the sand separation area, which is located in the San Jacinto River approximately 1000 feet northwest from the waste pits. The sand separation area (Figure 2) is where sand was separated from the rest of the dredged material during sand mining. Dioxin/furan results in surface sediment samples from two locations adjacent to the upland sand separation area are above 100 ng/kg, at estimated concentrations of 121 ng/kg (Station SJNE041) and 153 ng/kg (Station SJNE032). All other dioxin/furan results in surface sediment outside of the impoundment perimeter are generally much lower. While some of the surface sediment dioxin levels outside of the waste pits are above the cleanup level of 30 ng/kg TEQ dioxin, the average for the area within EPA's Preliminary Site Perimeter is 12.5 ng/kg.

In the vicinity of the upland sand separation area (Station SJNE032), two deep subsurface intervals (4 to 5 feet and 7 to 8 feet below mudline) have TEQ levels of 349 and 339 ng/kg, respectively, the highest dioxin/furan level measured outside the northern impoundment perimeter. However, because these results are only contained in two samples, the EPA does not believe these results are representative of the area, and additional sediment sampling will be conducted there during the Remedial Design.

In the vicinity of the Southern Impoundment, surface sediment samples around the southern end (generally downstream) contain dioxin/furan at 74.6 ng/kg, 52.6 ng/kg, 50.9 ng/kg, and 49.3 ng/kg (Figure 20). The highest subsurface sediment sample in this area was 133 ng/kg dioxin/furan TEQ adjacent to the southwest part of the Southern Impoundment. These results indicate a waste material release from the Southern Impoundment because the sediment results north of these sample locations, but south of the northern waste pits, are much lower and indicative of background values

Sediment and Waste Material PCBs

The distribution of PCB $TEQ_{P,M}$ concentrations in surface and subsurface sediments and waste material is shown in Figures 22 and 23, respectively. Summary statistics for PCBs in surface sediments and waste materials are listed in Table 9, and for subsurface sediments and waste materials in Table 10. PCB congener detection frequency ranges from 0 for PCB congener169 in subsurface samples to 87 percent for PCB congener 105 in surface samples. In surface samples, PCB congeners 105, 118, and 156/157 have a greater than 80 percent detection frequency, while PCB congeners 81, 126, and 169 were detected in less than 20 percent of the samples.

PCB $TEQ_{P,M}$ concentrations are highest in samples collected from within the perimeter of the impoundments north of I-10, with the maximum value of 38.1 ng/kg from the 4- to 6-foot depth interval in core SJGB012 (Figure 23). The PCB $TEQ_{P,M}$ concentrations in most surface and subsurface samples within the northern impoundment exceed 1 ng/kg, while all but two values outside of the northern impoundment are below 1 ng/kg. The exceptions are one surface and one subsurface sample location along the northwest portion of the peninsula south of I-10. These are in the surface interval at Station SJSD004 (6.85 ng/kg), and in the 12- to 24-inch depth interval of SJSD002 (1.58 ng/kg).

Concentrations of PCBs were either significantly correlated with concentrations of dioxins or were non-detect.

Tissue Dioxin/Furan

Tissue samples were collected from three site fish collection areas (FCAs) presented on Figure 24:

- FCA 1 – Downstream of I-10 (identified as SJFCA1 on Figure 24)
- FCA 2 – In the area surrounding the impoundments north of I-10 and the upland sand separation area (identified as SJFCA2 on Figure 24)
- FCA 3 – Upstream of the northern impoundments and upland separation area (identified as SJFCA3 on Figure 24).

Dioxins and furans were generally detected in tissue samples collected at the site and from background locations. In some samples, many congeners were never detected. Data for blue crab, hardhead catfish, clams, and Gulf killifish are summarized in this section.

Mean dioxin/furan results in edible blue crab tissue range from 0.146 ng/kg at FCA 3 to 0.739 ng/kg in FCA 1 (Table 11). Means for edible crab tissue in FCA 2 and FCA 3 at 0.23 and 0.146 ng/kg, respectively, are closer to the background mean (0.157 ng/kg) than to the mean in FCA 1. In all FCAs, 2,3,7,8-TCDF has the highest mean and the highest individual concentrations among the dioxin and furan congeners in crab tissue.

Mean TEQ results in hardhead catfish fillet range from 2.94 in FCA 1 to 3.87 ng/kg in FCA 2 with the highest mean and the highest maximum in FCA 2 (Table 12). The overall range of TEQ concentrations in catfish fillet from FCAs 1 through 3 is 0.801 ng/kg in FCA 1 to 5.85 ng/kg in FCA 2, with the three maximum values for the three FCAs being fairly similar.

Edible clam (common rangia) tissues had the highest mean and maximum TEQ results within the site perimeter, with both the highest mean and the highest maximum in FCA 2. The mean TEQ in clams in FCA 2 is 7.89 ng/kg, where the maximum TEQ is 27 ng/kg, nearly as high as the maxima for whole catfish in FCA 1 and FCA 2. In addition, all but three dioxin and furan congeners were detected at least once in FCA 2; in all other areas (including background), the same four congeners were detected in clams: 2,3,7,8-TCDD, 1,2,3,4,6,7,8- heptachlorodibenzo-p-dioxin (HpCDD), 2,3,7,8-TCDF, and OCDD (Table 13). Other congeners were never detected in clams from FCA 1 and FCA 3 nor in clams from upstream.

Dioxins and furans were never detected in killifish samples from FCA 1, and only two dioxin congeners (1,2,3,4,6,7,8-HpCDD and OCDD) and one furan congener (2,3,7,8-TCDF) were detected in killifish from FCA 3 (Table 14). A total of seven dioxin and furan congeners (2,3,7,8-TCDD, 1,2,3,4,6,7,8-HpCDD, OCDD, 2,3,7,8-TCDF, 2,3,4,7,8-pentachlorodibenzo-furan, 1,2,3,4,7,8-hexachlorodibenzofuran [HxCDF], and 1,2,3,6,7,8-HxCDF) were detected in killifish from FCA 2. The maximum TEQ concentration in killifish (10.1 ng/kg) was in killifish from FCA 2.

Stepwise statistical analysis supported pooling of data for hardhead catfish fillet and crab tissue data for FCA 2 and FCA 3 and supported pooling of data for clam tissue data for FCA 1 and FCA 3.

Tissue PCBs

As described above, tissue samples were collected from three site FCAs (Figure 24). PCBs were detected in all edible and whole crab samples, including those from background. Like dioxins and furans, total PCB concentrations (as the sum of all congeners with nondetects set to one-half the detection limit) are higher in whole crab than in edible crab (Table 11). Among edible crab samples, background minimum, maximum, and mean total PCB concentrations are 0.55 µg/kg, 2.1 µg/kg, and 1.29 µg/kg, respectively. At the site, mean total PCB concentrations in edible crab tissue range from 2.0 µg/kg in FCA 1 to 7.4 µg/kg in FCA 2.

Therefore, the mean PCB concentration in edible crab was higher at the Site (7.4 µg/kg at FCA 2) than for background areas (1.29 µg/kg). Similarly, the highest mean $TEQ_{P,M}$ occurs in FCA 2, where the overall maximum $TEQ_{P,M}$ also occurs. The spatial pattern of PCBs in crab is therefore different from that of dioxins and furans as TEQ for which the highest concentrations in crab tissue are in FCA 1.

PCBs were detected in all catfish samples (Table 12). Total PCB concentrations are higher in whole catfish tissue samples than in catfish fillet, both from at the Site and in Cedar Bayou. Total PCBs in Cedar Bayou catfish fillet samples range from 25.5 to 88.4 µg/kg, with a mean total PCB concentration of 46.5 µg/kg. At the Site, the mean total PCB concentrations in catfish fillet ranges from 97.7 µg/kg in FCA 1 to 107 µg/kg in FCA 3.

Therefore, the mean PCB concentration in catfish fillets was higher at the Site (107 µg/kg at FCA3) than for background (46.5 µg/kg). The smallest range in total PCB concentrations in catfish fillet occurs in FCA 2, which has the highest minimum among the FCAs. Mean and median total PCB concentrations in catfish tissue samples from all three FCAs are greater than those in catfish collected from the Cedar Bayou background sampling area.

In contrast to TEQ in catfish fillet tissue, the highest maximum and mean concentrations for $TEQ_{P,M}$ are in fish from FCA 3 at 2.79 ng/kg and 1.36 ng/kg, respectively. Patterns are similar for whole catfish, except the highest maximum is in FCA 3 while the highest mean is in FCA 1. In whole catfish from all three FCAs, differences in the $TEQ_{P,M}$ concentrations at the site relative to those from Cedar Bayou are much smaller than the differences between these two locations for TEQ.

PCBs were detected in all edible clam tissue samples, including background (Table 13). At the site, mean total PCB concentrations ranges from 23.6 µg/kg in FCA 1 to 46.1 µg/kg in FCA 2. The range is 20.2 µg/kg in FCA 2 to 95.4 µg/kg in FCA 2. Background minimum, maximum, and mean total PCB concentrations are 9.54 µg/kg, 17.8 µg/kg, and 12.9 µg/kg, respectively.

Therefore, the mean PCB concentration in edible clam tissue was higher at the Site (46.1 µg/kg at FCA2) than for background (12.9 µg/kg). Concentrations of PCB $TEQ_{P,M}$ are generally lower in clams than those of dioxin/furan TEQ. The mean PCB $TEQ_{P,M}$ is higher in FCA 2 (0.502 ng/kg) than its mean in FCA 1 (0.22 ng/kg) or FCA 3 (0.366 ng/kg). The same pattern holds for maximum values within the three FCAs (Table 13). Clams from FCA 1 have the lowest maximum (0.271 ng/kg) and the lowest median (0.225 ng/kg) PCB $TEQ_{P,M}$ concentrations. In comparison, the minimum, maximum, and mean upstream background PCB $TEQ_{P,M}$ concentrations are 0.118 ng/kg, 0.283 ng/kg, and 0.181 ng/kg, respectively. Concentrations of PCB $TEQ_{P,M}$ in clams (and killifish) are not significantly different in FCA 1 than in the upstream background area.

PCBs were detected in all Gulf killifish tissue samples, including in upstream background samples (Table 14). At the site, mean total PCB concentrations range from 36.2 µg/kg in FCA 1 to 82.6 µg/kg in FCA 2. The maximum PCB $TEQ_{P,M}$ concentration in killifish (2.92 ng/kg) is also for FCA 2. Background minimum, maximum, and mean total PCB concentrations are 10.2 µg/kg, 14.6 µg/kg, and 12 µg/kg, respectively. Mean total PCB concentrations detected Gulf killifish tissue samples at the site are significantly greater than in background Gulf killifish tissue, but $TEQ_{P,M}$ is not significantly different in FCA 1 or FCA 3 than in background.

South of I-10 Soil Dioxin/Furan

Dioxin/furan concentrations in surface soil from Soil Investigation Area 4 (Southern Impoundment) and adjacent sampled areas range from 1.35 to 36.9 ng/kg (Table 15). Dioxin/furan concentrations above 30 ng/kg in surface soil occur at both the southern (Stations SJSB023 and SJSB024) and northern (Stations SJSB001 and SJSB014) ends of Soil Investigation Area 4 (Figure 25). These are the only locations where dioxin/furan in surface soils exceeds the surface soil reference envelope value for this parameter of 24.3 ng/kg.

A reference envelope value incorporates the use of tolerance limits on the background area data to define a threshold for comparisons of individual stations or samples. Such comparisons allow determination of whether the concentration of a chemical in an individual sample is or is not consistent with the background condition. The statistical representation of the reference envelope value is a one-sided upper tolerance limit on an upper percentile of the background data, derived to characterize background conditions. Tolerance intervals are a type of statistical interval that defines the limits within which a certain proportion of a population falls, given a predetermined confidence level. The resulting comparison would indicate, for an individual sample with a concentration greater than the reference envelope value, that there is at least a 95 percent chance ($\alpha = 0.05$) that the concentration in the sample is greater than expected for the highest 5 percent of all background results.

Substantially lower concentrations including the minimum dioxin/furan concentration of 1.35 ng/kg are found at stations in close proximity to those that exceed the surface soil reference envelope value, indicating that these few slightly elevated dioxin/furan concentrations are localized. The average surface soil dioxin/furan in Soil Investigation Area 4 and adjacent areas is most similar to that of Soil Investigation Area 2, beneath I-10, in the TxDOT Right-of-Way (Table 4). Within Soil Investigation Area 4 (Southern Impoundment), the congener with the highest concentration in surface soil is OCDD, at 64,900 ng/kg (Table 15). TCDD concentrations range up to 24.3 ng/kg.

In subsurface soils from 6 to 24 inches, dioxin/furan results range from 0.134 to 303 ng/kg, with an average of 16.5 ng/kg (Figure 25). The second highest result in this depth interval (43.1 ng/kg at Station SJSB018) is much lower than the maximum (Figure 25). The average dioxin/furan result in subsurface soils from 6 to 24 inches deep is slightly greater in the area of investigation on the peninsula south of I-10 than north of I-10, which includes the upland sand separation area and the nearby access road north of I-10 (Table 5). As for surface soils, the congener with the highest results in subsurface soils collected south of I-10 is OCDD at 106,000 ng/kg (Table 16).

Dioxin/furan concentrations in the Southern Impoundment soils significantly increase at a depth greater than 2 feet. The dioxin/furan results deeper than 2 feet range from 0.092 to 50,100 ng/kg and average 743 ng/kg (Table 17). The maximum core sample dioxin/furan occurs at a depth of 6 to 8 feet and is at Station SJSB019 in the southern part of soil investigation area 4 (Figure 25). Station SJSB023 has the second-highest TEQ concentration (35,500 ng/kg, at depth interval of 4 to 6 feet [Figure 25]); the highest concentration in surface soils is also found at this location. The majority of the highest core sample dioxin/furan concentrations occur between 6 and 12 feet deep, and are associated with stations located near the center of the peninsula south of I-10.

South of I-10 Soil PCB

PCB concentrations were measured in Soil Investigation Area 4 soils as Aroclors in 2011 and then as congeners in 2012. Total PCB concentrations in surface soil from Soil Investigation Area 4 range from 1.05 to 468 µg/kg, with an average concentration of 98 µg/kg (Table 18). The highest concentrations in surface soil occur in the southern portion of Soil Investigation Area 4 (Figure 26), with the maximum concentrations found at Stations SJSB018 and SJSB019; others in the same area range from 141 to 374 µg/kg. The lowest concentrations, by contrast, occur in the northern portion of the Soil Investigation Area 4.

Total PCB concentrations in Soil Investigation Area 4 subsurface soil range from 0.97 to 838 µg/kg and average 105 µg/kg (Table 18). The general pattern of total PCB distribution in the subsurface soil mirrors that of the surface soil (Figure 26). The maximum subsurface concentrations occur at Stations SJSB018 and SJSB019 in the south-central part of Soil Investigation Area 4. The lowest concentrations are located in the northern portion of Soil Investigation Area 4.

Total PCB concentrations in soil deeper than 2 feet range from 0.25 to 6,590 µg/kg, with an average concentration of 348 µg/kg (Table 18). The maximum concentrations occur at Station SJSB023 at a depth of 4 feet (Figure 26). This result at depth at Station SJSB023 corresponds to the second-highest $TEQ_{DF,M}$ concentration in soils (of 35,500 ng/kg). The next highest total PCB concentrations occur at Stations SJSB015 (5,960 µg/kg at 12 feet) and SJSB019 (3,270 µg/kg at 8 feet). At both stations, the elevated total PCB concentration corresponds to a sample where $TEQ_{DF,M}$ is also elevated (2,950 ng/kg at Station SJSB015 and 50,100 ng/kg at Station SJSB019). The majority of the highest total PCB concentrations are found deeper than 4 feet, and many occur in soils deeper than 6 feet. Higher total PCB concentrations occur evenly distributed across Soil Investigation Area 4 in the deep soils, a departure from the pattern evident at shallower depths.

South of I-10 Groundwater

Three or more dioxin and furan congeners were detected within the waste material in all three monitoring wells south of I-10. For those that were detected, the highest concentrations consistently occur in SJMW001. The dioxin/furan result in SJMW001 of 47.3 pg/L within the waste material. The average concentration of 2,3,7,8-TCDD in the waste material in all wells is 17.1 pg/L (using the estimated result in SJMW002 of 8.92 pg/L and the detection limit in SJMW003 of 9.9 pg/L). Table 19 presents summary statistics for groundwater samples collected south of I-10.

2.5.4 *Chemical Fate and Transport*

Section 5.6 of the RI Report contains a summary of the chemical fate and transport processes affecting the concentrations of dioxins and furans at the site. The most significant points of this discussion are summarized in the FS (EPA 2016) and are provided below:

- Dioxins and furans break down very slowly and releases from long ago remain in the environment. Dioxins and furans are therefore classified as persistent organic pollutants.

- Sediment-water interactions – Dioxins and furans are hydrophobic and preferentially bind to particulate matter. Particulate-associated dioxins and furans within the sediment bed enter the water column through sediment deposition and erosion processes. Deposition of sediments with low concentrations of chemicals in some areas may support natural recovery. However, riverbed erosion/scour has also occurred in some areas as demonstrated by the 2016 and the 2017 flooding when eroded areas were discovered adjacent to the eastern part of the temporary cap.

- Partitioning and dissolved phase flux – Because dioxins and furans are hydrophobic, they will be present primarily in particulate form, and their fate is therefore determined largely by sediment transport processes. Dioxins and furans within the sediment matrix include dissolved-phase dioxins and furans in porewater through partitioning processes, which can result in a transfer of dissolved-phase mass to the water column under certain conditions.

- Transport in the water column – Dioxins and furans present in the water column in any phase are transported by surface water currents, which are affected by hydrodynamic processes within the larger San Jacinto River.

- External sources – Publicly owned treatment plant outfalls, other point-source discharges, storm water runoff, and atmospheric deposition are all sources of dioxins and furans, although not generally the TCDDs and TCDFs associated with the site waste. As documented in the RI Report, groundwater is not a source of dioxins or furans to the San Jacinto River.

It should also be noted that data analyses and literature review, including evaluation of region-specific multivariate datasets, indicates that the majority of dioxin and furan congeners do not consistently bioaccumulate in fish or invertebrate tissue, although this general statement is not true for the tetrachlorinated congeners found in high levels in the site waste material. Systematic predictions of bioaccumulation from concentrations of dioxins and furans in abiotic media (both sediment and water) are only possible for tetrachlorinated congeners.

2.6 CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

This section summarizes the current and reasonably anticipated future land and resource use at the site and surrounding the site. This information forms the basis for the exposure assessment assumptions and risk characterization conclusions discussed in Section 2.7.

2.6.1 *Land Use*

Current land use at the site is primarily industrial and commercial use, as presented on Figure 27. Current land use surrounding the site includes mixed residential and industrial uses to the west, and undeveloped or residential areas to the east and north. Immediately south of the site is commercial/industrial land use. Moving farther from the site, the amount of residential land use increases, along with other land use categories not found in the immediate vicinity, such as undeveloped land, farms, parks, and lands listed as “other” (e.g., schools and hospitals). The future land use is not anticipated to be different from the current land use.

2.6.2 *Surface Water Use*

The San Jacinto River watershed encompasses nearly 4,000 square miles and approximately 310 miles of open streams including primary streams and tributary channels. The San Jacinto River flows from its headwaters near Huntsville, Texas through Lake Conroe and Lake Houston. The Port of Houston Authority operates the Houston Ship Channel (HSC), which originates at the Turning Basin on Buffalo Bayou and follows to the San Jacinto River. The HSC continues through the San Jacinto River and San Jacinto Bay to Galveston Bay.

South of the dam at Lake Houston, the San Jacinto River, including the area surrounding the site, is tidally influenced. The area south of the site is dominated by the HSC and the industrial sites that are served by the barges and ocean-going vessels that use the HSC. From the site north to Lake Houston there is much less industrialization along the river. The water quality segments upstream and downstream include the following uses: aquatic life, general, recreation, and restricted fish consumption.

Lynchburg Reservoir, located on the east bank of the San Jacinto River just south of the I-10 Bridge, uses water pumped in from the Trinity River. It is owned by the City of Houston, and construction was completed in 1976. At normal levels the lake has a surface area of 200 acres. The lake dam is earthen construction, with a height of 35 feet and a length of 15,315 feet. The lake capacity is 5,188 acre-feet; however, normal storage is 4,700 acre-feet. The lake drains an area of 0.32 square miles. Lost Lake (located south of I-10 between the primary channel of the San Jacinto River and the Old Channel to the west) is not a surface water reservoir; rather, it is a confined disposal facility for sediments from the HSC maintenance dredging program. It is managed by the Port of Houston Authority and U.S. Army Corps of Engineers Galveston District.

Harvesting Shellfish and Fish

Commercial and recreational fishing activity occurs throughout Galveston Bay. The San Jacinto River along with nearby Upper Galveston Bay, Tabbs Bay, and the San Jacinto State Park have "many points of public access and support both recreational and subsistence fishing activities" (Texas Department of State Health Services [TDSHS] 2005). Near the site, fishing is known to occur, however the amount and frequency of fishing has not been determined (Integral and Anchor 2013a). No known subsistence fishing communities have been documented by the Texas Department of State and Health Services in the area.

Consumption of mollusks and shellfish (clams, mussels, and oysters) taken from public fresh waters is prohibited by TDSHS. Within public salt waters, these shellfish may be taken only from waters approved by TDSHS. TDSHS shellfish harvest maps designate approved or conditionally approved harvest areas. Waters near the site are not included on these maps (TPWD 2009).

Other Recreational Use

Although the Site north of I-10 is private land, access points along the San Jacinto River allowed for a variety of recreational activities including picnicking, swimming, nature walks, bird watching, wading, fishing, boating, water sports, and other shoreline uses. In the area just to the south of the I-10 Bridge on the west side of the river, children and adults have been reported to at times play along the shoreline, wade in the water, and fish (Integral and Anchor 2013a). The Southern Impoundment area is private industrial land where recreational activities are not likely allowed.

Potable Surface Water Use

There are no surface water intakes within 15 miles downstream of the northern impoundments or of the peninsula south of I-10 (TCEQ 2006).

2.7 SUMMARY OF SITE RISKS

The primary hazardous substances present at the Site are dioxins and furans. PCBs also contribute to the risks associated with the site, but in comparison to the dioxins and furans, they are not the risk drivers. PCBs at the site are co-located with dioxins and furans and will therefore be addressed by a remedy addressing the dioxins and furans. Dioxins are the by-products of various industrial processes (i.e., bleaching paper pulp, and chemical and pesticide manufacture) and combustion activities (i.e., burning household trash, forest fires, and waste incineration).

After being absorbed, dioxin distributes to organs according to lipid (fat) content and readily accumulates in body fat. TCDD, or 2,3,7,8-tetrachloro dibenzo-p-dioxin, is a tetrachlorinated congener of dioxin found in the site waste. The half-life of TCDD in the human body ranges from 7 to 12 years. The most common health effect in people exposed to large amounts of dioxins, in particular TCDD, is chloracne. Chloracne cases have typically been the result of accidents or significant contamination events. Chloracne is a severe skin disease with acne-like lesions that occur mainly on the face and upper body. Other skin effects noted in people exposed to high doses of TCDD include skin rashes, discoloration, and excessive body hair (ATSDR, 1998).

In addition to chloracne, dioxins can cause several health effects, including long-term changes in glucose metabolism, subtle changes in hormone levels, transient mild liver damage (hepatotoxicity) and peripheral nerve damage (neuropathy)., Other potential effects include porphyria cutanea tarda (liver dysfunction and photosensitive skin lesions), Type 2 diabetes, neurobehavioral development effects in infants, and men in highly exposed populations are less likely to father boys (ATSDR, 1998).

Noncancer adverse health effects were observed in sensitive susceptible very young members of the population during their development in utero. Increased thyroid-stimulating hormone levels in newborns born to mothers who were exposed to TCDD during the Seveso accident was reported (Baccarelli et al., 2008). Decreased sperm concentration and sperm motility in men who were exposed to TCDD during childhood during the Seveso accident was also reported and identified the first 10 years of life as a critical window of susceptibility to TCDD induced sperm effects in young children (Mocarelli et al., 2008).

TCDD carcinogenicity in animals is well established. However, the specific carcinogenic mechanism for TCDD has not been fully elucidated. TCDD produces cancer at all sites in animals. Epidemiological data support that TCDD increases cancer incidence in all sites for humans. The World Health Organization (WHO, 1997), and the U.S. National Toxicology Program (NTP, 2001). Dioxin also increases the risk for several individual cancers, including soft-tissue malignant tumor (sarcoma), lung cancer, cancer of the lymphatic tissue (non-Hodgkin's lymphoma), and malignant enlargement of the lymph nodes, spleen, and liver (Hodgkin's disease) (ATSDR, 2006).

Polychlorinated biphenyls are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known natural sources of PCBs. PCBs are either oily liquids or solids that are colorless to light yellow. Many commercial PCB mixtures are known in the U.S. by the trade name Aroclor. PCBs were used in a variety of industrial equipment (e.g., electrical, heat transfer, and hydraulic equipment) because they don't burn easily and are good insulators and consumer products (e.g., plasticizers in paints, plastics, and rubber products). The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence they build up in the environment and can cause harmful health effects (ATSDR, 2014 & EPA, 2007).

The most commonly observed health effects in people exposed to large amounts of PCBs are skin conditions such as chloracne (as described above) and rashes. Studies in exposed workers have shown changes in blood and urine that may indicate liver damage. PCB exposures in the general population are not likely to result in skin and liver effects (EPA, 2007).

The primary targets of PCBs are the endocrine (hormonal) and nervous systems. PCB exposure during prenatal and early childhood development has been associated with low birth weight, neurobehavioral developmental delays, cognitive deficits, changes in production of thyroid hormones, and altered reproductive system development in males and females. PCB exposure has also been associated with liver cancer in experimental animals (EPA, 2007).

Most of the studies of health effects of PCBs in the general population examined children of mothers who were exposed to PCBs. Women who were exposed to relatively high levels of PCBs in the workplace or ate large amounts of fish contaminated with PCBs had babies that weighed slightly less than babies from women who did not have these exposures. Babies born to women who ate PCB-contaminated fish also showed abnormal responses in tests of infant behavior. Some of these behaviors, such as problems with motor skills and a decrease in short-term memory, lasted for several years. Other studies suggest that the immune system was affected in children born to and nursed by mothers exposed to increased levels of PCBs. The most likely way infants will be exposed to PCBs is from breast milk. In most cases, the benefits of breast-feeding outweigh any risks from exposure to PCBs in mother's milk (ATSDR, 2014).

Few studies of workers indicate that PCBs were associated with certain kinds of cancer in humans. Rats that ate food containing high levels of PCBs for two years developed liver cancer. PCBs are classified by the U.S. EPA as B2, probable human carcinogens, based on liver tumors in adult rats (https://cfpub.epa.gov/ncea/iris/iris_documents/documents/subst/0294_summary.pdf) (EPA, 1996). The World Health Organization International Agency for Research on Cancer (IARC) in 1998 classified PCBs as Group 2A, probably carcinogenic in humans (http://monographs.iarc.fr/ENG/Monographs/vol107/mono107.pdf) (WHO, 2016).

Twelve PCB congeners show structural similarity to chlorinated dibenzo-p-dioxins and dibenzofurans, and are often referred to as "dioxin-like" PCBs. Dioxin-like congeners include the non-*ortho* PCBs 77, 81, 126, and 169 and mono-*ortho* PCBs 105, 114, 118, 123, 156, 157, 167, and 189. These dioxin-like PCBs elicit a spectrum of biochemical and toxicological responses similar to dibenzo-p-dioxins and dibenzofurans including environmental persistence and bioaccumulation in the food chain (EPA, 1996). Like dioxins and furans, dioxin-like PCB congeners have also been assigned toxic equivalency factors (TEFs) ranging from 0.1 (PCB-126) to 0.00003 relative to TCDD, which is assigned a TEF of 1 (Van den Berg, 2006). Concentrations of these congeners in various media are multiplied by their respective TEF to yield toxic equivalent concentrations which are summed to provide a measure of total dioxin-like activity. Dioxin-like PCBs toxicity can therefore be expressed as a fraction of the toxicity of TCDD, and it is recommended that their risk also be assessed using the TEQ approach (EPA, 2010a).

A site-specific baseline human health risk assessment (BHHRA) and a baseline ecological risk assessment (BERA) were conducted to determine potential pathways by which people (human receptors) or animals (ecological receptors) could be exposed to upland or aquatic contamination in sediment, soil, water, or biota, the amount of contamination receptors of concern may be exposed to, and the toxicity of those contaminants if no action were taken to address contamination at the Site (Integral & Anchor 2013b, Integral 2013). These assessments provide the basis for taking action and identify the contaminants and exposure pathways that need to be addressed by the remedial action. Section 2.7.1 provides a summary of the relevant portions of the BHHRA as summarized from Integral and Anchor (2013b). Section 2.7.2 provides a summary of the relevant portions of the BERA as summarized from Integral (2013). Section 2.7.3 discusses the basis for action at the site.

2.7.1 *Summary of Human Health Risk Assessment*

The baseline human health risk assessment estimates what risks the site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the BHHRA.

Identification of Chemicals of Concern

The tables below present the COCs and exposure point concentrations for each of the COCs detected in media (i.e., the concentration that was used to estimate the exposure and risk from each COC). The tables include the number of samples per exposure unit, the frequency of detection (i.e., the number of times the chemical was detected in the samples collected at the site), the exposure point concentration, and how the exposure point concentration was derived.

Chemicals of Concern and Baseline Exposure Point Concentrations
North of I-10 and Aquatic Environment

Scenario Timeframe: Baseline						
Exposure Unit	**Chemical of Concern**	**Number of Samples**	**Maximum Result (ng/kg)**	**Frequency of Detection (percent)**	**Exposure Point Concentration (ng/kg)**	**Statistical Measure**
Sediment						
Beach Area A	TEQ(ND=1/2)	5	0.495	100	0.456	95UCL
	TEQ(ND=0)	5	0.373	100	0.339	95UCL
	Aroclors(ND=1/2)	Not Sampled	--	--	--	--
	Aroclors(ND=0)	Not Sampled	--	--	--	--
	TEQ_{P}(ND=1/2)	Not Sampled	--	--	--	--
	TEQ_{P}(ND=0)	Not Sampled	--	--	--	--
Beach Area B/C	TEQ(ND=1/2)	10	10.9	100	6.36	95UCL
	TEQ(ND=0)	10	10.7	100	6.12	95UCL
	Aroclors(ND=1/2)	Not Sampled	--	--	--	--
	Aroclors(ND=0)	Not Sampled	--	--	--	--
	TEQ_{P}(ND=1/2)	Not Sampled	--	--	--	--
	TEQ_{P}(ND=0)	Not Sampled	--	--	--	--
Beach Area D	TEQ(ND=1/2)	7	2.9	100	2.12	95UCL
	TEQ(ND=0)	7	2.8	100	2.0	95UCL
	Aroclors(ND=1/2)	Not Sampled	--	--	--	--
	Aroclors(ND=0)	Not Sampled	--	--	--	--
	TEQ_{P}(ND=1/2)	Not Sampled	--	--	--	--
	TEQ_{P}(ND=0)	Not Sampled	--	--	--	--
Beach Area E	TEQ(ND=1/2)	17	47,000	100	13,000	95UCL
	TEQ(ND=0)	17	46,000	100	13,000	95UCL
	Aroclors(ND=1/2)	4	1,400,000	0	1,400,000	Max A 1254
	Aroclors(ND=0)	4	0	0	0	Max
	TEQ_{P}(ND=1/2)	4	4.5	100	4.5	Max
	TEQ_{P}(ND=0)	4	2.43	100	2.35	95UCL
Tissue – Hardhead Catfish Fillet						
FCA 1	TEQ(ND=1/2)	10	5.45	100	3.92	95UCL
	TEQ(ND=0)	10	5.32	100	3.86	95UCL
	PCB_{C}(ND=1/2)	12	156,000	100	104,000	95UCL
	PCB_{C}(ND=0)	12	156,000	100	104,000	95UCL
	TEQ_{P}(ND=1/2)	12	2.27	100	1.67	95UCL
	TEQ_{P}(ND=0)	12	2.17	100	1.43	95UCL

Chemicals of Concern and Baseline Exposure Point Concentrations North of I-10 and Aquatic Environment (Continued)

Exposure Unit	Chemical of Concern	Number of Samples	Maximum Result (ng/kg)	Frequency of Detection (percent)	Exposure Point Concentration (ng/kg)	Statistical Measure
Scenario Timeframe: Baseline						
Tissue – Hardhead Catfish Fillet						
FCA 2/3	TEQ(ND=1/2)	20	5.85	100	4.06	95UCL
	TEQ(ND=0)	20	5.84	100	3.99	95UCL
	PCB_C(ND=1/2)	20	129,000	100	94,200	95UCL
	PCB_C(ND=0)	20	129,000	100	94,200	95UCL
	TEQ_P(ND=1/2)	20	2.79	100	1.57	95UCL
	TEQ_P(ND=0)	20	2.7	100	2.38	95UCL
Tissue – Edible Clam						
FCA 1/3	TEQ(ND=1/2)	10	2.19	100	1.65	95UCL
	TEQ(ND=0)	10	2.12	100	1.51	95UCL
	PCB_C(ND=1/2)	10	26,900	100	21,700	95UCL
	PCB_C(ND=0)	10	26,900	100	21,600	95UCL
	TEQ_P(ND=1/2)	10	0.436	100	0.346	95UCL
	TEQ_P(ND=0)	10	0.104	100	0.0802	95UCL
FCA 2	TEQ(ND=1/2)	15	27	100	19	95UCL
	TEQ(ND=0)	15	26.9	100	21.4	95UCL
	PCB_C(ND=1/2)	15	61,800	100	50,000	95UCL
	PCB_C(ND=0)	15	61,800	100	50,000	95UCL
	TEQ_P(ND=1/2)	15	1.9	100	0.824	95UCL
	TEQ_P(ND=0)	15	0.787	100	0.442	95UCL
Tissue – Edible Crab						
FCA 1	TEQ(ND=1/2)	10	1.91	100	1.07	95UCL
	TEQ(ND=0)	10	1.85	100	0.972	95UCL
	PCB_C(ND=1/2)	10	4,820	100	3,350	95UCL
	PCB_C(ND=0)	10	4,740	100	3,290	95UCL
	TEQ_P(ND=1/2)	10	0.234	100	0.148	95UCL
	TEQ_P(ND=0)	10	0.0271	100	0.0201	95UCL
FCA 2/3	TEQ(ND=1/2)	20	0.558	60	0.286	95UCL
	TEQ(ND=0)	20	0.523	60	0.176	95UCL
	PCB_C(ND=1/2)	20	11,400	100	7,170	95UCL
	PCB_C(ND=0)	20	11,300	100	7,130	95UCL
	TEQ_P(ND=1/2)	20	0.547	100	0.296	95UCL
	TEQ_P(ND=0)	20	0.525	100	0.186	95UCL
Soil						
North of I-10	TEQ(ND=1/2)	46	153	100	22.6	95UCL
	TEQ(ND=0)	46	152	100	23.8	95UCL
	Aroclors(ND=1/2)	15	130,000	26.7	48,400	95UCL
	Aroclors(ND=0)	15	130,000	26.7	48,400	95UCL
	TEQ_P(ND=1/2)	12	2.83	91.7	2.65	95UCL
	TEQ_P(ND=0)	12	2.83	91.7	2.83	Max

Note:
95UCL – 95 percent upper confidence limit
FCA – fish collection area
Max – maximum result
Max A 1254 – maximum result of Aroclor 1254
ND=0 – nondetect results assumed equal to zero in TEQ calculation
ND=1/2 – nondetect results assumed equal to ½ the detection limit in TEQ calculation
ng/kg – nanograms per kilogram
PCB_C – sum of 43 PCB congeners
TEQ – 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalent
TEQ_P – toxicity equivalent for dioxin-like polychlorinated biphenyls

Chemicals of Concern and Baseline Exposure Point Concentrations
South of I-10

Scenario Timeframe: Baseline						
Exposure Unit	**Chemical of Concern**	**Number of Samples**	**Maximum Result (ng/kg)**	**Frequency of Detection (percent)**	**Exposure Point Concentration (ng/kg)**	**Statistical Measure**
Surface Soil						
0-6 Inches	TEQ(ND=1/2)	26	36.9	100	27.9	95UCL
	TEQ(ND=0)	26	36.9	100	28.2	95UCL
Surface and Shallow Subsurface Soil						
0-12 Inches	TEQ(ND=1/2)	26	36.9	100	24.6	95UCL
	TEQ(ND=0)	26	36.9	100	24.7	95UCL
Surface and Deep Subsurface Soils (0-10 Feet)						
DS-1	TEQ(ND=1/2)	10	6,530	100	2,400	DWA
	TEQ(ND=0)	10	6,530	100	2,400	DWA
DS-2	TEQ(ND=1/2)	10	50,100	100	10,900	DWA
	TEQ(ND=0)	10	50,100	100	10,900	DWA
DS-3	TEQ(ND=1/2)	10	1,570	100	5.94	DWA
	TEQ(ND=0)	10	1,570	100	5.71	DWA
DS-4	TEQ(ND=1/2)	10	35,500	100	7,770	DWA
	TEQ(ND=0)	10	35,500	100	7,770	DWA
DS-5	TEQ(ND=1/2)	10	2,050	100	552	DWA
	TEQ(ND=0)	10	2,050	100	552	DWA

Note:
DS- Deep Subsurface soil
DWA – Depth-weighted average calculated as described in the BHHRA, page 6-1, Section 6.1.2.2.1, second paragraph and BHHRA Appendix M, page M-5, Section 3.1.1.
ND=0 – nondetect results assumed equal to zero in TEQ calculation
ND=1/2 – nondetect results assumed equal to ½ the detection limit in TEQ calculation
ng/kg – nanograms per kilogram
TEQ – 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalent

Exposure Assessment

Exposure pathways quantitatively evaluated in the BHHRA for the area north of I-10 and aquatic environment included the following:

- Recreational Fisher – direct contact (incidental ingestion and dermal contact) with sediment and soils, ingestion of finfish (represented by Hardhead catfish), and ingestion of shellfish (represented by blue crab and clam, *Rangia cuneata*)

- Subsistence Fisher – direct contact (incidental ingestion and dermal contact) with sediment and soils, ingestion of finfish (represented by Hardhead catfish), and ingestion of shellfish (represented by blue crab and clam, *Rangia cuneata*)

- Recreational Visitor – direct contact (incidental ingestion and dermal contact) with sediment and soils.
- Exposure pathways for the area north of I-10 and aquatic environment are presented in the conceptual site model (Figure 12) and discussed in Section 5.1.1 of the BHHRA (Integral and Anchor, 2013b). Both recreational and subsistence fishers are assumed to ingest fish and/or shellfish caught at the site. It is assumed that 25 percent of the total fish or shellfish intake by recreational fishers is site-related (Table 20). Subsistence fishers are assumed to ingest 100 percent of total fish or shellfish intake that is site-related (Table 20). In the absence of detailed information regarding fishing activities and consumption patterns in the area, exposures were estimated using three scenarios: 1) ingestion of

finfish only, 2) ingestion of clams only, and 3) ingestion of crabs only. Assuming a single-tissue type exposure is a conservative approach because it identifies and quantifies potential exposure to the tissue type that may result in the highest potential for exposure (Integral and Anchor 2013b). Cumulative exposures (i.e., ingestion and dermal contact) were summed for each tissue ingestion scenario separately by exposure area. Baseline sediment, tissue, and soil exposure areas are presented on Figures 28 through 30, respectively. Table 21 provides a complete set of hypothetical exposure scenarios evaluated for the baseline condition. As a part of the BHHRA, the potential for adverse health effects to hypothetical receptors under conditions following the TCRA (termed as the post-TCRA condition) were also evaluated for dioxins and furans. As discussed in Section 2.2.5, TCRA construction was completed in 2011 and included installation of an armored cap, fencing, and warning signs over and around the northern impoundments.

Table 20 provides exposure parameter assumptions used for the area north of I-10 and the aquatic environment. The EPA based its remedy decision on the pre-TCRA hazards and risks.

Exposure pathways quantitatively evaluated in the BHHRA for the area south of I-10 included the following:

- Trespasser – direct contact (incidental ingestion and dermal contact) with surface soil
- Commercial Worker – direct contact (incidental ingestion and dermal contact) with surface and shallow subsurface soil
- Future Construction Worker – direct contact (incidental ingestion and dermal contact) with surface and subsurface soil.

Exposure pathways for the area south of I-10 are presented in the conceptual site model (Figure 14) and discussed in Section 6.1.1 of the BHHRA (Integral and Anchor 2013b). Exposure to future construction workers was evaluated using five 0.5-acre exposure units. Table 22 provides exposure parameter assumptions used for the area south of I-10.

The potential inhalation of dioxins and furans in air and exposure via direct contact with surface water were identified as minor exposure pathways and only addressed qualitatively. Inhalation exposure via vapor is considered minor because dioxins and furans are not volatile compounds and therefore would not tend to volatilize into air. Inhalation of particulates derived from the resuspension of surface soil may occur; however, this pathway generally contributes less than one percent of total estimated exposure when direct soil contact pathways (ingestion and dermal contact) are considered. Exposure to dioxins and furans in surface water is also considered to be a minor pathway because they are hydrophobic (not soluble in water), and tend to be bound to organic carbon in sediment. It is possible suspended sediment particles in the water column could come in contact with human receptors; however, those exposures are assumed to be brief and minimal because the movement of surface water would likely wash away the majority of sediment particles that contact the skin.

Toxicity Assessment

The tables below provide the carcinogenic and noncarcinogenic risk information relevant to COCs in sediment, soil, and tissue that was used in the BHHRA (Integral and Anchor, 2013b).

Cancer Toxicity Data

Chemical of Concern	Oral Cancer Slope Factor	Units	Source	Weight of Evidence/Cancer Guideline Description	Date of Most Recent Update
TEQ [1]	130,000	$(mg/kg\text{-}day)^{-1}$	CalEPA	B2- probable human carcinogen, sufficient evidence in animals and inadequate or no evidence in humans	2011
Polychlorinated Biphenyls[2]	2.0	$(mg/kg\text{-}day)^{-1}$	IRIS	B2- probable human carcinogen, sufficient evidence in animals and inadequate or no evidence in humans	1997

Note:
[1] 2,3,7,8-TCDD values were used to evaluate TEQ.
[2] Information presented was used in the reasonable maximum exposure calculations of the BHHRA, different values were used for central tendency exposure.
BHHRA – baseline human health risk assessment
mg/kg – milligrams per kilogram
TCDD – tetrachlorodibenzo-p-dioxin
TEQ – 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalent

Noncancer Toxicity Data

Chemical of Concern	Chronic			Subchronic			Primary Target Organ	Date of Most Recent Update
	Oral RfD Value (pg/kg-day)	Source	Combined Uncertainty/ Modifying Factors	Oral RfD Value (pg/kg-day)	Source	Combined Uncertainty/ Modifying Factors		
TEQ[1]	0.7	IRIS	30	0.7	IRIS[2]	30	Reproductive/ Developmental Issues	2/17/2012
Polychlorinated Biphenyls[3]	20,000	IRIS	300	60,000	calculated[4]	100	Immune System	11/1/1996

Note:
[1] 2,3,7,8-TCDD values were used to evaluate TEQ.
[2] no subchronic RfD was available, the chronic RfD was selected.
[3] Values for Aroclor 1254 presented. Aroclor 1254 was the only Aroclor detected at the site.
[4] Derivation of the chronic RfD included a factor adjust for less than lifetime exposure. This value was removed to derive the subchronic exposure.
IRIS – Integrated Risk Information System
pg/kg – picograms per kilogram
RfD – reference dose
TCDD – tetrachlorodibenzo-p-dioxin
TEQ – 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalent

Risk Characterization

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

$$\textbf{Risk} = \textbf{CDI} \times \textbf{SF}$$

Where:

risk = a unitless probability (e.g., $2x10^{-5}$) of an individual developing cancer as a result of site-related exposure

CDI = chronic daily intake averaged over 70 years (picograms per kilogram [pg/kg]-day)

SF = slope factor, expressed as $(pg/kg\text{-}day)^{-1}$.

These risks are probabilities that usually are expressed in scientific notation (e.g., $1x10^{-6}$). An excess lifetime cancer risk of $1x10^{-6}$ indicates that an individual has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. According to the American Cancer Society, the chance of an individual developing cancer from other causes has been estimated to be as high as one in three for females and one in two for males EPA's generally acceptable risk range for site-related exposures is 10^{-4} to 10^{-6}.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ<1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The hazard index (HI) is generated by adding the HQs for all COCs that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI<1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic noncarcinogenic effects from contaminants are unlikely. An HI≥1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

Where:

CDI = chronic daily intake

RfD = reference dose.

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

The excess lifetime cancer risk to a recreational fisher from direct exposure to sediment through the inadvertent ingestion and dermal contact and indirect exposure to sediment through the ingestion of fish/shellfish routes of intake was estimated for Beach Area E at 7.0 X 10^{-4}, which is greater than the upper end of the EPA's generally accepted excess cancer risk range of 1 X 10^{-4}. The other Beach Areas (Beach Area A, B/C, and D) had excess cancer risk less than the lower end of the EPA generally accepted risk range of 1 X 10^{-6} (Khoury, 2016). Cancer risk was estimated using CalEPA tier 3 toxicity value or cancer slope factor of 1.3 X 10^{5} $(mg/kg\text{-}day)^{-1}$. Tier 3 toxicity values usually do not go through rigorous review as EPA tier 1 toxicity values; using current tier 3 toxicity values for protecting human health at dioxin levels associated with 10^{-4} excess cancer risk effects will not be protective for non-cancer adverse health effects at a HI of 1. Therefore, EPA relied on the tier 1 non-cancer risk toxicity value in its human health risk assessment and in determining cleanup levels for the site, but not the cancer risk. EPA's rationale that cleaning down to the noncancer effects level will also be protective at the midlevel for the EPA's acceptable excess cancer risk range.

The text and tables below provide a summary of site related noncancer HIs above 1identified in the BHHRA (Integral and Anchor 2013b). HIs presented below are based on calculations of reasonable maximum exposure. Reasonable maximum exposure is defined as the highest exposure that could be reasonably anticipated to occur for a given exposure pathway and scenario at the site. Central tendency exposure, or the average estimate of exposure, was also evaluated in the BHHRA (Integral and Anchor 2013b); however, it will not be included here for brevity.

North of I-10 and the Aquatic Environment Noncancer Hazards for a Recreational Fisher

The deterministic risk assessment for a recreational fisher north of I-10 and the aquatic environment is presented in Section 5.2.2.1 of the BHHRA (Integral and Anchor, 2013b) and is summarized below. For a recreational fisher in Exposure Scenarios 3A, 3B, and 3C (direct exposure to Beach Area E and the ingestion of catfish, clam, or crab from the fishing areas identified), the reproductive/developmental noncancer HIs are greater than one and indicate a potential for adverse noncancer effects. The table below provides noncancer HQs for exposure to sediment and fish or shellfish for all scenarios, with endpoint-specific HIs greater than one for recreational fisher exposure scenarios.

North of I-10 and the Aquatic Environment
Noncancer Hazards for a Recreational Fisher

Scenario Timeframe: Receptor Population: Receptor Age: Calculation Assumption:	Baseline Recreational Fisher Young Child Reasonable Maximum Exposure				
		Noncancer Hazard Quotient			
Chemical[1]	Primary Target Organ	Incidental Ingestion of Sediment	Dermal Contact with Sediment	Consumption of Fish or Shellfish[2]	Exposure Route Total[3]
Scenario 1A: Direct Exposure Beach Area A; Ingestion of Catfish from FCA 2/3					
TEQ	Reproductive/Developmental	0.00023	0.0013	**1.1**	**1.1**
				Reproductive/Developmental Endpoint-Specific Hazard Index	**1.1**
Scenario 2A: Direct Exposure Beach Area B/C; Ingestion of Catfish from FCA 2/3					
TEQ	Reproductive/Developmental	0.0032	0.018	**1.1**	**1.1**
				Reproductive/Developmental Endpoint-Specific Hazard Index	**1.1**
Scenario 3A: Direct Exposure Beach Area E; Ingestion of Catfish from FCA 2/3					
TEQ	Reproductive/Developmental	**6.5**	**37**	**1.1**	**45**
				Reproductive/Developmental Endpoint-Specific Hazard Index	**45**

PCBs	Immune	0.049	0.65	0.88	**1.6**
				Immune Endpoint-Specific Hazard Index	**1.6**
Scenario 3B: Direct Exposure Beach Area E; Ingestion of Clam from FCA 2					
TEQ	Reproductive/Developmental	**6.5**	**37**	0.21	**44**
				Reproductive/Developmental Endpoint-Specific Hazard Index	**44**
Scenario 3C: Direct Exposure Beach Area E; Ingestion of Crab from FCA 2/3					
TEQ	Reproductive/Developmental	**6.5**	**37**	0.0032	**44**
				Reproductive/Developmental Endpoint-Specific Hazard Index	**44**
Scenario 4A: Direct Exposure Beach Area D; Ingestion of Catfish from FCA 1					
TEQ	Reproductive/Developmental	0.0011	0.006	**1.0**	**1.0**
				Reproductive/Developmental Endpoint-Specific Hazard Index	**1.0**

Note:
Numbers in Bold represent an HQ>1 or an HI>1.
[1] All chemicals with primary target organ exposure route totals greater than 1 are included in this table.
[2] See scenario title for identification of tissue consumed
[3] Two significant figures presented, differences between values presented in the risk assessment tables and those presented here are either a result of the number of significant figures presented, rounding, or both.
FCA – fish collection area
PCB – polychlorinated biphenyls
TEQ – 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalent

North of I-10 and the Aquatic Environment Noncancer Hazards for a Recreational Fisher

The deterministic risk assessment for a subsistence fisher north of I-10 and the aquatic environment is presented in Section 5.2.2.2 of the BHHRA (Integral and Anchor 2013b) and is summarized below. For a subsistence fisher exposure to any of the beaches and the ingestion catfish, clam, or crab from the fishing areas identified have reproductive/developmental noncancer HIs greater than one and indicate a potential for adverse noncancer effects. The table below provides noncancer HQs for exposure to sediment and fish or shellfish for all scenarios with endpoint-specific HIs greater than one for subsistence fisher exposure scenarios.

North of I-10 and the Aquatic Environment Noncancer Hazards for a Subsistence Fisher

Scenario Timeframe: **Receptor Population:** **Receptor Age:** **Calculation Assumption:**	Baseline Subsistence Fisher Young Child Reasonable Maximum Exposure				
		Noncancer Hazard Quotient			
Chemical[1]	**Primary Target Organ**	**Incidental Ingestion of Sediment**	**Dermal Contact with Sediment**	**Consumption of Fish or Shellfish[2]**	**Exposure Route Total[3]**
Scenario 1A: Direct Exposure Beach Area A; Ingestion of Catfish from FCA 2/3					
TEQ	Reproductive/Developmental	0.00061	0.0035	**9.2**	**9.2**
				Reproductive/Developmental Endpoint-Specific Hazard Index	**9.2**
PCBs	Immune	--	--	**7.4**	**7.4**
				Immune Endpoint-Specific Hazard Index	**7.4**
Scenario 2A: Direct Exposure Beach Area B/C; Ingestion of Catfish from FCA 2/3					
TEQ	Reproductive/Developmental	0.0085	0.048	**9.2**	**9.2**
				Reproductive/Developmental Endpoint-Specific Hazard Index	**9.2**
PCBs	Immune	--	--	**7.4**	**7.4**
				Immune Endpoint-Specific Hazard Index	**7.4**

North of I-10 and the Aquatic Environment Noncancer Hazards for a Subsistence Fisher (Continued)

Scenario Timeframe: **Receptor Population:** **Receptor Age:** **Calculation Assumption:**	Baseline Subsistence Fisher Young Child Reasonable Maximum Exposure				
		Noncancer Hazard Quotient			
Chemical[1]	**Primary Target Organ**	**Incidental Ingestion of Sediment**	**Dermal Contact with Sediment**	**Consumption of Fish or Shellfish[2]**	**Exposure Route Total[3]**
Scenario 2B: Direct Exposure Beach Area B/C; Ingestion of Clam from FCA 2					
TEQ	Reproductive/Developmental	0.0085	0.048	**2.9**	**2.9**
Reproductive/Developmental Endpoint-Specific Hazard Index					**2.9**
Scenario 3A: Direct Exposure Beach Area E; Ingestion of Catfish from FCA 2/3					
TEQ	Reproductive/Developmental	**17**	**99**	**9.2**	**130**
Reproductive/Developmental Endpoint-Specific Hazard Index					**130**
PCBs	Immune	0.13	1.7	7.4	**9.2**
Immune Endpoint-Specific Hazard Index					**9.2**
Scenario 3B: Direct Exposure Beach Area E; Ingestion of Clam from FCA 2					
TEQ	Reproductive/Developmental	**17**	**99**	**2.9**	**120**
Reproductive/Developmental Endpoint-Specific Hazard Index					**120**
PCBs	Immune	0.13	**1.7**	0.26	**2.1**
Immune Endpoint-Specific Hazard Index					**2.1**
Scenario 3C: Direct Exposure Beach Area E; Ingestion of Crab from FCA 2/3					
TEQ	Reproductive/Developmental	**17**	**99**	0.043	**120**
Reproductive/Developmental Endpoint-Specific Hazard Index					**120**
PCBs	Immune	0.13	1.7	0.038	**1.9**
Immune Endpoint-Specific Hazard Index					**1.9**
Scenario 4A: Direct Exposure Beach Area D; Ingestion of Catfish from FCA 1					
TEQ	Reproductive/Developmental	0.0028	0.016	**8.8**	**8.9**
Reproductive/Developmental Endpoint-Specific Hazard Index					**8.9**
PCBs	Immune	--	--	**8.2**	**8.2**
Immune Endpoint-Specific Hazard Index					**8.2**

Note:
Numbers in Bold represent an HQ>1 or an HI>1.
[1] All chemicals with primary target organ exposure route totals greater than 1 are included in this table.
[2] See scenario title for identification of tissue consumed
[3] Two significant figures presented, differences between values presented in the risk assessment tables and those presented here are either a result of the number of significant figures presented, rounding, or both.
FCA – fish collection area
PCB – polychlorinated biphenyls
TEQ – 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalent

The deterministic risk assessment for a recreational visitor north of I-10 and the aquatic environment is presented in Section 5.2.2.3 of the BHHRA (Integral and Anchor 2013b) and is summarized below. For a recreational visitor in Exposure Scenario 3 (direct exposure to Beach Area E), the reproductive/developmental noncancer HI is greater than one and indicates there is a potential for adverse noncancer effects. The table below provides noncancer HQs for exposure to sediment and soil for all scenarios with endpoint-specific HIs greater than one for recreational fisher exposure scenarios.

North of I-10 and the Aquatic Environment Noncancer Hazards for a Recreational Visitor

Scenario Timeframe:	Baseline					
Receptor Population:	Recreational Visitor					
Receptor Age:	Young Child					
Calculation Assumption:	Reasonable Maximum Exposure					
		Noncancer Hazard Quotient				
Chemical[1]	**Primary Target Organ**	**Incidental Ingestion of Sediment**	**Incidental Ingestion of Soil**	**Dermal Contact with Sediment**	**Dermal Contact with Soil**	**Total[2]**
Scenario 3: Direct Exposure Beach Area E						
TEQ	Reproductive/ Developmental	**8.7**	0.015	**49**	0.0021	**58**
		Reproductive/Developmental Endpoint-Specific Hazard Index				**58**

Note:
[1] All chemicals with primary target organ exposure route totals greater than 1 are included in this table.
[2] Two significant figures presented, differences between values presented in the risk assessment tables and those presented here are either a result of the number of significant figures presented, rounding, or both.
TEQ – 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalent quotient

North of I-10 and the Aquatic Environment Noncancer Hazards for a Recreational Visitor

Following completion of the deterministic risk assessment, results of which are presented above, refinement analyses were completed if north of I-10 and the aquatic environment exposure scenarios met one or both of the following thresholds:

- An incremental cancer risk greater than one in 10,000.
- A total endpoint-specific noncancer HI greater than 1

Refinement analyses are discussed in Section 5.2.3 of the BHHRA (Integral and Anchor, 2013b) and included: 1) an analysis and comparison of background hazards with estimated deterministic hazards for the area, 2) an evaluation of post-TCRA condition hazards, and 3) a probabilistic risk assessment of potential hazards.

The background hazard evaluation is presented in Section 5.2.3.1 of the BHHRA (Integral and Anchor, 2013b), the results of which are summarized below. The tables below provide summaries of noncancer and TEQ cancer HIs for recreational fisher, subsistence fisher, and recreational visitor exposure scenarios, respectively. Evaluation of background hazards, performed in the BHHRA, indicated the following:

- Sediment
  - Exposure to beach area E through the ingestion and dermal routes of intake resulted in hazards exceeding background.
  - Exposure to other beach areas results in hazards consistent with background
- Catfish
  - Ingestion of catfish from FCA 1 and FCA 2/3 resulted in hazards exceeding background
  - Background hazards contribute to total hazards (e.g., provide almost ½ the total hazards for PCBs and TEQ)
- Clams

- Ingestion of clams from FCA 2 results in hazards exceeding background
- Ingestion of clams from FCA 1/3 results in hazards slightly higher than background.

Recreational Fisher Summary of Background Hazards

Scenario	Incidental Ingestion of Sediment	Dermal Contact with Sediment	Fish or Shellfish Ingestion	Hazard Index Total[1]
Noncancer Hazard Index				
A – Direct Exposure to Sediment; Ingestion of Catfish	0.002	0.01	**1**	**1**
B – Direct Exposure to Sediment, Ingestion of Clam	0.002	0.01	0.01	0.03
C – Direct Exposure to Sediment; Ingestion of Crab	0.002	0.01	0.01	0.03

Note:
Numbers in Bold represent an HI>1.
[1] Calculations based on reasonable maximum exposure.
TEQ – 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalent

Subsistence Fisher Summary of Background Hazards

Scenario	Incidental Ingestion of Sediment	Dermal Contact with Sediment	Fish or Shellfish Ingestion	Hazard Index Total[1]
Noncancer Hazard Index				
A – Direct Exposure to Sediment; Ingestion of Catfish	0.005	0.04	**10**	**10**
B – Direct Exposure to Sediment; Ingestion of Clam	0.005	0.04	0.2	0.2
C – Direct Exposure to Sediment; Ingestion of Crab	0.005	0.04	0.1	0.2

Note:
Numbers in Bold represent an HI>1.
[1] Calculations based on reasonable maximum exposure.
TEQ – 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalent

Recreational Visitor Summary of Background Hazards

Scenario	Incidental Ingestion of Sediment	Incidental Ingestion of Soil	Dermal Contact with Sediment	Dermal Contact with Soil	Hazard Index Total[1]
Noncancer Hazard Index					
Direct Exposure to Sediment and Soil	0.002	0.01	0.02	0.003	0.04

Note:
[1] Calculations based on reasonable maximum exposure.
TEQ – 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalent

The probabilistic risk assessment is presented in Section 5.2.3.3 of the BHHRA (Integral and Anchor, 2013b); the results of which are summarized below. The probabilistic risk assessment modeled exposure for young child fishers and young child recreational visitors for exposure to TEQ in sediment, tissue, and soils, PCBs in all tissue types, and methylmercury in catfish. Appendix G of the BHHRA (Integral and Anchor, 2013b) provides a complete presentation of the probabilistic risk assessment. The tables below present the deterministic and probabilistic results for noncancer. The results provide insight into the variability of exposures and hazards that may occur. Variability in various factors that influence exposure has a large impact on estimated hazards. Because the reasonable maximum exposure for a young child did not account for these sources of variability, they likely overestimated hazards (Integral and Anchor, 2013b).

Probabilistic Results for Noncancer Hazards, Area North of I-10 and Aquatic Environment

Scenario	Endpoint Category	Hazard Index			
		Deterministic Results[1]		Probabilistic Results	
		Recreational	Subsistence	90th Percentile	95th Percentile
BASELINE HAZARDS					
Fisher Scenarios (Direct Contact / Tissue Ingestion)					
1A – Beach A / Catfish FCA 2/3	Immunotoxicity	0.9	**7**	**2**	**3**
	Reproductive/Developmental	**1**	**10**	**2**	**3**
2A – Beach B/C / Catfish FCA 2/3	Immunotoxicity	0.9	**7**	**2**	**3**
	Reproductive/Developmental	**1**	**10**	**2**	**3**
3A – Beach E / Catfish FCA 2/3	Immunotoxicity	**2**	**9**	**2**	**3**
	Reproductive/Developmental	**40**	**100**	**8**	**10**
4A – Beach D / Catfish FCA 1	Immunotoxicity	**1**	**8**	**2**	**3**
	Reproductive/Developmental	**1**	**10**	**2**	**4**
2B – Beach B/C / Clam FCA 2	Immunotoxicity	0.02	0.3	0	0.07
	Reproductive/Developmental	0.2	3	0.03	0.3
3B – Beach E / Clam FCA 2	Immunotoxicity	0.7	2	0	0.07
	Reproductive/Developmental	**40**	**100**	**6**	**10**
3C – Beach E / Crab FCA 2/3	Immunotoxicity	0.7	**2**	0	0.01
	Reproductive/Developmental	**40**	**100**	**6**	**10**
Visitor Scenario (Direct Contact)					
3 – Beach E and Soil North of I-10	Reproductive/Developmental	60	--	2	4
BACKGROUND HAZARDS					
Fisher Scenarios (Direct Contact / Tissue Ingestion)					
A – Direct Exposure to Sediment; Ingestion of Catfish	Immunotoxicity	0.5	**4**	**1**	**2**
	Reproductive/Developmental	0.7	**6**	**1**	**2**
B – Direct Exposure to Sediment; Ingestion of Clam	Immunotoxicity	0.005	0.06	0	0.03
	Reproductive/Developmental	0.008	0.08	0.003	0.03
C – Direct Exposure to Sediment; Ingestion of Crab	Immunotoxicity	0.0004	0.006	0	0.003
	Reproductive/Developmental	0.006	0.06	0.003	0.02
Visitor Scenario (Direct Contact)					
Direct Exposure to Sediment and Soil	Reproductive/Developmental	0.009	--	0.0009	0.001

Note:
Numbers in Bold represent an HI>1.
[1] Calculations based on reasonable maximum exposure.
FCA – fish collection area
TCRA – time critical removal action
TEQ – 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalent

The human health risk assessment summary and conclusions for the area south of I-10 is presented in Section 6.2.4 of the BHHRA (Integral and Anchor, 2013b) and is summarized below. For the area south of I-10, the future construction worker TEQ noncancer His are greater than one for exposure areas DS-1, DS-2, and DS-4. The tables below provide endpoint-specific HIs and cumulative noncancer HIs for future construction worker exposure scenarios that have a noncancer HI greater than one.

South of I-10 Noncancer Hazards for a Future Construction Worker

Scenario Timeframe: **Receptor Population:** **Receptor Age:** **Calculation Assumption:**	Baseline Construction Worker Adult Reasonable Maximum Exposure			
		Noncancer Hazard Quotient		
Chemical[1]	**Primary Target Organ**	**Incidental Ingestion of Soil**	**Dermal Contact with Soil**	**Total[2]**
Scenario DS-1: Direct Exposure to Surface and Subsurface Soils				
TEQ	Reproductive/Developmental	**4.8**	0.49	**5.3**
			Reproductive/Developmental Endpoint-Specific Hazard Index	**5.3**
Scenario DS-2: Direct Exposure to Surface and Subsurface Soils				
TEQ	Reproductive/Developmental	**22**	**2.2**	**24**
			Reproductive/Developmental Endpoint-Specific Hazard Index	**24**
Scenario DS-4: Direct Exposure to Surface and Subsurface Soils				
TEQ	Reproductive/Developmental	**16**	**1.6**	**17**
			Reproductive/Developmental Endpoint-Specific Hazard Index	**17**

Note:
Numbers in Bold represent an HQ>1 or an HI>1.
[1] All chemicals with primary target organ exposure route totals greater than 1 are included in this table.
[2] Two significant figures presented, differences between values presented in the risk assessment tables and those presented here are either a result of the number of significant figures presented, rounding, or both.
TEQ – 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalent

The BHHRA identifies the following as sources contributing to risk assessment uncertainty in Sections 5.2.4 and 6.2.3:

- Data collection, analysis, and treatment (e.g., elevated detection limits for PCBs as Aroclors, analysis of 43 PCB congeners rather than the complete set of 209)
- Calculation of dioxin and furan TEQs (e.g., use of ½ the detection limit for nondetect congeners)
- Exposure assessment assumptions (e.g., the lack of quantification of minor pathways, age assumptions, fish and shellfish consumption rates)
- Toxicity criteria (e.g., dioxins and furans, PCBs).

However, the BHHRA also states that "the parameters used for evaluating potential exposures and estimating risks and hazards relied on multiple conservative assumptions, which enhance the likelihood that potential assumed exposures and estimated risks are overestimated" (Integral and Anchor 2013b).

The USEPA developed its own risk assessment to augment the BHHRA and support a comprehensive cleanup level for the site. It did so in a Memorandum dated August 29, 2016 (Khoury, 2016a). An exposure scenario for a hypothetical recreational young child fisher for potential noncancer effects was evaluated for dioxin and dioxin like compounds. For potential cancer effects of dioxin, an exposure scenario for a hypothetical adult fisher was evaluated who was exposed to dioxin in sediments for the first six years of his life as a child and the remaining

20 years of life exposed as an adult. Exposure through the ingestion and dermal contact with sediment and through the ingestion of fish/shellfish was evaluated for both scenarios. The noncancer risk to a recreational child fisher from exposure to sediment through the ingestion and dermal routes of intake was calculated for Beach Area E at a hazard index of 63, which is greater than the EPA acceptable level of a HI of one. The excess cancer risk for an adult fisher exposed to sediment through the ingestion and dermal routes of intake was estimated at 6.6 X 10^{-4} which is greater than the upper end of the EPA's generally accepted excess cancer risk range of 1 X 10^{-4}. The other beach areas (Beach Area A, B/C, and D) had levels lower than the EPA acceptable HI of one and a cancer risk less than the lower end of the acceptable cancer risk range of 1 X 10^{-6}.

The risk to a hypothetical recreational young child fisher from ingestion of fish and shellfish at fish collection area (FCA) 1 and combined fish collection areas 2 and 3 (FCA2/3) was estimated at a HI of 1.8 for each of the fish collection areas, which is higher than the EPA acceptable level of a HI of one. Most of the noncancer risk was due to ingestion of Hardhead catfish fillet which was used as a conservative representative of finfish ingestion. Catfish are bottom feeders and would come in contact with the sediment more often than other finfish. Ingestion of shellfish (edible crab and clam) was found to be acceptable if ingested at the rate used in the calculations (i.e. 600 mg/day for a child and 2,000 mg/day for an adult).

All exposure input parameters used in the baseline human health risk assessment (Table 5-8 in Integral and Anchor, 2013b) were used in EPA's addendum risk assessment for a young recreational fisher. The only changes EPA made were for the body weight of a child, lowered from 19 Kg to 15 Kg, and the averaging time was changed from 78 years to 70 years to be consistent with EPA national guidance.

Studies done to develop site specific biota-sediment accumulation factor (BSAF) to correlate sediment concentration to fish tissue concentration failed to come up with a reliable, defensible number. In the absence of a reliable BSAF value for fish, EPA used the default BSAF value provided in the US EPA Combustion Guidance in order to be able to develop a sediment cleanup number for the site.

The USEPA suggests that, along with ethnic characteristics and cultural practices of an area's population, the poverty rate could contribute to any determination of the rate of subsistence fishing in an area. The USEPA and the TDSHS find it is important to consider subsistence fishing as occurring at any water body because subsistence fishers (as well as recreational anglers and certain tribal and ethnic groups) usually consume more locally caught fish than the general population. These groups sometimes harvest fish or shellfish from the same water body over many years to supplement caloric and protein intake. People who routinely eat fish from chemically contaminated water bodies or those who eat large quantities of fish from the same waters could increase their risk of adverse health effects. The USEPA suggests that states assume that at least 10% of licensed fisherman in any area are subsistence fishers. Subsistence fishing, while not explicitly documented by the TDSHS, likely occurs in Texas. The TDSHS assumes the rate of subsistence fishing to be similar to that estimated by the USEPA.

In the TDSHS Public Health Assessment that was released in October 2012, one of the exposure scenarios was that of a subsistence fisherman. This was incorporated by EPA to account for the potential exposure pathway to children and adults that may be subsistence fishermen and consume fish caught from areas surrounding the SJRWP. The scenario used was: adults who fish 260 days/year for 30 years and children of subsistence fishers who are exposed from age 3 – 50 (child becomes a subsistence fisherman in adult years (TDSHS, 2012).

Through TDSHS outreach activities, most of the people interviewed along the San Jacinto River, Houston Ship Channel, and Upper Galveston Bay have told TDSHS that they are fishing and/or crabbing for recreational purposes; however, some people do admit to consuming fish and/or crabs from these areas. Given the general lack of predictability of subsistence behaviors based on demographic characteristics, and the very low likelihood that long-term subsistence fishing is occurring within USEPA's Preliminary Site Perimeter (TDSHS 2012), the subsistence fisher, as evaluated in this BHHRA, is hypothetical and unlikely to have been present or to be present in the future in the area under study.

A cleanup level for the protection of the most sensitive and vulnerable segment of the exposed population was developed for the northern impoundments and sediments. A young hypothetical recreational fisher was assumed to be exposed to dioxin and dioxin like compounds in sediment through the inadvertent ingestion and dermal contact with contaminated sediment for an exposure frequency of 39 days/year for 6 years. The same young recreational fisher is also expected to eat fish/shellfish collected from areas with contaminated sediment. The total cleanup level for the site was estimated at 30 ng/Kg for dioxin TEQs associated with a HI of 1. The total excess cancer risk associated with a sediment concentration of 30 ng/Kg is estimated at 2.1×10^{-5}. By protecting the health of a young recreational fisher, this cleanup level is also protecting the health of a recreational adult fisher.

2.7.2 *Summary of Ecological Risk Assessment*

A screening level ecological risk assessment (SLERA) for the site, not addressing the Southern Impoundment, was completed in 2010. The initial SLERA is included as Appendix B to the RI/FS Work Plan (Anchor and Integral, 2010). Following completion of the SLERA, a BERA for the site, not addressing the Southern Impoundment, was completed (Integral, 2013). A SLERA for the Southern Impoundment was completed concurrently with the site BERA and is included as Appendix E to the BERA (Integral, 2013). A BERA for the Southern Impoundment was subsequently completed and is included as Appendix D to the RI Report (Integral and Anchor, 2013a).

Identification of Chemicals of Potential Ecological Concern

The BERA for the area north of I-10 and aquatic environments identified chemicals of potential ecological concern (COPECs). Tables 23 and 24 present the COPEC screening. Chemicals in sediment with a detection frequency of at least 5 percent in the RI dataset that were either 1) present in at least one sample at a concentration greater than sediment screening concentrations protective of benthic invertebrate communities or 2) have no screening value protective of benthic invertebrate communities and were not correlated with dioxins and furans, are considered COPECs for benthic macroinvertebrate communities (Integral, 2013). If a chemical was detected in greater than 5 percent of sediment samples in the RI dataset, and is thought to be bioaccumulative (TCEQ, 2006), it was considered to be a COPEC and was evaluated for risk to fish and wildlife (Integral, 2013).

Exposure Assessment

The site is located in a low gradient, tidal estuary near the confluence of the San Jacinto River and the Houston Ship Channel, as discussed above in Section 2.5 of this ROD. Habitats include upland, aquatic, and riparian.

There are no site-specific data describing wildlife uses of the upland portions of the site. Based on local wildlife lists and the types of habitat and land uses, it is reasonable to expect a suite of generalist terrestrial species that are not highly specialized in their habitat requirements and are adapted to moderate levels of disturbance. The reptiles and amphibians that could occur in the vicinity of the site include snakes, alligators, and turtles. Avian taxa using upland habitats may include sparrows and other generalist passerines, starlings, pigeons and doves, corvids, and killdeer. Mammals expected in a semi-urban environment like the site include small mammals (rodents), skunks, raccoons, coyotes, and opossums. Upland habitats could support mammals, such as marsh rice rats and deer that could migrate to the islands close to mainland areas, as well as passerines that could use the vegetated uplands for nesting and foraging, and shoreline birds such as sandpipers and herons that could wade and forage in the shallow areas adjacent to the islands.

The tidal portions of the San Jacinto River and upper Galveston Bay provide rearing, spawning, and adult habitat for a variety of marine and estuarine fish and invertebrate species. Species known to occur in the vicinity of the site include clams and oysters, blue crab (*Callinectes sapidus*), black drum (*Pagonius cromis*), southern flounder (*Paralichthys lethostigma*), hardhead catfish (*Ariopsis afelis*), blue catfish (*Ictalurus furcatus*), spotted sea trout (*Cynoscion nebulosis*), and grass shrimp (*Paleomonetes pugio*) (Gardiner et al., 2008; Usenko et al., 2009).

Aquatic birds and semiaquatic mammals that are found in the vicinity of the site include ducks, shorebirds, wading birds (herons and egrets), diving piscivores, and various others. There are a number of migratory bird species known to winter in the vicinity of the site. They include belted kingfisher (*Megaceryle alcyon*), red breasted merganser (*Mergus serrator*), greater yellowlegs (*Tringa melanoleuca*), western sandpiper (*Calidris mauri*), and dabbling ducks including gadwall (*Anas strepera*) and teal. Herons and closely related birds that use wetland and estuarine habitats and that may be present in the site vicinity include the green (*Butorides virescens*), tri-colored (*Egretta tricolor*), and little blue (*E. cerulea*) herons, and also the black-crowned (*Nycticorax nycticorax*) and yellow-crowned (*N. violacea*) night-herons.

Raptors, rails, pelicans, gulls, ducks, and sandpipers are also among the aquatic-dependent and aquatic-associated bird species that use the aquatic habitat that is present in the vicinity of the site. Sandpipers, egrets, and herons are wading birds that forage along shallow intertidal areas for benthic macroinvertebrates and small fish. Piscivorous bird species that may forage in the open waters of the river include cormorants, osprey, and pelicans. Omnivores including gulls and ducks may forage at the river's edge as well as in the water column. Mammals using both aquatic and wetland habitats that could occur in the vicinity of the site include the marsh rice rat, muskrats, nutria, and raccoon.

Endangered and Threatened Species

Wildlife that are state-listed as threatened and endangered and have the potential to be found in the general vicinity of the site are:

- Timber rattlesnake
- Smooth green snake
- Alligator snapping turtle
- White-faced ibis
- Brown pelican
- Rafinesque’s big-eared bat.

In addition to these listed species, the American bald eagle, protected under the federal Bald and Golden Eagle Protection Act and listed as threatened by the State of Texas, may be found in the vicinity of the site.

Ecological Receptors and Receptor Surrogates

Ecological receptor surrogates were selected to be representative of the trophic and ecological relationships known or expected at the site. In selecting receptor surrogates, the following criteria were considered:

- The receptor is or could potentially be present at the site.
- The receptor is representative of one or more feeding guilds.
- The receptor is known to be either sensitive or potentially highly exposed to COPECs at the site.
- Life history information is available in the literature or is available for a similar species that can be used to inform life history parameters for the receptor.

Tables 25 and 26 provide receptors used in the north of I-10 and south of I-10 BERAs, respectively. Tables 27 and 28 provide assessment endpoints, lines of evidence, and measurement of exposure for the area north of I-10 and aquatic environment, and the area south of I-10, respectively.

Ecological Risk Characterization

The table below presents a summary of baseline ecological risks identified in the BERA (Integral, 2013) for the area north of I-10 and aquatic environment.

Summary of Baseline Ecological Risks for the Area North of I-10 and Aquatic Environment

Receptor of Concern	Feeding Guild	Chemical of Concern	Baseline Risk Identified[1]
Benthic Macroinvertebrates			
Mollusks	Filter feeders	2,3,7,8-TCDD	Reproductive risks to mollusks (primarily in the area which surrounds the waste impoundments)
Individual mollusks	Filter feeders	2,3,7,8-TCDD	Low risks of reproductive effects (sediments adjacent to the upland sand separation area)
Birds			
Spotted sandpiper	Invertivore (probing)	Dioxins and furans	Moderate risks to individual birds, low risk to populations
Killdeer	Invertivore (terrestrial)	Dioxins and furans	Moderate risks to individual birds, low risk to populations
Killdeer	Invertivore (terrestrial)	Zinc	Low to negligible risk to populations
Mammals			
Marsh rice rat	Omnivore	$TEQ_{,M}$	Risk to individual small mammals with home ranges that include areas adjacent to the impoundments, low to negligible risk to populations

Note:
[1] Risk to individuals of characterized as negligible are not included in this table.
2,3,7,8-TCDD – 2,3,7,8-tetrachlorodibenzo-p-dioxin
Dioxins – polychlorinated dibenzo-p-dioxins
Furans – polychlorinated dibenzofurans
$TEQ_{,M}$ – toxicity equivalent for 2,3,7,8-tetrachlorodibenzo-p-dioxin calculated using toxicity equivalent factors for mammals

The table below presents a summary of baseline ecological risks identified in the BERA (Integral and Anchor, 2013a) for the area south of I-10.

Summary of Baseline Ecological Risks for the Area South of I-10

Receptor of Concern	Feeding Guild	Chemical of Concern	Baseline Risk Identified[1]
Birds			
Terrestrial birds	--	Cadmium Chromium Copper	Low to negligible risks to the assessment endpoint of stable or increasing populations
Killdeer	Invertivore (terrestrial)	Lead Zinc	Risks to individual birds are present and population-level risks may be present

Note:
[1] Risk to individuals of characterized as negligible are not included in this table.

Baseline risks to ecological receptors associated with the wastes in the impoundments north of I-10 are the result of exposures to dioxins localized to the immediate vicinity of the impoundments. Baseline ecological risks include reproductive risks to mollusks from dioxin, but primarily in the area that surrounds the former waste impoundments north of I-10, and low risks of reproductive effects in individual mollusks in sediments adjacent to the sand separation area, but not to populations of mollusks. Baseline risks include moderate risks to individual birds like the killdeer or spotted sandpiper whose foraging area could regularly include the shoreline adjacent to the impoundments north of I-10, but low risk to populations because of the low to moderate probability that individual exposures reach effects levels. Baseline risks include risks to individual small mammals with home ranges that include areas adjacent to the impoundments such as the marsh rice rat, but low to negligible risks to small mammal populations because of the moderate probability that exposures will reach levels associated with reproductive effects in individuals, and because small mammals reproduce rapidly. Baseline risks to benthic macroinvertebrate communities and populations of fish, birds, mammals, and reptiles resulting from the presence of metals, bis(2-ethylhexyl) phthalate, PCBs, carbazole, and phenol on the site are negligible. Risks to fish populations from all chemicals of potential concern are negligible.

There are negligible risks to populations of wading birds represented by the great blue heron, and to populations of diving birds like the neotropic cormorant. There are negligible risks to populations of terrestrial mammals such as the raccoon. There are low to negligible risks to individual terrestrial insectivorous birds like the killdeer from exposure to zinc, and negligible risks to populations of such birds. Although the upper bound of estimated daily intakes of zinc by individual killdeer is about equal to conservative effects thresholds, the exposure estimate is influenced by the use of generic models to estimate zinc concentrations in the foods of the killdeer, and this model likely overestimates ingested tissue concentrations, resulting in overestimates of exposure and risk. The highest exposures of killdeer to zinc occur outside of the northern impoundment perimeter, and background exposures less than 30 percent were lower than on the site. In addition, the low probability of individual exposures exceeding effects levels indicates low risk to populations. There are also low to negligible risks to individual terrestrial insect eating birds from exposure to dioxins.

2.7.3 *Basis for Action*

In summary, the site poses unacceptable risks to the recreational fisher (Hazard Index 65), to the recreational visitor (Hazard Index 66), and, for the Southern Impoundment, to the construction worker (Hazard Index 46). These risks result from release or threatened releases of dioxins, furans, and PCBs from the site.

The response action selected in this ROD is necessary to protect the public health or welfare and the environment from actual or threatened releases of hazardous substances, as defined by NCP §300.5, into the environment.

2.8 REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) describe what the proposed site cleanup is expected to accomplish. According to the NCP, 40 CFR §300.430(a)(1)(i), the "national goal of the remedy selection process is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste." Based on information relating to types of contaminants, environmental media of concern, and potential exposure pathways, site specific RAOs were developed. The remedial action objectives developed consider the current and reasonably anticipated future land use including the use for industrial applications and by recreational fishers. Concentrations of polychlorinated bi-phenyls in waste materials and sediments were either significantly correlated with concentrations of dioxins or were generally below detection limits. Therefore, no remedial action objective was developed for polychlorinated bi-phenyls because remediation of material contaminated with dioxins will also remediate the co-located polychlorinated bi-phenyls. While the human health risk assessment considered subsistence fisher populations, the Texas Department of State and Health Services (DSHS) could not identify subsistence fishers in the area of the site. Therefore, this receptor is not considered to be consistent with the current or future land use. The Environmental Protection Agency used the next most conservative value of a child recreational fisher for its risk calculations.

The Remedial Action Objectives are:

- RAO 1: Prevent releases of dioxins and furans above cleanup levels from the former waste impoundments to sediments and surface water of the San Jacinto River.
- RAO 2: Reduce human exposure to dioxins and furans from ingestion of fish by remediating sediments to appropriate cleanup levels.
- RAO 3: Reduce human exposure to dioxins and furans from direct contact with or ingestion of paper mill waste, soil, and sediment by remediating affected media to appropriate cleanup levels.
- RAO 4: Reduce exposures of benthic invertebrates, birds, and mammals to paper mill waste derived dioxins and furans by remediating affected media to appropriate cleanup levels.

The following cleanup levels provide numerical criteria that will be used to measure the progress in meeting the Remedial Action Objectives. The cleanup levels are acceptable exposure levels (i.e., contaminant concentration levels) that are protective of human health and the environment, and are developed considering applicable or relevant and appropriate requirements, as specified in the National Contingency Plan.

Site risk-based cleanup levels are presented below:

- Dioxin in sediment – 30 ng/kg (recreational fisher). This level is also protective for ecological risk.
- Dioxin in paper mill waste material and soil in the Northern Impoundments – 30 ng/kg (recreational fisher).
- Dioxin in paper mill waste material and soil in the Southern Impoundment – 240 ng/kg (Southern Impoundment construction worker).
- Texas Surface Water Quality Standard for Dioxins/Furans – 7.97×10^{-8} µg/L (as TCDD equivalents). [30 Texas Administrative Code §307.6(d)(a)(A) and (B) and §307.10]. This standard was updated by the Texas Commission on Environmental Quality in 2014 and approved by the Environmental Protection Agency to base the dioxin standard on water column criteria. The standard was calculated based on an oral cancer slope factor of 156,000 $(\text{mg/kg-day})^{-1}$ found in in the Environmental Protection Agency 2002 National Recommended Water Quality Criteria Matrix.

The sediment cleanup level of 30 ng/kg was developed for the Site based on protecting human health of the most vulnerable potentially exposed group or individual of the community. In this case a recreational child fisher was assumed to get exposed to contaminated sediment through incidental ingestion, dermal contact, and from the ingestion of fish/shellfish. The 30 ng/kg is associated with a noncancer Hazard Index of one with the understanding that protection at a Hazard Index of one will also protect for cancer effects near the middle (2.1 x 10-5) of the Environmental Protection Agency's generally acceptable cancer risk range.

The 240 ng/kg cleanup level applies to waste material and sub-surface soil for the Southern Impoundment (Figure 33) and is associated with a non-cancer Hazard Index of one. In this case a construction worker was assumed to get exposed to contaminated sub-surface soils in the area during construction activities.

The background sediment reference envelope value upstream from the Site has a dioxin concentration of 7.2 ng/kg, which is well below the sediment cleanup level of 30 ng/kg. Therefore, re-contamination of the Site by new sediment being carried downstream is not likely. There is no cleanup level for fish tissue because the required sediment cleanup measures at the site will reduce contaminant concentrations in tissue, but these concentrations will continue to be affected by factors outside the scope of the Comprehensive Environmental Response, Compensation, and Liability Act site cleanup, including upstream and downstream dioxin inputs from other sources. Measuring trends against target tissue concentrations is useful for assessing risk reduction and for risk communication, but tissue cleanup levels are not required to evaluate these trends. It is anticipated that the 30 ng/kg dioxin cleanup level in sediment will be achieved relatively soon after construction of the Preferred Alternative (Alternative 6N) is completed, or approximately 2½ years after construction begins. The 240 ng/kg dioxin cleanup level for the Southern Impoundment will be achieved when construction of the Preferred Alternative there (Alternative 4S) is completed, or approximately 7 months after construction begins.

The cleanup level for sediment (30 ng/kg) is based upon risk concerns. Figure 34 does show sediment areas that are greater than the cleanup level of 30 ng/kg. However, when considering the overall Site, the average surface sediment concentration, at 12.5 ng/kg, is significantly less than the cleanup level of 30 ng/kg. This assessment of the weighted average sediment concentration outside of the impoundments is below the cleanup level and does not pose an overall unacceptable risk. Notwithstanding the previous statements, the sediment in the Sand Separation Area will be addressed under the remedial alternatives discussed below, with the exception of the No Further Action alternative.

2.9 DESCRIPTION OF ALTERNATIVES

The feasibility study identified and screened possible response actions and remedial technologies applicable to the site. Several treatment technologies, including thermal (in-pile thermal desorption) and chemical (solvated electron technology and base catalyzed decomposition) processes, were also considered for use at the site but were not included in a remedial alternative, as discussed further in the Feasibility Study. The feasibility study contains a detailed analysis of each alternative against the remedy selection criteria and a comparative analysis of how the alternatives compare to each other.

Following the screening process, remedial alternatives were developed to address the area north of I-10 and the area south of I-10. Alternatives that address the area north of I-10 and aquatic environment include the letter "N" in the title (e.g., 1N, 2N), and alternatives that address the area south of I-10 include the letter “S” in the title (e.g., 1S, 2S). During the Feasibility Study, cost estimates were developed for each remedial action alternative for comparison purposes. The expected accuracy of Feasibility Study cost estimates ranges from –30 percent to +50 percent. The EPA developed additional cost information in the process of responding to public comments. The total present worth costs for this and all other alternatives are calculated using a 30-year timeframe and a 7% discount rate.

Alternatives for the San Jacinto River and Area North of I-10:

Alternative 1N – Temporary Armored Cap and Ongoing Operations, Inspection, and Maintenance (No Further Action)

Estimated Maintenance Cost (e.g., inspection, maintenance): $0.4 million
Estimated Total Present Worth Cost: $0.4 million
Estimated Construction Time/Time to meet RAOs: Construction complete

Under this alternative, No Further Action would be conducted for the temporary armored cap constructed under the Time Critical Removal Action, and no additional remedial action would be implemented. Treatment through solidification of a portion (6,000 cubic yards) of the paper mill waste material was completed to aid construction of the cap. However, this alternative has no further provision for treatment or removal of the Principal Threat Wastes (PTW). In general, PTW are those source materials considered to be highly toxic or highly mobile and which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. A more detailed discussion of PTW is included below in the “Principal Threat Waste” section.

This alternative includes ongoing operations, inspection, and maintenance of the armored cap, which includes inspection and periodic maintenance. This alternative has no provision for the sand separation area. This alternative will not comply with all of the Applicable or Relevant and Appropriate Requirement (ARARs) for the Site.

Alternative 2N – Armored Cap, Institutional Controls, Ground Water Monitoring, and Monitored Natural Recovery

Estimated Maintenance Cost: $2.0 million
Estimated Total Present Worth Cost: $2.0 million
Estimated Construction Time/Time to meet RAOs: Construction complete

This alternative includes all of the elements discussed under Alternative 1N, plus institutional and engineering controls, ground water monitoring, and Monitored Natural Recovery. Monitored Natural Recovery would be used to achieve the cleanup level for sediment in the sand separation area and the Texas Surface Water Quality Standard in the San Jacinto River. Hydrodynamic and sediment transport modeling of the San Jacinto River in the vicinity of the Site determined that there is a net deposition of sediment that will support Monitored Natural Recovery. Further, approximately two feet of sediment deposition found in deeper areas over the toe of the cap in the northwest area during an Environmental Protection Agency Dive Team inspection of the cap supports the depositional nature of some areas. However, riverbed erosion/scour has also occurred in some areas as demonstrated by the 2015 and the 2017 flooding when eroded areas were discovered adjacent to the eastern part of the temporary cap. Because future sedimentation is uncertain, monitoring will be conducted to assess natural recovery. This Alternative 2N this would not result in treatment of the Principal Threat Waste other than the solidification for the original construction of the cap.

Ground water monitoring would be implemented to ensure that there are no long-term unacceptable impacts to ground water resulting from the waste left in place. Groundwater monitoring will be conducted in areas bounding waste materials (both vertically and laterally) and will include both dissolved phase COC concentrations and concentrations that may result from facilitated transport. Institutional controls are non-engineered instruments such as administrative and legal controls that help minimize the potential for human exposure to contamination and protect the integrity of a remedy by limiting land or resource use. Engineering controls are physical measures such as fencing or signage that are used to limit access to contaminated areas or areas that may pose a physical hazard. Institutional controls would be implemented to place restrictions on dredging and anchoring to protect the integrity of the armored cap and to limit potential disturbance and resuspension of buried sediment near the sand separation area. Under this remedial alternative, the following institutional and engineering controls would be implemented:

- A special sampling and analysis protocol will be required for each permittee conducting activities under the Clean Water Act Section 404 and Rivers and Harbors Action Section 10 within a defined watershed area around the remediated areas. This protocol will be monitored and enforced by a joint EPA, USACE, and TCEQ agreement and will ensure that permitted dredging activities do not impact site cleanup. These restrictions will protect the integrity of the armored cap and sand separation area and limit potential disturbance and resuspension of buried sediment.
- Alert property owners of the presence of subsurface materials exceeding cleanup levels.
- Public notices and signage around the perimeter of the armored cap site would be maintained or provided, as appropriate.
- As a result of the long term persistence of dioxin, it is anticipated that the institutional controls will be essentially permanent measures.

This alternative includes ongoing operations, inspection, and maintenance of the armored cap, which includes inspection and periodic maintenance, and the Environmental Protection Agency 5-year reviews as required under the National Contingency Plan in 40 Code of Federal Regulations 300.430 (f)(iv)(2). A periodic sampling and analytical program would also be implemented to monitor the progress of natural recovery. The current temporary cap has had no impact on navigation, and this alternative is not expected to be different.

Alternative 3N – Upgraded Cap, Institutional Controls, Ground Water Monitoring, and Monitored Natural Recovery

Estimated Capital Cost: $1.77 million
Estimated In-Direct and Operation & Maintenance Cost: $2.38 million

Estimated Total Present Worth Cost: $4.1 million
Estimated Construction Time/Time to meet RAOs: 2 months

This alternative includes the actions described under Alternative 2N plus additional improvements to the temporary armored cap to create an upgraded cap. The improvements use a higher factor of safety of 1.5 for sizing the armor stone, and include flattening submerged slopes from 2-horizontal to 1-vertical (2H:1V) to 3H:1V and flattening the slopes in the surf zone from 3H:1V to 5-horizontal to 1-vertical (5H:1V). In addition, the Upgraded Cap uses larger rock sized for the "No Displacement" design scenario, which is more conservative than the "Minor Displacement" scenario used in the Armored Cap's design. This alternative will increase the long-term stability of the armored cap compared to Alternatives 1N and 2N. However, the upgraded cap under Alternative 3N is expected to experience 80% erosion of the cap during a severe storm as modelled by the Corps of Engineers and documented in the Corps' report (Appendix A of the Feasibility Study). Cost estimates for this alternative also include additional measures to protect the upgraded cap from potential vessel traffic in the form of a protective perimeter barrier and could include construction of a 5-foot high submerged rock berm outside the perimeter of the upgraded cap, in areas where vessels could potentially impact the cap. Monitored Natural Recovery would be used to achieve the cleanup level for sediment in the sand separation area and the Texas Surface Water Quality Standard in the San Jacinto River.

This Alternative 3N would not result in treatment other than the previously performed solidification for construction of a portion of the Principal Threat Waste, which is defined as material containing dioxin greater than 300 ng/kg.

Upon completion, the Upgraded Cap would be constructed to a standard that exceeds Environmental Protection Agency and United States Army Corps of Engineers design guidance, and meets or exceeds the recommended enhancements suggested by the United States Army Corps of Engineers in their 2013 evaluation. Ground water monitoring would be implemented to ensure that there are no long-term unacceptable impacts to ground water resulting from the waste left in place. Groundwater monitoring will be conducted in areas bounding waste materials (both vertically and laterally) and will include both dissolved phase COC concentrations and concentrations that may result from facilitated transport. Institutional controls would be implemented to place restrictions on dredging and anchoring to protect the integrity of the armored cap and to limit potential disturbance and resuspension of buried sediment near the sand separation area. Under this remedial alternative, the following institutional and engineering controls would be implemented:

- A special sampling and analysis protocol will be required for each permittee conducting activities under the Clean Water Act Section 404 and Rivers and Harbors Action Section 10 within a defined watershed area around the remediated areas. This protocol will be monitored and enforced by a joint EPA, USACE, and TCEQ agreement and will ensure that permitted dredging activities do not impact site cleanup. These restrictions will
- protect the integrity of the armored cap and sand separation area and limit potential disturbance and resuspension of buried sediment. Alert property owners of the presence of subsurface materials exceeding cleanup levels.

- Public notices and signage around the perimeter of the armored cap site would be maintained or provided, as appropriate.
- As a result of the long term persistence of dioxin, it is anticipated that the institutional controls will be essentially permanent measures.404

This alternative includes ongoing operations, inspection, and maintenance of the armored cap, which includes inspection and periodic maintenance, and the Environmental Protection Agency 5-year reviews as required under the National Contingency Plan in 40 Code of Federal Regulations 300.430 (f)(iv)(2). A periodic sampling and analytical program would also be implemented to monitor the progress of natural recovery. The current temporary cap has had no impact on navigation, and this alternative is not expected to be different.

Alternative 3aN – Enhanced Cap, Protective Pilings, Institutional Controls, Ground Water Monitoring, and Monitored Natural Recovery

Estimated Capital Cost: $19.7 million
Estimated In-Direct and Operation & Maintenance Cost: $5.1 million
Estimated Total Present Worth Cost: $24.8 million
Estimated Construction Time/Time to meet RAOs: 15 months

The Corps of Engineers determined that the cap considered for Alternative 3N may experience 80% erosion of the armor cap (Appendix A of the Feasibility Study), and substantial erosion of the underlying paper mill waste material in a future severe storm. This alternative, 3aN, includes the actions described under Alternative 3N plus additional enhancements to the armored cap recommended by the Corps of Engineers to create an enhanced cap with increased long-term stability.

The additional cap enhancements added for this alternative include pre-stressed concrete or concrete filled steel pipe pilings placed 30 feet apart around the perimeter of the cap to protect from barge strikes. The spacing is designed to catch a typical barge, which is 35 feet wide. An additional armor stone cap with a thickness of at least 24 inches would be placed over the armor cap for Alternative 3N. The armor stone would have a median diameter of 15 inches. This additional armor stone would cover 13.4 acres of the 17.1-acre armored cap. Also, a coarse gravel filter layer would be placed on 1.5 acres of the Northwest Area where there is currently no geotextile under the armor cap. The actual scope and design of the cap enhancements, and additional area needed to construct the required slopes, would be determined in the Remedial Design. This additional weight of rock on top of the waste pits may cause cap settling and/or pushing the waste material out the sides of the cap; the Remedial Design will consider the significance of and design issues related to this. Monitored Natural Recovery would be used to achieve the cleanup level for sediment in the sand separation area and the Texas Surface Water Quality Standard in the San Jacinto River.

This Alternative 3aN this would not result in treatment of the Principal Threat Waste, which is defined as site material containing dioxin greater than 300 ng/kg, with the exception of the solidification for construction of the western cell of the original cap. Alternative 3aN also would require ongoing maintenance to ensure cap integrity over the hundreds of years the site waste will remain toxic.

Ground water monitoring would be implemented to ensure that there are no long-term unacceptable impacts to ground water resulting from the waste left in place. Groundwater monitoring will be conducted in areas bounding waste materials (both vertically and laterally) and will include both dissolved phase COC concentrations and concentrations that may result from facilitated transport. Institutional controls would be implemented to place restrictions on dredging and anchoring to protect the integrity of the armored cap and to limit potential disturbance and resuspension of buried sediment near the sand separation area. Under this remedial alternative, the following institutional and engineering controls would be implemented:

- A special sampling and analysis protocol will be required for each permittee conducting activities under the Clean Water Act Section 404 and Rivers and Harbors Action Section 10 within a defined watershed area around the remediated areas. This protocol will be monitored and enforced by a joint EPA, USACE, and TCEQ agreement and will ensure that permitted dredging activities do not impact site cleanup. These restrictions will
- protect the integrity of the armored cap and sand separation area and limit potential disturbance and resuspension of buried sediment. Alert property owners of the presence of subsurface materials exceeding cleanup levels.
- Public notices and signage around the perimeter of the armored cap site would be maintained or provided, as appropriate.
- As a result of the long term persistence of dioxin, it is anticipated that the institutional controls will be essentially permanent measures.

This alternative includes ongoing operations, inspection, and maintenance of the armored cap, which includes inspection and periodic maintenance, and the Environmental Protection Agency 5-year reviews as required under the National Contingency Plan in 40 Code of Federal Regulations 300.430 (f)(iv)(2). Because Alternative 3aN is the most robust containment alternative, the EPA further evaluated the operation and maintenance costs of this alternative for the purpose of comparison with the removal alternative. A periodic sampling and analytical program would also be implemented to monitor the progress of natural recovery. The current temporary cap has had no impact on navigation, and this alternative is not expected to be different.

Alternative 4N – Partial Solidification/Stabilization, Upgraded Cap, Institutional Controls, Ground Water Monitoring, and Monitored Natural Recovery

Estimated Capital Cost: $11.1 million
Estimated In-Direct and Operation & Maintenance Cost: $3.7 million
Estimated Total Present Worth Cost: $14.8 million
Estimated Construction Time/Time to meet RAOs: 17 months

This remedial alternative provides for solidification and stabilization of the most highly contaminated material. The purpose of solidification/stabilization at the site is to reduce the mobility of the waste material, thereby reducing the potential for a dioxin release into the San

Jacinto River. A dioxin and furan value that exceeds 13,000 ng/kg dioxin was used to define the most highly contaminated material. This alternative would result in treatment of a portion of the Principal Threat Waste. Under this alternative, 3.6 acres of the armor cap would be removed and about 52,000 cubic yards of materials beneath the cap exceeding 13,000 ng/kg dioxin regardless of waste material depth would undergo solidification and stabilization. The type of amendments would be determined during the Remedial Design. The extent of the area for partial solidification and stabilization is the western cell and a portion of the eastern cell that is currently covered by the armored cap. Based on current site data, all samples exceeding 13,000 ng/kg dioxin are located in areas where the water depth is 10 feet or less, so the maximum depth of solidification and stabilization in the western cell would be to approximately 10-feet below the current base of the armored cap and on average approximately 5-feet below the current base of the armored cap in the eastern cell and northwestern area.

For solidification/stabilization, amendments such as Portland cement or other materials would be mixed with the waste material. Mixing of amendments and the waste material could be accomplished using large diameter augers or conventional excavators. Before mixing, portions of the armored cap armor rock where mixing will occur would need to be removed and stockpiled for reuse, if possible, or washed to remove adhering sediment and disposed in an appropriate facility. The geotextile and geomembrane in those areas would also need to be removed and disposed of as contaminated debris. Submerged areas to be stabilized would need to be isolated from the surface water with sheet piling and mostly dewatered prior to mixing with treatment reagents using conventional or long reach excavators.

Finally, an upgraded cap would be constructed as described in 3N, including replacement of the armor rock layer geomembrane and geotextile over the solidification and stabilization footprint; and the measures described under Alternative 3N to protect the upgraded cap from vessel traffic would be implemented. If this alternative had been selected, an enhanced cap (as described for Alternative 3aN) would have been considered for inclusion instead of the cap described under Alternative 3N.

Monitored Natural Recovery would be used to achieve the sediment cleanup level in the sand separation area and the Texas Surface Water Quality Standard in the San Jacinto River. Institutional controls would be implemented to place restrictions on dredging and anchoring to protect the integrity of the armored cap and to limit potential disturbance and resuspension of buried sediment near the sand separation area. Under this remedial alternative, the following institutional and engineering controls would be implemented:

- A special sampling and analysis protocol will be required for each permittee conducting activities under the Clean Water Act Section 404 and Rivers and Harbors Action Section 10 within a defined watershed area around the remediated areas. This protocol will be monitored and enforced by a joint EPA, USACE, and TCEQ agreement and will ensure that permitted dredging activities do not impact site cleanup. These restrictions will
- protect the integrity of the armored cap and sand separation area and limit potential disturbance and resuspension of buried sediment.
- Alert property owners of the presence of subsurface materials exceeding cleanup levels.

- Public notices and signage around the perimeter of the armored cap site would be maintained or provided, as appropriate.
- As a result of the long term persistence of dioxin, it is anticipated that the institutional controls will be essentially permanent measures.

Ground water monitoring would be implemented to ensure that there are no long-term unacceptable impacts to ground water resulting from the waste left in place. Groundwater monitoring will be conducted in areas bounding waste materials (both vertically and laterally) and will include both dissolved phase COC concentrations and concentrations that may result from facilitated transport.

The estimated footprint of this alternative is approximately 2.6 acres in the western cell and 1.0 acre of submerged waste material spanning the eastern cell and the northwestern area. Based on the horizontal and vertical limits identified for this alternative, a total of approximately 52,000 cubic yards of soil and waste material would be treated.

This alternative includes ongoing operations, inspection, and maintenance of the armored cap, which includes inspection and periodic maintenance, and the Environmental Protection Agency 5-year reviews as required under the National Contingency Plan in 40 Code of Federal Regulations 300.430 (f)(iv)(2). A periodic sampling and analytical program would also be implemented to monitor the progress of natural recovery. The current temporary cap has had no impact on navigation, and this alternative is not expected to be different.

Alternative 5N – Partial Removal, Upgraded Cap, Institutional Controls, Ground Water Monitoring, and Monitored Natural Recovery

Estimated Capital Cost: $24.86 million
Estimated In-Direct and Operation & Maintenance Cost: $4.94 million
Estimated Total Present Worth Cost: $29.8 million
Estimated Construction Time/Time to meet RAOs: 13 months

This remedial alternative provides for removal and offsite disposal of the most highly contaminated material. A dioxin and furan value that exceeds 13,000 ng/kg dioxin was used to define the most highly contaminated material; however, this would not result in removal or treatment of all of the Principal Threat Waste, which is defined as site material containing dioxin greater than 300 ng/kg. Under this alternative, 3.6 acres of the armor cap would be removed and about 52,000 cubic yards of materials beneath the cap exceeding 13,000 ng/kg dioxin, regardless of waste material depth, would be removed. The lateral and vertical extent and volume of waste material removed under this alternative is the same as the waste material to be treated as described in the previous section for alternative 4N. Construction of an upgraded cap, institutional controls, and Monitored Natural Recovery for the sand separation area, as described in Alternative 3N, are also included in this remedial alternative. If this alternative had been selected, an enhanced cap (as described for Alternative 3aN) would have been considered for inclusion instead of the cap described under Alternative 3N.

To mitigate potential water quality issues, submerged areas would need to be isolated using berms, sheet piles, and/or turbidity barrier/silt curtains prior to excavating waste material. Upland areas would not need to be isolated with sheet piling, but the excavation would require continuous dewatering and may need to be timed to try to avoid high water and times of year when storms are most likely.

Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during the remediation will be tested to comply with the applicable requirements Effluent from excavated waste material dewatering would need to be handled appropriately, potentially including treatment prior to disposal. Following completion of the excavation, the work area would be backfilled to replace the excavated waste material and then the upgraded cap would be constructed, including replacing the armor rock layer above the excavation footprint and the geomembrane and geotextile layers. Institutional controls would be implemented to place restrictions on dredging and anchoring to protect the integrity of the armored cap and to limit potential disturbance and resuspension of buried sediment near the sand separation area. Under this remedial alternative, the following institutional and engineering controls would be implemented:

- A special sampling and analysis protocol will be required for each permittee conducting activities under the Clean Water Act Section 404 and Rivers and Harbors Action Section 10 within a defined watershed area around the remediated areas. This protocol will be monitored and enforced by a joint EPA, USACE, and TCEQ agreement and will ensure that permitted dredging activities do not impact site cleanup. These restrictions will
- protect the integrity of the armored cap and sand separation area and limit potential disturbance and resuspension of buried sediment.
- Alert property owners of the presence of subsurface materials exceeding cleanup levels.
- Public notices and signage around the perimeter of the armored cap site would be maintained or provided, as appropriate.
- As a result of the long term persistence of dioxin, it is anticipated that the institutional controls will be essentially permanent measures.

Ground water monitoring would be implemented to ensure that there are no long-term unacceptable impacts to ground water resulting from the waste left in place. Groundwater monitoring will be conducted in areas bounding waste materials (both vertically and laterally) and will include both dissolved phase COC concentrations and concentrations that may result from facilitated transport.

This alternative includes ongoing operations, inspection, and maintenance of the armored cap, which includes inspection and periodic maintenance, and the Environmental Protection Agency 5-year reviews as required under the National Contingency Plan in 40 Code of Federal Regulations 300.430 (f)(iv)(2). A periodic sampling and analytical program would also be implemented to monitor the progress of natural recovery. The current temporary cap has had no impact on navigation, and this alternative is not expected to be different.

Alternative 5aN - Partial Removal, Upgraded Cap, Institutional Controls, Ground Water Monitoring, and Monitored Natural Recovery

Estimated Capital Cost: $60.38 million
Estimated In-Direct and Operation & Maintenance Cost: $9.21 million
Estimated Total Present Worth Cost: $69.6 million
Estimated Construction Time/Time to meet RAOs: 19 months

For purpose of this partial removal alternative, the original cleanup level for a recreational visitor of 200 ng/kg dioxin was considered for the areas within the armored cap, which are either above the water or where the water depth is 10 feet or less. As an additional criterion for this alternative, locations exceeding 13,000 ng/kg dioxin are also removed regardless of water depth; however, all samples exceeding 13,000 ng/kg dioxin are located in areas where the water depth is 10 feet or less. This alternative entails removal of approximately 137,600 cubic yards of waste material from the waste pits.

As with Alternatives 4N and 5N, the existing armored cap (consisting of cap rock, geomembrane, and geotextile) would need to be removed prior to beginning excavation work.

This alternative also includes an engineered barrier to manage water quality during construction. In shallow water areas (water depths up to approximately 3 feet), this barrier would be constructed as an earthen berm, extending to an elevation at least 2 feet above the high water elevation in consideration of wind generated waves and vessel wakes.

Submerged areas would need to be isolated using berms, sheet piles, and/or turbidity barrier/silt curtains prior to excavating waste material. Excavated waste material would be offloaded, dewatered, and stabilized at a dedicated offloading location, as necessary, to eliminate free liquids for transportation and disposal.

Following removal of impacted waste material, the area from which waste materials are removed would be covered with a residuals management layer of clean cover material.

Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during the remediation will be tested to comply with the applicable requirements

In the deeper water areas of the waste pits where removal is not conducted, the existing armored cap would be maintained. Monitored Natural Recovery would be used to achieve the cleanup level for sediment in the sand separation area. Institutional controls would be implemented to place restrictions on dredging and anchoring to protect the integrity of the armored cap and to limit potential disturbance and resuspension of buried waste material near the sand separation area. Under this remedial alternative, the following institutional and engineering controls would be implemented:

- A special sampling and analysis protocol will be required for each permittee conducting activities under the Clean Water Act Section 404 and Rivers and Harbors Action Section 10 within a defined watershed area around the remediated areas. This protocol will be monitored and enforced by a joint EPA, USACE, and TCEQ agreement and will ensure that permitted dredging activities do not impact site cleanup. These restrictions will protect the integrity of the armored cap and sand separation area and limit potential disturbance and resuspension of buried sediment. Alert property owners of the presence of subsurface materials exceeding cleanup levels.
- Public notices and signage around the perimeter of the armored cap site would be maintained or provided, as appropriate.
- As a result of the long term persistence of dioxin, it is anticipated that the institutional controls will be essentially permanent measures.

Ground water monitoring would be implemented to ensure that there are no long-term unacceptable impacts to ground water resulting from the waste left in place. Groundwater monitoring will be conducted in areas bounding waste materials (both vertically and laterally) and will include both dissolved phase COC concentrations and concentrations that may result from facilitated transport.

This alternative includes ongoing operations, inspection, and maintenance of the armored cap, which includes inspection and periodic maintenance, and the Environmental Protection Agency 5-year reviews as required under the National Contingency Plan in 40 Code of Federal Regulations 300.430 (f)(iv)(2). A periodic sampling and analytical program would also be implemented to monitor the progress of natural recovery. The current temporary cap has had no impact on navigation, and this alternative is not expected to be different.

Alternative 6N - Removal of Waste Materials Exceeding Cleanup Levels, MNR, and Institutional Controls

Estimated Capital Cost: $ 93.7 million
Estimated In-Direct and Operation & Maintenance Cost: $11.8 million
Estimated Total Present Worth Cost: $ 105 million
Estimated Construction Time/Time to meet RAOs: 27 months

This alternative involves the removal of all waste material that exceeds the cleanup level of 30 ng/kg regardless of depth in the northern waste pits. Removal of the majority of the existing armored cap and the removal of 162,000 cubic yards of material would be implemented. Monitored Natural Recovery (MNR) will be used for the sediment in the sand separation area.

As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging.

Regarding the implementability of Alternative 6N, the use of a BMP such as a cofferdam is considered to be an effective best management practice to control releases and residuals for complete removal of the waste material at the San Jacinto River Waste Pits. Cofferdams offer flexibility in construction methods and material to accommodate the local site conditions and project goals. Additionally, the cofferdam can be placed outside of the armored cap to prevent disturbance of the contaminated sediment prior to containment. Cofferdams have been constructed in similar locales for excavation and construction activities such as at the Formosa Plastics, Texas site for contaminated sediment removal, at Matagorda Bay for archeological recovery and at numerous coastal sites for construction. The Phase 1 Removal Action in Passaic River included sheetpile enclosures as a cofferdam for dioxin-contaminated sediment. Removal in the "dry" was performed to control organic chemical liquid releases in the upper 1 ½ miles of the Housatonic River site using cofferdams and by-passing the river flows. Sheet pile wall cofferdams have been used in a large sediment removal in the "dry" project in the Grand Calumet River in Indiana to control organic chemical liquid releases. Berms have been employed to form cofferdams to control resuspension at Hooker Chemical site in New York. In conclusion, the use of cofferdams is a proven technology previously implemented at multiple sites.

While the final BMPs will be determined during the remedial design, EPA and USACE have demonstrated that there is at least one technology (cofferdams) that is implementable and would be effective in preventing releases from the Site during removal. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.

Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during the remediation will be tested to comply with the applicable requirements. Some operations, such as water treatment, may be barge mounted.

This alternative entails removal of approximately 162,000 cubic yards of waste material from the waste pits footprint, which would require an offloading and waste material processing facility to efficiently accomplish the work. Additional activities would include management and disposal of dewatering effluent, including treatment if necessary. Material that is removed would be transported in compliance with applicable requirements and permanently managed in an approved permitted facility in accordance with the Environmental Protection Agency's offsite rule. Approximately 13,300 truck trips may be required to transport the waste material to the off-site approved permitted facility; however, the capacity of roads to handle the loads will impact the truck size that can be used. The method of transportation and number of trips will be determined during the Remedial Design, as well as other transportation alternatives, including rail and/or barge transport. Under this remedial alternative, the following institutional and engineering controls would be implemented:

- A special sampling and analysis protocol will be required for each permittee conducting activities under the Clean Water Act Section 404 and Rivers and Harbors Action Section 10 within a defined watershed area around the remediated areas. This protocol will be monitored and enforced by a joint EPA, USACE, and TCEQ agreement and will ensure that permitted dredging activities do not impact site cleanup. These restrictions will
- protect the integrity of the sand separation area and limit potential disturbance and resuspension of buried sediment. Alert property owners of the presence of subsurface materials exceeding cleanup levels in the sand separation area.
- As a result of the long term persistence of dioxin, it is anticipated that the institutional controls will be essentially permanent measures.

This alternative includes the Environmental Protection Agency 5-year reviews as required under the National Contingency Plan in 40 Code of Federal Regulations 300.430 (f)(iv)(2) because contaminants will remain at the site above levels that allow for unlimited use and unrestricted exposure. The current temporary cap has had no impact on navigation, and this alternative is not expected to be different.

Alternatives for the Former Southern Impoundment:

Alternative 1S – No Action

Estimated Capital Cost: $0
Estimated In-Direct and Operation & Maintenance Cost: $0
Estimated Total Present Worth Cost: $0
Estimated Construction Time/Time to meet RAOs: None

Under this remedial alternative for the area of investigation south of I-10, impacted soil would remain in place and no steps would be taken to alert future landowners or construction workers of the presence, at depth, of dioxin concentrations exceeding cleanup goals. This alternative will not comply with all of the ARARs for the Site.

Alternative 2S – Institutional Controls and Ground Water Monitoring

Estimated Capital Cost: $65,000
Estimated In-Direct and Operation & Maintenance Cost: $959,000
Estimated Total Present Worth Cost: $1.02 million
Estimated Construction Time/Time to meet RAOs: None

This alternative would apply to locations in the area south of I-10 where the dioxin concentration in certain levels within the upper 10 feet of soil exceed the cleanup goal for the future construction worker (240 ng/kg TEQ). The upper 10 feet depth is based on the depth for the exposure scenario, i.e., construction worker. Dioxin concentrations in the upper 10 feet of soil exceed the cleanup level. Ground water monitoring would be implemented to ensure that there are no long-term unacceptable impacts to ground water resulting from the waste left in place. Groundwater monitoring will be conducted in areas bounding waste materials (both vertically and laterally) and will include both dissolved phase COC concentrations and concentrations that may result from facilitated transport. Under this remedial alternative, the following institutional controls would be implemented:

- Deed restrictions would be applied to parcels in which the depth-weighted average dioxin concentrations in the upper 10 feet of subsurface soil exceed the soil cleanup goal for the future construction worker.
- Notices would be attached to deeds of affected properties to alert potential future purchasers of the presence of waste and soil with dioxin concentrations exceeding the soil cleanup goal.
- As a result of the long term persistence of dioxin, it is anticipated that the institutional controls will be essentially permanent measures.

This alternative includes ongoing ground water monitoring, and the Environmental Protection Agency 5-year reviews as required under the National Contingency Plan in 40 Code of Federal Regulations 300.430 (f)(iv)(2).

Alternative 3S – Enhanced Institutional Controls and Ground Water Monitoring

Estimated Capital Cost: $367,000
Estimated In-Direct and Operation & Maintenance Cost: $1.04 million
Estimated Total Present Worth Cost: $1.4 million
Estimated Construction Time/Time to meet RAOs: 1 month

This remedial alternative would incorporate the Institutional controls identified in Alternative 2S and add physical features to enhance the effectiveness of the institutional controls. The physical features would include bollards to define the areal extent of the remedial action areas at the surface and a marker layer that would alert workers digging in the area that deeper soil may be impacted. Implementation of this remedial alternative may include the following steps:

- Removing up to 2 feet of surface soil.
- Temporarily stockpiling the soil onsite.
- Placing the marker layer (such as a geogrid or similar durable and readily visible material) at the bottom of the excavation.
- Returning the soil to the excavation and re-establishing vegetative cover.
- Placing bollards at the corners of the remedial action areas.

Ground water monitoring would be implemented to ensure that there are no long-term unacceptable impacts to ground water resulting from the waste left in place. Groundwater monitoring will be conducted in areas bounding waste materials (both vertically and laterally) and will include both dissolved phase COC concentrations and concentrations that may result from facilitated transport.

Under this remedial alternative, the following institutional controls would be implemented:

- Deed restrictions would be applied to parcels in which the depth-weighted average dioxin concentrations in the upper 10 feet of subsurface soil exceed the soil cleanup goal for the future construction worker.
- Notices would be attached to deeds of affected properties to alert potential future purchasers of the presence of waste and soil with dioxin concentrations exceeding the soil cleanup goal.
- As a result of the long term persistence of dioxin, it is anticipated that the institutional controls will be essentially permanent measures.

This alternative includes ongoing ground water monitoring, and the Environmental Protection Agency 5-year reviews as required under the National Contingency Plan in 40 Code of Federal Regulations 300.430 (f)(iv)(2).

Alternative 4S – Removal and Offsite Disposal, Institutional Controls

Estimated Capital Cost: $9.07 million
Estimated In-Direct and Operation & Maintenance Cost: $0.85 million
Estimated Total Present Worth Cost: $9.9 million
Estimated Construction Time/Time to meet RAOs: 7 months

This remedial alternative involves excavation and replacement of soil in the areas exceeding the cleanup level. Implementation of this remedial alternative would require dewatering to lower the water table to allow excavation of impacted soil in relatively dry conditions, and may need to be timed to try to avoid high water and periods when storms are most likely. Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during the remediation will be tested to comply with the applicable requirements. Effluent from excavation and subsequent dewatering would need to be handled appropriately, potentially including treatment prior to disposal. Excavated soil would be disposed of at an approved permitted landfill to be determined during the Remedial Design; the excavation would be backfilled with imported soil, and vegetation would be re-established. An existing building (an elevated frame structure) and a concrete slab would need to be demolished and removed prior to excavating the underlying soil. These features would be replaced, if necessary. Ground water monitoring is not a part of this Alternative 4S because material containing dioxin above the cleanup level will be removed and disposed of off-site.

The removal volume (50,000 cubic yards) was calculated assuming a conservative excavation side slope of 2-horizontal to 1-vertical. Transportation and disposal costs were estimated assuming that all of the excavated material would be transported to a licensed landfill for disposal. Institutional controls will be applied to insure the continued industrial use of the area.

Under this remedial alternative, the following institutional controls may be implemented:

- Deed restrictions would be applied to parcels where dioxin concentrations do not allow for unrestricted use and unlimited access.
- Notices would be attached to deeds of affected properties to alert potential future purchasers of the presence of waste and soil with dioxin concentrations exceeding EPA's protective level of 51 ng/kg for residential exposures (unlimited use and unrestrictive access) (https://semspub.epa.gov/work/03/2245085.pdf; 2017).
- As a result of the long term persistence of dioxin, it is anticipated that the institutional controls will be essentially permanent measures.

2.10 SUMMARY OF COMPARARTIVE ANALYSIS OF ALTERNATIVES

The National Contingency Plan requires the use of nine criteria to evaluate the difference of remediation alternatives individually and in comparison to each other. These criteria include threshold criteria that each alternative must meet in order to be eligible for selection. Primary balancing criteria are used to weigh major trade-offs among alternatives, and modifying criteria involve state and community acceptance.

The two threshold criteria are: 1) overall protection of human health and the environment, and 2) compliance with applicable or relevant and appropriate requirements. The five primary balancing criteria are: 3) long-term effectiveness and permanence; 4) reduction of toxicity, mobility, or volume through treatment; 5) short-term effectiveness; 6) implement-ability; and 7) cost. The two modifying criteria are: 8) state acceptance, and 9) community acceptance. The Environmental Protection Agency assesses public comment on the Proposed Plan to gauge community acceptance. This section discusses the relative performance of each alternative against the nine criteria and the rationale for selecting the Preferred Alternatives.

Threshold Criteria

The two threshold criteria are overall protection of human health and the environment, and compliance with applicable or relevant and appropriate requirements. Of the nine criteria used to evaluate remedial alternatives, discussed above, the first two criteria are considered threshold criteria and must be met for an alternative to be a viable option.

Threshold Criteria – Overall Protection

The containment alternatives (2N through 5aN) are protective if they are properly maintained for the length of time (hundreds of years) that the impounded waste retains its toxicity, and their integrity is not compromised by extreme weather events, barge strikes and/or changes in the river channel which could result in a future release. Alternative 6N is protective and best realizes the Threshold Criteria because the waste material would be removed from its current location in and adjacent to the San Jacinto River, and therefore not subject to a potential future release.

There are significant differences between the northern impoundment alternatives regarding the amount of potential dioxin impacts to the San Jacinto River, and when those impacts may occur. For example, Alternative 3N would not result in any significant short term increases in dioxin impacts during construction because the existing cap is not removed. However, based on the

Corps of Engineers review (Appendix A of the Feasibility Study), a severe future storm could result in significant erosion of 80% of the armor cap and up to 2.4 feet of scour into the waste pits. Removal alternatives with dredging will result in some releases of waste materials during implementation, estimated by the Corps of Engineers to be between 0.2% and 0.34%. Other best management practices, including the use of a cofferdam with excavation in the “dry”, would preclude any material release during removal.

For the area south of I-10, other than Alternative 1S, the remedial alternatives considered in the Feasibility Study Report are protective. However, the removal alternative (4S) is more protective in the long-term and permanent because the waste material could not be potentially compromised by future extreme weather events. The potentially affected receptor (future construction worker) would be protected from exposure to soil with elevated dioxin concentrations by warnings and restrictions (Alternatives 2S and 3S) or removal of impacted soil (Alternative 4S).

Threshold Criteria – Compliance with Applicable or Relevant and Appropriate Requirement (ARARs)

Table 29 contains a list of the applicable or relevant and appropriate requirements, or ARARs, identified for this site. The remedy relies on few chemical-specific ARARs because the final cleanup standards are based primarily on risk calculations presented at length above rather than ARARs drawn from other environmental statutes. ARARs such as the Texas Surface Water Quality Standards, ordinarily treated as chemical-specific, are more action-specific for this site.

Given the location of the Site, location-specific ARARs such as the Coastal Zone Management Act and Texas Coastal Management Plan would be applied when designing and implementing the remedial alternatives except for No Action. Surveys conducted in 2009-2010 for the presence of species or artifacts did not trigger applicability of potential ARARs such as the Endangered Species Act, National Historic Preservation Act, Fish and Wildlife Coordination Act, State of Texas Threatened and Endangered Species regulations, and the Texas Antiquities Code, but EPA remains in consultation with the responsible state and federal agencies. Location-specific ARARs and To Be Considered (TBCs) criteria for CERCLA activities in waterways, floodplains, and wetlands, such as the Coastal Zone Management Act, Rivers and Harbors Act, federal Executive Orders on Floodplain Management and Protection of Wetlands, FEMA floodplain regulations, Texas Coastal Management Plan, Texas regulations concerning obstructions to navigation, and Harris County Regulations for Floodplain Management, etc., would be germane to all remedial alternatives given the location of the site.

Action-specific ARARs would be followed for specific types of response activities appearing in various combinations among the alternatives. Certain response alternatives may meet ARARs more effectively. Action-specific ARARs for various alternatives are discussed below.

Alternatives for the San Jacinto River and Area North of I-10

Alternative 1N would not contribute further toward eventual achievement of federal and state surface water ARARs. Since there is no additional active remediation associated with this alternative, action-specific and location-specific ARARs would not apply.

Alternative 2N would comply with ARARs governing land use restrictions, fencing, and signage.

Alternatives 3N, 3aN, 4N, 5N, 5aN, and 6N all involve additional construction activities on the temporary cap. This activity would be subject to, and designed to comply with location and action-specific ARARs governing construction in or near the waterway and the floodplain. As construction on the temporary cap involves excavation, management of discharges to surface water, and possibly dredging, Clean Water Act Sections 303, 304, 309(b), 401, and 404, as well as Texas Surface Water Quality Standards and Texas Water Quality Certification requirements, would be observed to minimize short-term construction-related surface water quality impacts. Executive Orders governing Wetlands Protection and Floodplain Management and the Harris County Regulations for Flood Plain Management would also have to be considered in design and implementation. To the extent that waste categorized as hazardous under the Resource Conservation and Recovery Act (RCRA) is encountered in Alternatives 3N, 3aN, or 4N, it would be handled in accordance with RCRA as outlined further below.

Alternatives 5N, 5aN, and 6N call for excavation, dewatering, possible stabilization, and removal of wastes for off-site disposal. Action-specific ARARs outlined above for temporary cap fortification would apply to these alternatives as well. Action-specific ARARs germane to the nature of the waste would be followed depending upon waste categorization. RCRA Subtitle C requirements would be applied to excavation, stabilization, handling, transportation, and selection of a disposal facility for the RCRA hazardous wastes removed from the Site, and possibly to site waste categorized as RCRA non-hazardous but shipped off-site for disposal. RCRA Subtitle D and Texas requirements for Industrial Solid Waste and Municipal Hazardous Waste requirements would be observed in activities involving waste categorized as RCRA non-hazardous. Substantive requirements of the Toxic Substances Control Act would be integrated into design and implementation involving PCB remediation wastes. Finally, state and federal standards such as control of noise and air emissions from on-site activities would be incorporated into work plans for such activities.

All remedial alternatives identified for the northern impoundments comply with ARARs, except that it should be noted that the current levels of dioxins and furans in the San Jacinto River in the immediate vicinity of the site continue to exceed the Texas Surface Water Quality Standard (TSWQS) for dioxins/furans of 0.0797 pg/L TEQ [30 Texas Administrative Code §307.6(d)(a)(A) and (B) and §307.10] and also continue to exceed concentrations of dioxin and furans upstream of the site. Surface water sampling conducted in July 2016 found the highest average dioxin/furan concentration of 0.681 pg/L TEQ was directly above the eastern cell of the northern impoundments. The July 2016 surface water sampling indicated that tetra-dioxin and tetra-furan both more than tripled going over the cap. While concentrations upstream also exceed the TSWQS, the site continues to contribute dioxins and furans, particularly TCDD and TCDF, to the river system over six years after implementation of the TCRA. Based on the data and information in the record, additional measures taken to strengthen the cap in Alternatives 3N and 3aN, or to partially treat and/or remove a portion of the waste in Alternatives 4N, 5N and 5aN, and/or an additional length of time, will not necessarily improve the surface water quality issues currently associated with the site.

In response to comments received during the public comment period, the EPA worked with the USACE to develop at least one engineering method for Alternative 6N, use of a cofferdam, that would prevent releases during waste removal in exceedance of the Texas Surface Water Quality Standard for dioxins and furans, and other methods may be developed during the Remedial Design. In addition, one of the applicable requirements is the Clean Water Act §404(b)(1), which addresses discharges of dredge and fill material into waters of the United States. Under the 404(b)(1) guidelines, efforts should be made to avoid, minimize, and mitigate adverse effects on the waters of the U.S. and, where possible, select a practicable (engineering feasible) alternative with the least adverse effects.

The substantive requirements of Section 404 were considered in the development of Alternative 6N to minimize adverse impacts to waters of the United States through the use of best management practices such as a cofferdam to minimize releases to the San Jacinto River. Additional evaluations will be conducted during the Remedial Design to determine the potential habitat impacts related to impacts of dredging and placement of the clean residual layer management materials in order to document compliance with CWA Section 404(b)(1).

Several waste disposal facilities have been identified for the excavation alternatives that could potentially receive the waste material. The actual disposal location, as well as the specifics of the removal activities themselves, would be determined during the Remedial Design and would be required to comply with all ARARs.

Alternatives for the Former Southern Impoundment

For the area south of I-10, other than Alternative 1S, the remedial alternatives considered in the Feasibility Study Report comply with applicable or relevant and appropriate requirements.

Alternative 2S and 3S call for imposition of Institutional Controls, without active remedial measures. Institutional controls would include deed restrictions on parcels where dioxin cleanup goals are exceeded in the upper ten feet of subsurface soil and notices of contamination filed with the deeds of affected properties. ICs alone, though compliant with ARARs, do not reduce the toxicity, mobility or volume of the waste left in place. Under RCRA, a hazardous waste must be handled as hazardous waste if moved outside the area of contamination of its current location, as in Alternative 4S.

Alternative 4S, Removal and Off-Site Disposal, calls for excavation and replacement of soil in areas exceeding the remediation goals. Substantive RCRA requirements would apply to hazardous waste moved outside the current area of contamination and to handling, treatment (if any), transportation, and off-site disposal. PCB wastes would be managed in accordance with a remediation plan prepared pursuant to the Toxic Substances Control Act. Action-specific requirements for construction or excavation in the floodplain, as well as location-specific requirements for such activities discussed above in connection with alternatives for the Northern Area would be followed in remedy design and implementation.

Primary Balancing Criteria – Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to the expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain onsite following remediation and the adequacy and reliability of controls. All alternatives that leave waste material in place (Alternatives 1N through 5aN) are less permanent than the removal alternative (6N).

Alternatives 1N, 2N, and 3N are containment alternatives with some long-term protectiveness. However, the area is prone to tropical storms and hurricanes which could damage a cap. The current cap with enhancements (Alternative 3N) as modeled by US Army Corps of Engineers experienced significant cap erosion over 80% of the cap. Furthermore, future flooding and wave action may be even more intense than experienced in the past, which would increase the uncertainty of the long-term effectiveness of all of the containment alternatives.

Alternative 3aN is an enhanced capping alternative with armor cap improvements (larger 15” armor stone, 24” of additional cap thickness on top of the Alternative 3N cap) to address the deficiencies of Alternative 3N. Alternative 3aN likely would be better able to withstand a future severe storm; however, the modelling performed by the Corps of Engineers in response to comments submitted found that a future extreme storm (e.g., major hurricane with severe flooding, storm surge, and wind driven waves) would result in cap erosion over most of the Alternative 3aN cap. Hurricane Harvey did not produce these conditions because there was no storm surge or wind driven waves at the site. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. Unfortunately, these stronger hurricanes could not be reliably modeled because no relevant databases were available for use. In addition, there are uncertainties related to changes in channel planform morphology that may occur due to bank erosion, shoreline breaches, etc. during a high flow event caused by a major flood or hurricane, which is beyond the ability of existing sediment transport models to reliably simulate, as well as the uncertainty of making predictions that would have to remain relevant for hundreds of years into the future.

In 2014 the Interstate Technical and Regulatory Council published a guidance document which indicates site conditions that would increase cap stability include deep water, low erosive forces including low flow, limited wave effects, and limited navigation related prop wash (Interstate Technical and Regulatory Council, 2014). The site does not have low erosive forces and limited wave effects on a consistent basis. Further, the site is in an active navigation area.

To add to the uncertainties outlined above, future flooding may be even more intense. Warner and Tissot (2012) conservatively estimate a sea level rise at Galveston Bay of 2.1 feet over the 21st Century, and continuously increasing risks of flooding from storm surges as the century progresses. According to the U.S. National Climate Assessment, flooding along rivers and other areas following heavy downpours and prolonged rains is exceeding the limits of flood protection infrastructure designed for historical conditions. Sea level rise, storm surge, and heavy downpours in combination with the pattern of continued development in coastal areas are increasing damage to U.S. infrastructure and are also increasing risks to ports and other installations. Aerial photographs and past reports document that the site, even over just the last 60 years, is in a dynamic river environment that raises concerns about the permanence of any manmade structure. The use of an armored cap will be inadequate to reliably contain the pulp waste over the long-term at the site. Alternative 6N provides a more certain outcome than Alternative 3aN and the other containment alternatives with lower overall potential for release.

Alternatives 4N, 5N, and 5aN all provide increased long term effectiveness compared to Alternatives 1N, 2N, and 3N because the most highly contaminated waste would either be stabilized or removed. However, uncertainties still remain regarding long-term effectiveness of the cap and the potential impact of severe future storms and hurricanes. Alternative 6N provides the greatest long-term protectiveness and effectiveness because the waste material would be permanently removed from the San Jacinto River and there would be no potential for a future release above the risk based level from the site. Also, with Alternative 6N, there would be no concerns regarding the long-term viability and effectiveness of a maintenance program that would have to endure for an extremely long time (more than 500 years). Removal will eliminate the potential for the costs associated with cleaning up a large contaminated sediment site that may result from a failure of a cap, and will eliminate the potential for future environmental and human health impacts should a release occur. Alternative 6N is also the only alternative that provides for complete removal of the Principal Threat Waste from the northern impoundments, which will be treated to meet disposal requirements.

Additionally, surface water sampling conducted in 2017 indicated that tetra-dioxin and tetra-furan both more than tripled going over the cap. Removal of the source material will prevent contaminant mobility and decrease the time necessary to meet the surface water cleanup level.

Ground water monitoring would be included in Alternatives 2N through 5aN, where waste above the cleanup levels is left in place, to confirm that there would be no long-term future unacceptable impacts to ground water. Groundwater monitoring may not be required for Alternative 6N, although ground water monitoring will be performed during the Remedial Design.

For the area south of I-10, soil with dioxin concentrations exceeding the cleanup goal is isolated from the surface by relatively clean overburden. The only route of potential exposure is through excavation into the impacted depth interval. The physical markers (Alternative 3S) would draw attention to the institutional controls and enhance their effectiveness. Alternative 4S would achieve long-term effectiveness by permanently removing the impacted soil from the 0- to 10-foot depth interval from the site and securely disposing of the soil in an approved permitted landfill. While the institutional controls, particularly with the addition of physical markers (Alternative 3S), would provide long-term protection, they rely on the integrity of future construction workers to comply with the restrictions. Therefore, complete removal of the impacted soil in the depth interval of potential excavation (Alternative 4S) will provide the highest level of long-term effectiveness because it is not subject to inappropriate future use of the area or any erosion/scour of the waste material that may result from a future extreme storm. Alternative 4S is also the only alternative that provides for complete removal of the Principal Threat Waste from the Southern Impoundment and treatment of the waste to meet disposal requirements. Ground water monitoring would be included in Alternatives 2S and 3S, where waste above the preliminary remediation goals is left in place, to confirm that there would be no long-term future unacceptable impacts to ground water, but may not be required in Alternative 4S.

Primary Balancing Criteria – Reduction of Toxicity, Mobility, or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of the remedy. It also refers to the evaluation of an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present. Reduction of toxicity, mobility, or volume through treatment is considered a balancing criterion. Although CERCLA includes a statutory preference for treatment, this criterion is not a threshold that must be met. The preference is satisfied when treatment reduces the principal threats through the following mechanisms:

- Destruction of toxic contaminants,
- Reduction in contaminant mobility,
- Reduction in the total mass of toxic contaminants, and
- Reduction in the total volume of contaminated media.

Alternatives 1N, 2N, 3N, or 3aN do not include additional measures to reduce the toxicity, mobility, or volume of material. However, a portion of the soils in the western cell were previously solidified during the temporary armored cap construction. Thus, these alternatives are comparable in reduction of toxicity, mobility, or volume of material. Alternative 3N further reduces potential mobility, and to a further extent 3aN, within the temporary armored cap site by increasing the protection of the armored slopes, and both rank more favorably than Alternatives 1N and 2N. Alternatives 4N and 5N take additional measures through solidification and stabilization (Alternative 4N) or removal (Alternative 5N) of approximately 52,000 cubic yards of waste materials, and are comparatively better than Alternative 3N and 3aN for reduction of toxicity, mobility, or volume of material. Alternative 5aN removes approximately 137,600 cubic yards of waste material, and thus compares more favorably for reduction of toxicity, mobility, or volume of material than Alternatives 4N and 5N. Alternative 6N has the greatest volume of removal – 162,000 cubic yards. The potential mobility of the waste will be reduced because it will be removed from the river environment, and the waste will be treated as required for disposal. This alternative is the most effective in reducing the toxicity, mobility, and volume of waste compared to all of the other alternatives.

Alternatives 1S, 2S and 3S do not include any reduction in the toxicity, mobility, or volume of impacted soil. Alternative 4S is the only alternative that reduces the volume by complete removal of soils above the cleanup level. The excavated soil may require dewatering by treatment with fly ash, Portland cement or a similar material to eliminate free liquids for transportation and disposal.

Primary Balancing Criteria – Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during construction and operation of the remedy until cleanup levels are achieved. Under this criterion, alternatives are evaluated for their effects on human health and the environment during implementation of the remedial action. Short-term effectiveness is considered a balancing criterion. The following factors are considered when evaluating the short-term effectiveness of a remedial alternative:

- Exposure of the community during implementation of the remedy,
- Exposure of workers during construction,
- Environmental impacts, and
- Time to achieve the RAOs.

Alternatives 1N and 2N do not entail any construction, and thus have no short-term impacts. Alternative 3N has the shortest construction duration (two months) of the remaining alternatives. Alternatives 3aN, 4N, 5N, 5aN, and 6N have estimated construction durations ranging from 13 to 27 months. Alternative 3N and 3aN do not result in water column, sediment, or tissue impacts (except for minor turbidity during armor rock placement), and have the lowest risk to worker safety, the lowest greenhouse gas and particulate matter emissions, and the least traffic and ozone (smog) impact. Further, Alternative 3N does not disturb the armored cap or require handling of waste materials. Compared to Alternatives 4N, 5N, 5aN, and 6N, which all include at least some cap removal, Alternatives 3N and 3aN rank more favorably for short-term effectiveness because there is no cap removal and little potential for short-term dioxin releases to the San Jacinto River.

All of the alternatives involving either partial or full removal of the waste materials, including Alternatives 5N, 5aN, and 6N, would have re-suspension of sediment. Alternative 5N uses berms, sheet piles, or silt curtains to control the resuspension of sediment. Silt curtains are the least effective controls. Alternative 5aN uses additional resuspension controls including an engineered barrier (earthen berm) extending to an elevation at least 2 feet above the high water elevation barrier. Alternative 6N adds BMPs to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. The actual design and application of Best Management Practices for construction will be determined during the Remedial Design.

Alternatives 4N, 5N, 5aN, and 6N each have short-term impacts associated with sediment residuals and resuspension as well as any high-water events during construction. However, the actual impacts would be reduced to the maximum extent practicable by the use of Best Management Practices during construction, especially in Alternative 6N with the most extensive application of Best Management Practices to limit resuspension.

Alternatives 5aN and 6N have longer construction durations than the other alternatives. Compared to the other alternatives, there is higher potential worker safety issues and higher environmental impacts due to emissions of ozone precursors, particulate matter (smog-forming), and greenhouse gases. Under Alternative 6N, wastes would be transported in sealed and covered trucks. The potential spills of the wastes and contaminated sediments do not pose substantial short-term risks. The materials are not ignitable/flammable, corrosive, or reactive using the RCRA leachability test as characteristic of hazardous materials.

Best Management Practices can successfully mitigate and control re-suspension of sediment. Alternative 6N, the selected alternative, will include design and construction methodologies to mitigate and reduce the impact of storms during construction. These methodologies may include armor cap removal in sections, cofferdams, sheet piles, raised berms, operational controls, etc. Substantial containment structures are needed to isolate the removal operations, residuals and exposed sediment. To control the sediment re-suspension during construction, the containment structures may consist of berms, cofferdams, sheet pile walls and/or caissons to an elevation as determined during the Remedial Design.

For the Southern Impoundment, Alternative 2S does not entail any construction, and thus has no short-term impacts. Excavations (Alternatives 3S and 4S) would require Best Management Practices to control dust and storm water. Short-term impacts associated with Alternative 3S would be minimal given the shallow depth of excavation, limited volume of material that would be moved, and absence of significant concentrations of contaminants of concern in the shallow soil. Alternative 4S would require exposing soil with dioxin concentrations exceeding the cleanup levels, which introduces the potential for exposure to contaminants of concern through direct contact with the soil, inhalation or ingestion of impacted dust, and contact with impacted soil suspended in runoff. The volume of soil and the duration of the project would also be greater than for Alternative 3S; and Alternative 4S would require offsite transportation of the soil to a disposal facility, increasing the potential for exposure to contaminants of concern, emissions of greenhouse gasses, nitrogen oxides, and particulate matter, and potential tracking of contaminants of concern offsite. However, measures developed in the Remedial Design would be implemented to control the amount of any materials lost during transportation. During the Remedial Design, a plan will be prepared for notification of downstream stakeholders regarding site activities and any unexpected conditions at the site.

Primary Balancing Criteria – Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered. Implementability is considered a balancing criterion. The following factors are considered when evaluating the implementability of a remedial alternative:

- Ability to construct the technology,
- Monitoring requirements,

- Availability of equipment and specialists, and
- Ability to obtain approvals from regulatory agencies.

Alternatives 1N and 2N do not have any implementability issues because they do not entail construction. Both are more favorable from an implementability standpoint compared to Alternatives 3N, 3aN, 4N, 5N, 5aN, and 6N. Alternative 3N is a short-duration project that entails proven technology (i.e., the same activities were demonstrated during construction of the temporary armored cap) that can be deployed with readily available materials and local, experienced contractors. It should be noted that cap inspections in 2015 identified that geotextile material and rock were found to have sunk several feet or more into the waste material. This occurrence points to the need to carefully consider the load bearing capacity of the waste, especially with the potential addition of weight from the addition of several feet of larger armor stone over much of the cap, as envisioned for the upgraded cap in Alternative 3aN. This concern makes Alternative 3aN potentially less favorable from an implementability standpoint than Alternative 3N.

Implementability issues, such as the temporary armored cap site access, limited staging areas, restrictions on equipment size, and availability of offsite staging area properties are greater for Alternatives 4N, 5N, 5aN, and 6N compared to Alternative 3N and 3aN because of the much larger scope and scale of these alternatives. Identifying and securing an offsite staging area is considered an even greater challenge for Alternatives 5N, 5aN, and 6N compared to Alternative 4N due to the increased footprint necessary to handle larger volumes of material and the nature of the dredged material, which might make it difficult to find a willing landowner. However, it may be possible to conduct these operations on barges. Proper management of cap material and excavated wastes, and onsite processing and management for removed sediments for offsite transportation to neighboring roadways, will be critical for effective implementation of Alternatives 5N, 5aN, and 6N.

For the southern area, there are no significant implementability concerns associated with Alternatives 2S and 3S. None of the alternatives requires specialized equipment, techniques, or personnel. Coordination with property owners would be required to establish institutional controls and for access to the project work site. Alternative 4S would involve more physical activity for implementation, including offsite transportation of impacted soil, but the operations are routine for remedial actions. The additional implementability concerns are the increased truck traffic on Market Street and the potential for flooding while impacted soil is exposed during implementation of Alternative 4S. Provisions may need to be made to handle the additional volume of traffic. The duration of the excavation should not exceed 7 months, and implementation could be timed for periods when high water is least likely.

Primary Balancing Criteria – Cost

Costs to implement a remedial alternative include estimated capital and O&M costs as well as present worth costs. Capital costs consist of direct and indirect costs. Direct costs include the purchase of equipment, labor, and materials necessary to implement the alternative. Indirect costs include engineering, financial, and other services such as testing and monitoring. Annual O&M costs for each alternative include operating labor, maintenance materials and labor, auxiliary materials, and energy. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Costs are estimated using a discount rate of 7% over a 30-year period, though Operations and Maintenance costs for long-term containment would likely be incurred for longer than 30 years. Cost estimates are expected to be accurate within a range of +50 to -30 percent. Cost is considered a balancing criterion.

The estimated present worth costs for alternatives range from $0.4 million for Alternative 1N to $105 million for Alternative 6N, and from $0 for Alternative 1S to $9.9 million for Alternative 4S. Costs for each alternative are presented with the descriptions of each alternative.

Modifying Criteria – State and Community Acceptance

The state acceptance criterion considers whether the State of Texas agrees with the EPA's analysis and recommendations of the RI and FS Reports and the Preferred Alternative. State acceptance is considered a modifying criterion.

The State of Texas, through the Texas Commission on Environmental Quality (TCEQ), the support agency, has been informed about the Selected Remedy for the Site. The TCEQ has provided comments on the Proposed Plan, and the EPA has provided responses to these comments in the Responsiveness Summary. Many of the changes to the Proposed Plan Preferred Alternative that are incorporated in the Selected Remedy are based on comments from the TCEQ as well as the other commenters. However, to date, the TCEQ has not provided to EPA their acceptance of the Preferred Alternative.

The community acceptance criterion considers whether the local community agrees with the EPA's analyses of the technical documentation developed during the investigation of the site and identification of the Preferred Alternative in the Proposed Plan. Comments received from the public on the Proposed Plan are an important indicator of community acceptance. Community acceptance is considered a modifying criterion.

Community acceptance was determined based on letters, emails and web based comments received during the public comment period and the questions received at the public meeting. EPA received over 7,000 written comments and 48,000 signatures on petitions from individuals in the surrounding communities, various regions of the United States, school age children, elected officials, industry, industry associations, and non-governmental organizations. The comments from local residents generally support removal and off-site disposal, with over 94% of the comments received during the comment period voicing support for removal of the waste material.

2.11 PRINCIPAL THREAT WASTE

The National Contingency Plan establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (National Contingency Plan § 300.430(a)(1)(iii)(A)). In general, Principal Threat Wastes (PTW) are those source materials considered to be highly toxic or highly mobile and which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur.

Principal threats for which treatment is most likely to be appropriate include liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile materials (40 C.F.R. § 300.430(a)(iii)(A)). The EPA *Guide to Principal Threat and Low- level Threat Waste* further explains that PTW are those source materials considered highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur (*PTW Guidance at p.2, see also 55 Fed. Reg. at 8703 and 53 Fed. Reg. at 51422. Principal threats are characterized as waste that cannot be reliably controlled in place such as liquids, highly mobile materials (e.g., solvents), and high concentrations of toxic compounds (e.g., several orders of magnitude above levels that allow for unrestricted use and unlimited exposure)).* PTW includes liquids and other highly mobile materials (e.g. solvents) or materials having high concentrations of toxic compounds. No threshold of toxicity/risk has been established to equate to "principal threat." However, where toxicity and mobility of source material combine to pose a potential risk of 10^{-3} or greater, generally treatment alternatives should be evaluated. Also, treatment that destroys or reduces hazardous properties of contaminants (e.g., toxicity or mobility) frequently will be required to achieve solutions that afford a high degree of permanence.

The purpose of discussing PTW is not to set cleanup levels. The purpose is to reflect EPA's belief that certain source materials are addressed best through treatment because of technical limitations to the long-term reliability of containment technologies, or the serious consequences of exposure should a release occur.

Dioxin is highly toxic and persistent (will not break down for hundreds of years) in nature. With the regular occurrence of severe storms and flooding in the area, there is uncertainty that the waste material can be reliably contained over the long term and therefore should be considered potentially highly mobile due to its location in a dynamic river environment. Because the dioxin waste in the northern impoundments and Southern Impoundment at the site is both highly toxic and potentially highly mobile, it is considered a PTW.

EPA policy sets a precedent for defining PTW based on a multiple of a risk based level. For example, waste demonstrating a carcinogenic risk of 10^{-3}. which is 10 times higher than the upper end of the acceptable risk of 10^{-4}, is considered a principal threat.

Based on this precedent, the cleanup level of 30 ng/kg based on non-carcinogenic dioxin/furan toxicity was multiplied by 10. This results in a PTW designation for waste containing more than 300 ng/kg of dioxin/furan.

The following concentrations of dioxin have been detected at the Site:

- Waste material in the waste pits (more than 43,000 ng/kg).
- Soil in the Southern Impoundment (more than 50,000 ng/kg).

Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during the remediation will be tested to comply with the applicable requirements. Treatment of a portion of the paper mill waste by solidification with cement was successfully performed during the Time Critical Removal Action (TCRA) on a portion of the Western Cell materials.

2.12 SELECTED REMEDY

The Selected Remedy for cleaning up the Site is Alternative 6N (Removal of Waste Materials Exceeding Cleanup Levels, Off-Site Disposal, Monitored Natural Recovery for the Sand Separation Area, and Institutional Controls) and Alternative 4S (Removal and Offsite Disposal with Institutional Controls). These alternatives will achieve protectiveness by removal of dioxin waste materials at concentrations greater than the cleanup levels, including waste materials considered Principal Threat Waste, resulting in a permanent solution to address the risks posed by the site. The removed material will be transported to and disposed of at an approved permitted disposal facility to be determined during the Remedial Design.

SUMMARY OF THE RATIONALE FOR THE SELECTED REMEDY

The Selected Remedy is protective of human health and the environment, complies with ARARs, and provides the best balance of tradeoffs among the balancing criteria. It reduces risks within a reasonable time frame, provides for long-term reliability of the remedy, and minimizes reliance on institutional controls. It will achieve substantial risk reduction by removing the most contaminated materials, reducing remaining risks in the aquatic environment to the extent practicable through MNR, and managing the remaining risks to human health through ICs.

EPA considered several options for addressing contaminated materials at the site. EPA selected a remedy that includes removal of contaminated materials above cleanup levels for the waste impoundments and MNR for the lower contamination level in the Sand Separation Area. The reasons include:

- The material is highly toxic and under conditions in the San Jacinto River may be highly mobile. Dioxin causes many adverse health effects and is a probable cancer causing agent. Dioxin is also very persistent in the environment and expected to remain toxic for a long time. Samples of surface water at the site demonstrate the mobility of dioxin in the San Jacinto River environment; for example, surface water sampling conducted in July 2016 indicated that tetra-dioxin and tetra-furan both more than tripled going over the TCRA cap.

- The area has a high threat of repeated storm surges and flooding from hurricanes and tropical storms, which if the material was left in place, could result in a release of hazardous substances. Modeling by the U.S. Army Corps of Engineers projects a significant erosion of cap armor, even with the two most robust capping alternatives, as a result of combined hurricane and flood conditions.

- Historical experience with the TCRA cap indicates that containment would not be an effective or protective long term remedy. Over the six years since the completion of the TCRA cap, significant repairs have been required averaging approximately once a year, with no lessening of the magnitude of the needed repairs over this period. Sediment erosion and scour adjacent to the cap show the potential for storms to undermine the cap's integrity. There was also an underwater exposure of dioxin wastes in the river that occurred in 2015. The potential release and transport of the dioxin over the long-term would further impact ecological and human receptors. The long-term performance of the cap as well as the efficacy of maintenance for hundreds of years into the future is not reliable.

- The specific conditions of this site's location in the San Jacinto River also demonstrates that containment would not be protective in the long term. Guidance indicates that a cap is appropriate for areas of deep water with low flow, limited wave effects and limited navigation interference. The site is in a busy navigation area, and does not have low flow or limited wave effects, especially during the severe storms to which the area is subject. The site is also located downstream of a dam impoundment, is affected by tidal estuaries, and the San Jacinto River has eroded new channels in the past, all of which add to the dynamic nature of this river environment.

- Performing the dioxin removal using Best Management Practices, as determined during the Remedial Design in consultation with the U.S. Army Corps of Engineers and TCEQ, will reduce the short-term impacts and prevent any material release during the removal.

- Removal of the source waste material in the impoundments will eliminate the potential for a future release to the environment, which is a long-term benefit that outweighs the cost of removal. Any cleanup approach involving capping would have to reliably achieve containment in perpetuity by requiring regular cap repairs over an extended time, resulting in releases or threats of releases of dioxins and other hazardous substances in the event of a severe storm or maintenance failure. Given that the site is partially submerged in a river subject to extreme floods and hurricanes, containment is not a reliable solution for the site.

The Selected Remedy provides greater permanence in comparison to other alternatives. Less costly alternatives rely on remedies that have a higher chance of failure by leaving source materials in the river, resulting in greater uncertainty as to their long-term effectiveness. The Selected Remedy will reliably and effectively provide long-term protection of human health and the environment.

For the Sand Separation Area, MNR was selected due to a combination of lower dioxin concentrations (more than 100 times less dioxin than the northern impoundments) and data indicating that the area is subject to sediment deposition. For these reasons, MNR is the more cost-effective than excavation in this area of the site.

DESCRIPTION OF THE SELECTED REMEDY

The Selected Remedy is a final action for the San Jacinto River Waste Pits Site. It addresses site related, unacceptable human health risks associated with consumption of fish and direct contact (skin contact and incidental ingestion) with sediment and soil. It also addresses site related ecological risks to bottom-dwelling organisms (benthic invertebrates), birds, and mammals.

The Selected Remedy includes excavation and off-site disposal of wastes above the cleanup levels from impoundments in and adjacent to the San Jacinto River. It also provides for removal of Principal Threat Waste source materials and treatment of these materials to meet the requirements of disposal. ICs will be used to prevent disturbance of the remediated areas (e.g., dredging and anchoring for the Sand Separation Area; and construction, and excavation for the Southern Impoundment) and alert future property owners of subsurface materials exceeding cleanup goals in the Sand Separation Area and exceeding waste and soil with dioxin concentrations exceeding EPA's protective level of 51 ng/kg for unlimited use and unrestrictive access (https://semspub.epa.gov/work/03/2245085.pdf; 2017). MNR will be used to ensure remedy protectiveness in the aquatic environment. Changes to the selected remedy may be documented in the form of a memorandum in the Administrative Record file, an Explanation of Significant Differences, or a ROD Amendment.

North of I-10 and Aquatic Environment

For the removal alternative, the recreational visitor exposure scenario was considered for the area north of I-10. The cleanup goal for protection of the recreational visitor is a TEQ concentration of 30 ng/kg. Figure 35 present the area to be remediated.

The work area would be isolated with cofferdams, berms, and sheet piles, as determined during the Remedial Design. The excavation areas would be de-watered so that removal operations could be conducted in the "dry". The cap rock, geomembrane and geotextile from the existing armored cap, which currently isolates and contains impacted material, would be removed prior to beginning excavation activities. These actions would be done in sections as determined during the Remedial Design so that only the immediate area to be removed would be uncovered at any one time. Similarly, upland excavation could require dewatering to allow excavation of impacted sediment in relatively dry conditions. Excavated sediment would be further dewatered and stabilized as required for transportation and disposal as determined during the Remedial Design. Some operations, such as water treatment, could be barge mounted. Following removal of impacted sediment, the confining structures (i.e., cofferdams, sheet piles, and/or berms, etc.) would be removed as determined during the Remedial Design.

This alternative entails removal of approximately 162,000 cy of sediment from the TCRA footprint. Additional activities would include management and disposal of dewatering effluent, including treatment if necessary.

South of I-10

This remedial alternative involves excavation and replacement of soil in the Southern Impoundment that is above the cleanup level (Figure 33). Soil would be removed within these areas to a depth of 10 feet below grade. Implementation of this remedial alternative would require dewatering (groundwater lowering) to allow excavation of impacted soil in relatively dry conditions and may need to be timed to try to avoid high water and periods when storms are most likely. Excavated soil would be further dewatered, as necessary, and potentially treated to eliminate free liquids prior to transporting it for disposal. Effluent from excavation and subsequent dewatering would need to be handled appropriately, potentially including treatment prior to disposal. Excavated soil would be disposed of at an existing permitted landfill, the excavation would be backfilled with imported soil, and vegetation would be re-established.

An existing building (an elevated frame structure) and a concrete slab would need to be demolished and removed prior to excavating the underlying soil. These features would be replaced as necessary.

The removal volume (50,000 cy) was calculated assuming a conservative excavation side slope of 2-horizontal to 1-vertical. Transportation and disposal costs were estimated assuming that all of the excavated material would be transported to a licensed landfill for disposal. During Remedial Design, potential cost savings associated with segregating clean soil and using it as backfill may be explored.

Summary of the Estimated Remedy Costs

The estimated cost for the Selected Remedy (including Alternatives 6N and 4S) is $115 million. The information in the cost estimate summary tables presented in Appendix A are based on the best available information regarding the anticipated cost of the Selected Remedy. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is an order-of-magnitude engineering cost estimate that is expected to be within plus 50 to minus 30 percent of the actual project cost.

EXPECTED OUTCOMES OF SELECTED REMEDY

The intent of the Selected Remedy is to be protective of human health and the environment and to attain ARARs. It is consistent with current and reasonably anticipated future uses of the land and river. It is also intended to minimize reliance on ICs to the extent practicable. The Selected Remedy will reduce sediment contamination and remove Principal Threat Waste from the site in order to achieve long-term protectiveness.

2.13 STATUTORY DETERMINATIONS

Under CERCLA section 121, 42 U.S. Code §9621, the EPA must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

Protection of Human Health and Environment

The Selected Remedy will protect human health and the environment by removing contaminated materials from the Site, using MNR to further reduce concentrations in less contaminated areas, and placing ICs as necessary. Specifically, the exposure of recreational fishers and recreational visitors to dioxins and furans will be reduced through removal of the contaminated materials to risk based cleanup levels. Exposure of future construction workers to dioxins and furans in contaminated soil will not occur because soil above the risk based cleanup level in the Southern Impoundment will be removed from the site to a depth of 10 feet below grade. Ecological receptors (benthic invertebrates) will be protected because there will no longer be in an exposure pathway to contaminated materials.

Compliance with Applicable or Relevant and Appropriate Requirements

The NCP §§ 300.430(f)(5)(ii)(B) and (C) require that a ROD describe the Federal and State ARARs (Table 29) that the Selected Remedy will attain or provide justification for any waivers. The implementation of the remedy generally will not require Federal, State, or local permits because of the permit equivalency of the CERCLA remedy-selection process (40 CFR 300.400(e)(i)), but remedial actions will be completed in conformance with substantive technical requirements of applicable regulations.

The ARARs can be broken out into three different categories, although some ARARs may belong to more than one of these categories. In addition, to-be-considered criteria are discussed. These specific categories are listed below:

- Chemical-specific requirements
- Location-specific requirements
- Performance, design, or other action-specific requirements.
- To be considered

The alternatives, except for Alternatives 1N and 1S, would comply with all ARARs though the use of standard engineering and waste management techniques.

Chemical Specific

Chemical-specific ARARs are typically the environmental laws or standards that result in establishment of health- or risk-based numerical values. Chemical specific ARARs include Clean Water Act (CWA) criteria and State water quality and waste standards. Final chemical-specific remediation standards for this site are primarily based on risk calculations, not on ARARs drawn from other environmental statutes.

Section 303 and 304 of the Clean Water Act and Texas Surface Water Quality Standards - Section 303 of the CWA requires states to promulgate standards for the protection of water quality based on Federal water quality criteria. Federal water quality criteria are established pursuant to Section 304. Texas Surface Water Quality Standards are relevant to the evaluation of short-term and long-term effectiveness of the remedial alternatives.

Section 401 Water Quality Certification of the Clean Water Act as Administered by Texas - Section 401 requires that the applicant for Federal permits obtain certification from the appropriate State agency that the action to be permitted will comply with State water quality standards. Although environmental permits are not required for on-site CERCLA response actions, the selected remedy will incorporate elements to comply with State water quality standards. Consultation with the TCEQ may be necessary to confirm that the final design of the selected alternative meets the substantive requirements of Section 401 of the CWA.

Section 404 and 404 (b)(1) of the Clean Water Act - Section 404 requires that discharges of fill to waters of the United States serve the public interest. In selecting a remedial alternative including discharge of fill, EPA would be required to make the determination that the placement of materials into the San Jacinto River serves the public interest as necessary to remediate source material from within the EPA's Preliminary Site Perimeter. The area within the EPA's Preliminary Site Perimeter includes wetlands in the area north of I-10, and a plan will need to be established that addresses the requirements (to the extent practicable) of Section 404 and 404(b)(1).

Location Specific

Location-specific ARARs include restrictions placed on concentrations of hazardous substances or the implementation of certain types of activities based on the location of a site. Some examples of specific locations include floodplains, wetlands, historic places, land use zones, and sensitive habitats. Location-specific ARARs include the Rivers and Harbors Act, Coastal Zone Management Act, and Federal Emergency Management Agency/National Flood Insurance Program regulations.

Rivers and Harbor Act and Texas State Code Obstructions to Navigation - The site is within a navigable waterway, and the State of Texas regulates the obstruction of navigable waters within the State involving the construction of structures, facilities, and bridges or removal and placement of trees that would obstruct navigation (Riddell 2004). The State of Texas considers land within the bed and banks of rivers to be public and requires access for the public to such areas. With the exception of the TCRA Site, which is required to be restricted to minimize the potential for disturbance of the armored cap by vehicular traffic or vandalism, the remedial alternatives will not limit public access. Documentation of compliance with this ARAR would entail documenting, with State concurrence, the extent to which a remedial alternative would affect navigability of the San Jacinto River in the vicinity of the site.

Coastal Zone Management Act and Texas Coastal Management Plan - Federal agency activities that have reasonably foreseeable effects on any land or water use or natural resource of the coastal zone (also referred to as coastal uses or resources and coastal effects) must be consistent to the maximum extent practicable with the enforceable policies of a coastal State's Federally approved coastal management program (National Oceanic and Atmospheric Administration 2010). The Texas General Land Office administers the Texas Coastal Management Consistency certification process.

Action Specific

The action-specific ARARs are generally technology or activity-based limitations or guidelines for management of pollutants, contaminants, or hazardous wastes. These ARARs are triggered by the type of remedial activity selected to achieve the RAO and these requirements may indicate how the potential alternative must be achieved. Action-specific ARARs include CWA water quality certifications (Section 401) and discharges of dredged and fill material (Section 404), Clean Air Act, Endangered Species Act, and other wildlife protection acts.

Texas Pollutant Discharge Elimination System - Within the State of Texas, the National Pollutant Discharge Elimination System, which demonstrates compliance with Section 402 of the CWA, is administered by TCEQ and referred to as Texas Pollutant Discharge Elimination System. A Storm Water Pollution Prevention Plan in accordance with the general permit requirements of TXR150000 (permit for construction activities) will need to be prepared.

Noise Control Act - Noise abatement may be required if actions are identified as a public nuisance. Due to the TCRA Site being bounded by water on three sides and adjacent to a highway overpass on the fourth side and the industrial activities in the area south of the I-10, noise from the construction activity is unlikely to constitute a public nuisance. If necessary, BMPs would be implemented to reduce the noise levels. If materials are delivered to or removed from the project area by truck, noise greater than 60 decibels in close proximity to sensitive receptors (schools, residential areas, hospitals, and nursing homes) will be avoided. Truck routes will be selected to avoid sensitive receptors to the extent possible.

Hazardous Materials Transportation and Waste Management - The Selected Remedy includes removal and transportation of waste material to an off-site disposal facility. Off-site disposal would also be required for limited quantities of waste, such as used personal protective equipment and any debris or vegetated materials required to be removed during clearing and grading activities, associated with all of the remedial alternatives except for no further action. The contractor will be required to package any hazardous materials in appropriate containers and label containers in accordance with TxDOT requirements. The development of remedial alternatives anticipates that all disposal will be at a permitted landfill facility. If an off-site facility needs to be established for dewatering sediment or transloading waste from barges to trucks or rail cars, it may require a solid waste permit.

To-be-considered (TBC)

TBC criteria are non-promulgated, non-enforceable guidelines, or criteria that may be useful for developing a remedial action or that are necessary for evaluating what is protective to human health and/or the environment. Examples of TBC criteria include EPA drinking water health advisories, reference doses, and cancer slope factors.

Regulations of Harris County, Texas for Floodplain Management ("Harris County Floodplain Regulations") - are local government regulations which are not ARARs, but the EPA has determined that these regulations are to be considered as part of the remedy selection process as they address specifically construction issues within the San Jacinto River. Under the Harris County Floodplain Regulations, any permanent structure created at the Site could be considered a "Critical Facility" because it stores hazardous materials. Pursuant to Section 4.05 of the Harris County Floodplain Regulations, "[c]onstruction of critical facilities shall be, to the extent possible, located outside the limits of the 0.2% floodplain or 500-year floodplain." Construction of new critical facilities in these areas is permissible "if no feasible alternative site is available," with additional requirements for such construction (Section 4.05(d) of the Harris County Floodplain Regulations). Section 4.05(m) of the Harris County Floodplain Regulations contains additional requirements for development within floodways, with specific requirements for construction of structures within the San Jacinto River floodway. The reason stated for the San Jacinto specific requirements is that the foundations of structures within the floodway "have been determined to be prone to scour." Section 4.05(m)(4). The foundations system in the San Jacinto River floodway must extend to a depth below the maximum potential scour (assumed to be as great as ten (10) feet below natural grade) that is adequate to prevent excessive vertical and horizontal movement of the foundation system due to design axial and lateral loads imposed during flood conditions.

A complete listing of ARARs and TBCs can be found at Table 29.

Cost Effectiveness

The Selected Remedy is cost-effective and represents a reasonable value for the costs incurred. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness" (40 CFR 300.430(f)(1)(ii)(D)). EPA evaluated the "overall effectiveness" of those alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and ARAR-compliant) by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost-effectiveness.

For Alternative 3aN, the net present worth for Alternative 3aN is $24.8 million based on a 7% discount rate and 30-years of operation and maintenance costs in accordance with EPA policy.

For Alternative 6N, the cost estimate has been modified somewhat in response to the public comments, namely to employ the use of a cofferdam and to perform the excavation in the "dry" so that no material release is expected during the removal. These conditions are for the cost estimate only because the actual Best Management Practices (BMPs) to be employed will be determined during the Remedial Design. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. The cost estimate was further modified to include costs for the additional excavation required (about 10,000 cubic-yards) associated with lowering the cleanup level from 200 ng/kg as presented in the Proposed Plan to 30 ng/kg. Based on the additional capital cost for a cofferdam and additional excavation volume, the net present worth for Alternative 6N is $105 million.

Although the costs for Alternative 6N are higher than those for the other alternatives, a comparison of the overall effectiveness (evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness)) to the cost of each alternative lead to the determination that Alternative 6N is more cost-effective.

Removal of waste under Alternative 6N will eliminate the potential for the costs associated with cleaning up a large contaminated sediment site that may result from a failure of a cap, and will eliminate the potential for future environmental and human health impacts should a release occur. The history of the need for repeated cap repairs, the exposure of waste materials, the riverbed erosion that occurred adjacent to the cap, all of which occurred during storms with much less intensity than the hurricanes to which the area is prone, do not support capping as a cost-effective remedy. It should be further noted that the recent occurrence of Hurricane Harvey did not impact the Site with storm surge or wind driven waves typical of hurricanes. Storm surge and hurricane wind driven waves create more extensive damage than flooding alone. This is shown by a comparison of the 2016 modelling done by the Corps of Engineers for flood conditions similar to the 1994 flood, as opposed to the USACE modelling for both storm and hurricane conditions (equivalent to both the 1994 flood and Hurricane Ike occurring together).

The enhanced capping of the waste may be less expensive and less disruptive in the short-term, but it also results in less protection of human health and the environment for the long-term. Cap failure due to severe or extreme storm events or a lack of sustained effective maintenance would result in the release of the dioxin contaminated waste from the site.

Given the position of the Site in the San Jacinto River, the frequent storms, and the history of repeated damage to the cap, O&M of the cap is likely to be required even beyond the normal 30-year period that is the estimate for most capped sites. The true cost of a capping remedy at this Site may be significantly larger than expected.

The Selected Remedy, removal of the waste pits, is protective of human health and the environment, complies with applicable or relevant and appropriate requirements, and provides the best balance of tradeoffs among the balancing criteria. It reduces risks within a reasonable time frame, provides for long-term reliability of the remedy, and minimizes reliance on institutional controls. It will achieve substantial risk reduction by removing the contaminated materials, unlike capping, which would always be susceptible to a future release following a severe storm event, or due to a failure of maintenance over a period of centuries. The selected remedy is also cost-effective because its costs are proportional to its overall effectiveness, with overall effectiveness being determined by an evaluation of its long term effectiveness and permanence, reduction in toxicity, mobility or volume through treatment, and short-term effectiveness.

For the Sand Separation Area, MNR was selected due to a combination of lower dioxin concentrations (more than 100 times lower dioxin concentration than the northern impoundments) and data indicating that the area is subject to sediment deposition. For these reasons, MNR is the more cost-effective than excavation in this area of the site.

Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable

EPA has determined that the Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the site. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA has determined that the Selected Remedy provides the best balance of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element and bias against off-site treatment and disposal and considering State and community acceptance.

Preference for Treatment as a Principal Element

The NCP establishes the expectation that treatment will be used to address the principal threats posed by a site whenever practicable, (40 CFR 300.430[a] [1] [iii] [A]). In general, Principal Threat Wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be contained in a reliable manner, or will present a significant risk to human health or the environment should exposure occur. The Selected Remedy satisfies the statutory preference for treatment as an element of the remedy. Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during the remediation will be tested to comply with the applicable requirements. Treatment of a portion of the paper mill waste by solidification with cement was successfully performed during the Time Critical Removal Action (TCRA) on a portion of the Western Cell materials. Several in-situ treatment technologies were considered during the Feasibility Study, but were ruled out as either being not practical given the site location and conditions, or not commercially available.

Five-Year Review Requirements

Because this remedy will result in hazardous substances remaining on-site in the Sand Separation Area and the Southern Impoundment above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

2.14 DOCUMENTATION OF SIGNIFICANT CHANGES

To fulfill CERCLA §117(b) and NCP §§300.430(f)(5)(iii)(B) and 300.430(f)(3)(ii)(A), the ROD must document and discuss the reasons for any significant changes made to the Selected Remedy. Changes described in this section are limited to those that could have been reasonably anticipated by the public from the time the Proposed Plan and RI/FS Report were released for public comment to the final selection of the remedy. Changes that could not have been anticipated require an additional public comment period. The Administrative Record for the site contains documents supporting these changes.

The Proposed Plan for the San Jacinto Waste Pits Site was released for public comment on September 29, 2016. The Proposed Plan identified FS Alternative 6N, removal of materials exceeding the sediment cleanup goal, as the Preferred Alternative for impoundments north of I-10. The Proposed Plan also identified Alternative 4S, removal of materials exceeding soil cleanup goals to a depth of 10 feet below grade, as the Preferred Alternative for the impoundment south of I-10. During the public comment period, new information indicated that the following changes are appropriate:

- Commenters requested that EPA consider the use of additional Best Management Practices to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the “dry” to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.

- Commenters requested that EPA utilize a clean-up goal of 30 ng/kg for the northern waste pits instead of the 200 ng/kg presented in the Proposed Plan. The EPA adopted the 30 ng/kg clean-up goal for the northern waste pits because it is protective of the child fisherman exposure scenario used for the rest of the San Jacinto River; it would not require the placement of a residuals cover with questionable effectiveness given the history of cap damage and need for repairs following the installation of the temporary cap; maintenance would not be required; and because institutional controls would not be required for the northern waste pit area. Further, lowering the clean-up goal from 200 ng/kg to 30 ng/kg resulted in a removal of an additional 10,000 cubic yards of waste material which equates to an estimated 7% increase in removal volume.

- These changes resulted in the cost for Alternative 6N increasing from $87 million to $ 105 million, or about 21%.

PART 3: RESPONSIVENESS SUMMARY

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San Jacinto River Waste Pits Superfund Site Responsiveness Summary

1. Introduction

As required by CERCLA § 117 and the NCP at 40 C.F.R. §§ 300.430(f)(3)(i)(F) and 300.430(f)(5)(iii)(B), the Responsiveness Summary provides information about the views of the public regarding both EPA's Preferred Alternative and other remedial alternatives presented in the September 2016 Proposed Plan as well as general concerns about the Site. EPA solicited comments on the Proposed Plan and established a 60-day public comment period. EPA held a public meeting, attended by 340 citizens on October 20, 2016, where comments, questions, and recommendations were recorded. The EPA then extended the comment period an additional 45 days. The official public comment period ended on January 12, 2017. Extensive comments were received in varying formats, including mail, online, and email, as well as verbal during the public meeting. The Responsiveness Summary also presents EPA's response to these comments. The summary further documents, in the record, how comments were integrated into EPA's decision-making process. Any comments received after January 12, 2017 are included in EPA's Administrative Record for the Site, however, EPA did not consider these comments because they were submitted after the close of the comment period. Therefore, EPA has not provided responses to the late comments as part of this Responsiveness Summary.

EPA received over 7,000 individual comments on the Proposed Plan and 48,000 signatures on various petitions. Because of numerous duplicated and similar-issue comments, the comments have been organized into six categories. In consolidating the comments, EPA thoroughly reviewed every comment submitted to ensure that the summary comments captured every stakeholder concern.

The categories of public comments are as follows:
2.1 – Support for Removal
2.2 – Support for Cap Containment
2.3 – Risk Assessment
2.4 – Policy
2.5 – Cap Characteristics
2.6 – San Jacinto River Characteristics

2 Comments from the Public and Responses

This following sections provide a summary of comments received during the public comment period and responses to those comments. As discussed above, the Responsiveness Summary breaks out comments into the following sections

2.1 – Support for Removal
2.2 – Support for Cap Containment
2.3 – Risk Assessment
2.4 – Policy
2.5 – Cap Characteristics
2.6 – San Jacinto River Characteristics

2.1 Support for Removal

EPA received over 7,000 written comments and 48,000 signatures on petitions from individuals in the surrounding communities, various regions of the United States, foreign countries, school age children, elected officials, industry, industry associations, and non-governmental organizations. The comments from local residents generally support removal and off-site disposal, with over 94% of the comments received during the comment period voicing support for removal of the waste material.

The most common comment was that removal of the waste would have a long-term positive effect on the surrounding communities and the San Jacinto River. Commenters expressed concern that a permanent cap could be breached in the future and the wastes beneath the cap released as a result of hurricanes and flooding. The following comments cover the range of comments received.

2.1.1 Comment: The EPA's Preferred Remedy is the only method to ensure the residents of our county and region are protected, long-term, from the dioxin and other chemicals in this Site. Significantly, this EPA proposed plan for removal has unanimous local bi-partisan Congressional support.

Response: *EPA appreciates the support of Harris County and the Congressional members. In addition, removal of the source waste will eliminate the potential for a release to the environment and prevent the Site from becoming a large contaminated sediment site.*

2.1.2 Comment: Keeping the dioxin under a cap would continue to endanger all communities affected by the river and Bay waters. The temporary cap has failed repeatedly with a large hole discovered last December. The maintenance and repair program that was part of the Time Critical Removal Action did not ensure containment within the cap and a sample containing a staggering level of the most dangerous dioxin was found outside the cap immediately after the hole was discovered. The cap failed. Let me repeat myself – the cap failed.

Response: *Documented events have shown that the current cap has suffered repeated damages and deficiencies from floods that were less than a 100-year flood event, even though the northern impoundment was designed for a 100-year flood. Since the cap was completed in July 2011, necessary repairs were performed in July 2012, January 2013, January 2014, December 2015, February 2016, March 2016, and June 2016 since its completion in July 2011. The goal of the selected removal alternative is to eliminate the potential of an enhanced cap being breached and releasing contaminated material into the environment.*

2.1.3 Comment: Beyond the current problems, the current cap or a permanent cap can be severely damaged if it were hit by a barge or torn open by a major storm. The damage that would result could pollute the San Jacinto River and Galveston Bay for the next 700 years. The US Army Corps of Engineers analysis concludes that a strike will eventually occur. This failure is not a matter of "if"' but "when." The potential pollution is almost too big to comprehend. If we leave the waste in place, we could have a severely polluted river and bay for the next 7 centuries.

Response: *The US Army Corps of Engineers does report that barge strikes can pose the potential for contaminant loss. The predicted contaminant loss is low but EPA is concerned with any loss no matter the size. The US Army Corps of Engineers report is for one barge strike when there is the potential for simultaneous multiple barge strikes based on the number of barges staged upstream in proximity to the Site. The removal of the waste as identified under Alternative 6N will eliminate the concern of a release associated with a barge strike and will be more protective in the long-term.*

2.1.4 Comment: I think the only reasonable solution to the dioxin placed in the San Jacinto River between Highlands and Channelview is total removal. That is the only way that we can ensure that future generations of kindergarteners are not exposed to this poison.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.5 Comment: When Hurricane Ike struck there were barges on top of I-10. The barges were removed. Can you imagine huge barges floating on I-10? The wind and force were so severe that a person who lived across the river on the far bank adjacent to the waste Site is still looking for his grand piano. This is a story of the force of nature in this area for those who live far away. To think we have waste under a rock in this pathway is beyond belief.

Response: *The overwhelming majority of received comments agree that the removal of the waste pits is the most responsible remedy for long-term health of surround communities and the environment. EPA is also very concerned about the potential extreme weather conditions be it flooding or hurricane events.*

2.1.6 Comment: The health effects have been heartbreaking. Every female my age in the neighborhood we grew up in is dead of cancer. These women were under 65 years of age. These are good, law abiding, very hard working citizens of this area. They deserved more. To see the warning signs of contaminated fish can bring a tear. What is worse is to see families with small children fishing with these contaminated fish signs literally under their cooler. These caught contaminated fish are being placed in coolers. If approached they say with embarrassment "we are not eating them". Then why the coolers? Then to see small children swimming and wading in waste water areas from the river is shocking. Children swimming in dioxin laced water in the state of Texas is again a disgrace, beyond belief. Barge workers working with chains from the river are being exposed daily for many times 8, 12 or more hours per day. Would you want that done to your family? Good people simply earning a hard living. I am asking you to remove this waste for good, no fixes. Money has been set aside for restoration. What a dream as probably not in my lifetime to see water skiing, swimming and fishing again.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.7 Comment: Restaurants and grocery stores are dependent upon seafood harvested from Galveston Bay, which is also a primary recreational area for greater Houston. It is incomprehensible that the EPA would allow these waste pits to continue to pollute this vital natural resource. This dangerous environmental problem has gone on far too long. These pits must be properly cleaned up as soon as possible (and not capped), without any further extensions.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.8 Comment: My correspondence today it to bring to light some very important topics that can be seen by anyone honestly looking at the Site, meaning you do not need a college degree, PhD, or Master's Degree to understand the complexities of the toxic dump sight. Removal is the only plausible course of action in trying to rid our homes of this potentially deadly poison.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.9 Comment: Over the years since 2011 there has been a cap placed onto this deadly dump Site, and it has been breached or compromised many times since. That river, just like all rivers is alive, and it is also constantly changing. So by placing any type of "cap" over this Site, is accomplishing nothing more than creating an additional 50 years of maintenance, death, and destruction, leaving to our children and grandchildren the problems of responsibility of this catastrophe, that through actions would not set a good example of responsible stewards for them to follow.

Response: *The Time Critical Removal Action (TCRA) Cap was completed in 2011 and since its completion, documented events have shown that the current cap has suffered repeated damages and deficiencies from floods that were less than a 100-year flood event, even though the northern impoundment was designed for a 100-year flood. Repairs to the cap have been performed in July 2012, January 2013, January 2014, December 2015, February 2016, March*

2016, and June 2016 since its completion in July 2011. The goal of the selected alternative, including removal, is to eliminate the potential of a cap being breached and releasing contaminated material into the environment.

2.1.10 Comment: The very hazardous toxins of the San Jacinto River Waste Pits need to be removed entirely, once and for all.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community. Removal of the source waste will eliminate the potential for a release to the environment and prevent the Site from becoming a large contaminated sediment site.*

2.1.11 Comment: Never in 30 plus years had I heard about toxic waste at the Site. Never once did anyone ever say Waste Pits. No one warned the public. No one ever secured the property to protect the public. It is like they just did not care about the public health or the environment. Just write it off and walk away. Now they want to cover it up and leave it to future generations. What would happen if I were to dump waste in your yard? You would expect me to clean it up. The waste pits are in my back yard; I expect them to clean it up. For over 30 years I recreated in the river with never a thought it could be hazardous to my health. For over 30 years I ate seafood from the river and never thought it would be bad for my health. Never when we rode all-terrain vehicles in the area of the pits did we think it would be hazardous for our health. This problem is not something I want to leave for the future. It needs to be cleaned up as soon as possible. In my opinion there is no other option. It is their mess they need to take care of it. Dig and haul it out of there and dispose of it properly. I fully support the EPA Proposed Remedy of full remediation of the San Jacinto River Waste Pits. There is no way a cap should be used to contain this toxic mess. The people that left the mess are spending big money to promote a cap for containment; the cap there now does not work, why anybody would think they can make one that will safely contain this toxic mess for the life of the dioxins. The idea of just cover it up and everything will be OK is just beyond my belief. Out of sight out of mind I guess is the thinking. What happens when it fails many years down the road and these companies have to be forced to repair a cap. They do not want to do anything now and they are legally being forced to by the EPA. What says they would not do an Enron and file bankruptcy and then who will be on the hook for this mess? If the waste is dug up and hauled off for proper disposal this will never become an issue. This is exactly what we need the EPA to require.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.12 Comment: There has been a permit application for a new barge terminal in the river just upstream from the pits. This terminal will handle many hundreds of barges a month passing by the pits. There already is a serious risk of a barge strike, now with increased travel of future barge traffic, the risk is even greater. This river will eventually be more heavily traveled with tugboats and barges with the expansion of the chemical plants north of the railroad trestle which will mean even more barge traffic. There are just too many risks with leaving the Waste Pits in the river.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community. In addition, EPA does not have regulatory control over the placement of barges in the San Jacinto River. EPA will propose institutional controls to address barge traffic near the Site. These will include restrictions on dredging and anchoring to protect the integrity of the area. EPA anticipates this will be a permanent institutional control. This would apply only if the waste pits are left in place. We can mention that EPA is concerned by any increased barge activity that would cause a release. That is why removal of the waste pits is the best option.*

2.1.13 Comment: My neighbors and I are concerned about the weight of the added material of the cap forcing the toxins out from under any cap or destabilizing the side berms. I am really shocked that there were not soil samples taken from the last scour that had to be repaired. I cannot help but believe there were not any toxins in those holes escaping into the river. When you place anything heavy on mud it pushes out to the side of the weight. The cap as is and any further modification of it is a dangerous idea. There is no way that should be a permanent remedy. We need the EPA to hold the responsible parties to the highest standards.

Response: *EPA shares this concern that the added weight of large rock being placed on top of the permanent cap identified under Alternatives 3N and 3aN increase the risk of subsidence of the cap and the ejection of contaminated waste. This is one of the reasons that EPA has selected the removal of waste as a long-term solution rather than an upgraded cap with no, or partial waste removal.*

2.1.14 Comment: Plans I have seen show three lane feeder street bridges and five main lane bridges in both direction, there is no room for that expansion with the pits remaining in-place.

Response: *EPA discussed potential expansion with the Texas Department of Transportation (TXDOT). There are future plans to expand I-10, but no details were provided. Future I-10 road/bridge expansion and the issues associated with a permanent cap being used may limit the expansion of I-10 if the waste pits are left in place.*

2.1.15 Comment: In my personal opinion the only safe and secure way to take care of the Waste Pits is to fully remediate the Site and haul the toxins to a landfill that is designed to handle them. No way should they be left in the river. To build a coffer dam around the Site and dig it out is safest way to handle this situation. This can be done with best engineering practices without spreading anymore of the toxins than already have been. I understand the responsible parties are against this, they want the cheaper and less effective solution. They are there to make a profit and keep the stock holders happy and spending $100,000,000 or more to clean it up will hurt the bottom line. The cap they have now has needed many repairs over the 5-year life of it, how many repairs will it need in the life of a permanent cap? In 1994 the flood waters pushed over the east bound I-10 bridge, how well will that cap survive that kind of flood? I don’t want to see what happens. I want it cleaned up and out of the river completely.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.16 Comment: Please remove the waste pits, capping is not the answer.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.17 Comment: The temporary cap in place continues to be problematic, with repairs being required in 2012, 2013, 2015, and 2016 along with the recent discovery of an eight-foot area of degradation found in July of 2016 as noted in the Anchor QEA report. This history of repeated compromises is more than upkeep inherent with the cap as the owners would like us to believe.

Response: *The responsible parties have continually indicated that the current cap is designed for a 100-year flood event but since its completion, the cap has required repeated repairs during flood events below the 100-year flood level. The EPA believes that a capping system without removal of the waste material will continue to be a maintenance issue and the repeated repairs of a damaged cap can lead to the release of the waste material into the river and surrounding environment.*

2.1.18 Comment: The location of the pits makes it a ticking time bomb to destruction by storm surge as it lies in a tidally influenced waterway. The Severe Storm Prediction Education and Evacuation from Disasters (SSPEED) organization's annual report demonstrates that it is only a matter of time before the area that the Site exists on is inundated from storm surge again and the Site is compromised even further.

Response: *The overwhelming majority of received comments agree that the removal of the waste pits is the most responsible remedy for the long-term health of surrounding communities and the environment. EPA is also very concerned about the potential extreme weather conditions be it flooding or hurricane events.*

2.1.19 Comment: Ensuring proper safeguards are in place and removal with best engineering practices is no doubt feasible. In fact, it has been completed successfully at other sites to date. With proper planning and third party oversight of the removal operation it can be a success.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.20 Comment: I fully support and recommend the EPA's proposed plan of Alternatives 6N and 4S for the North and South pits, respectively.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.21 Comment: I have been involved with a lot of decades old pits, landfills and other efforts to store waste in a geologic environment. This Site is one of the most vulnerable storage attempts that I have seen. Geologists and engineers plan a pit, or landfill, to encapsulate waste in a stable environment, the waste is kept dry and any accumulated leachate is drained through a collection system—and to assure stability, the situation is monitored in several ways. Federal and Texas regulations would not permit the least innocuous garbage dump at this Site, much less this leak-prone, dioxin laden accident waiting to happen. Your investigations at the Site have consistently shown that this containment, immersed in the water of Galveston Bay, leaks—and repeated attempts to repair even the surface cover have failed.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.22 Comment: This Site is particularly vulnerable in several ways related to its location in the upper part of Galveston Bay where it is subject to both hurricane surge and San Jacinto River flooding. Regardless of whether or not these projects are ever accomplished, the fact remains that the San Jacinto Waste Pits Site is at the upper end focus of hurricane surge effects in Galveston Bay—a fundamental reason that your recommendation to remove the waste is wise.

Response: *The overwhelming majority of received comments agree that the removal of the waste pits is the most responsible remedy for long-term health of the environment and communities. EPA is also very concerned about the potential extreme weather conditions be it flooding or hurricane events.*

2.1.23 Comment: I would like for the EPA to mandate and oversee the complete removal and destruction of the dioxin. Apparently, there is a process for destroying the dioxin. This deadly toxic bi-product should not be pushed off into someone else's back yard or made the responsibility of someone else's grandchildren as it has been handed to us.

Response: *The final management and disposition of the removed waste will be fully developed in the Remedial Design phase. Excavated waste material would be dewatered (decanted) and stabilized by addition of Portland cement or other additive, as necessary, to eliminate free liquids for transportation and disposal. Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during the remediation will be tested to comply with the applicable requirements. Material that is removed would be transported in compliance with applicable requirements and permanently managed in an approved permitted facility in accordance with the Environmental Protection Agency's offsite rule.*

2.1.24 Comment: The efforts to clean our waters are working. I've never seen the water on our beaches this clear before. Now it's time to move inward, focusing on the removal of chemicals, waste havens, and businesses focused on dumping in our lakes and rivers. Let it be known that I believe removal is the only option.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.25 Comment: There is flooding during tropical storms and hurricanes which would damage the toxic pit. The residents with wells have had to use bottled water for months. There are warning signs not to eat the seafood from the river. It's time to completely remove the toxic waste.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.26 Comment: Please remove the pits. Every time it floods it leaks and we are put in further danger. The responsible parties could not, would not, manage this Site responsibly for decades, can they be trusted to manage it for centuries to come?

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.27 Comment: Remove these waste pits from our area. This is not an acceptable way to treat waste, and it is clear the cap is not working and has failed. It will continue to fail and pollute the environment. We cannot continue to allow this to happen.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.28 Comment: I believe that removal of the waste from the San Jacinto waste pits is the only solution that will be permanent in the long run. As a resident of this area, I have seen firsthand the damage that can be caused by the floods and hurricanes that this area is regularly subjected to. Capping the pits will not work as no amount of planning or design will ever be able to account for everything that nature can cause over the long run. Engineering failures occur often when attempting to protect against the effects of nature as was catastrophically demonstrated when the levees in New Orleans failed during Hurricane Katrina, and, as some residents of the area will recall, the Fred Hartman Bridge had to be shut down for emergency repairs soon after opening due some of the cables snapping off from the combined effects of drizzle and a light breeze that none of the designers had thought could pose a problem.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.29 Comment: Leaving the waste in place will eventually result in a breach that would release far more toxins and do more damage to the environment than any attempt at removal could. I swam in the river and lived along the river. As a young person that suffered miscarriages and myself being born with a congenital heart defect, it is pathetic that this type of horrible deceit occurred in America. Personally, I am appalled that there is any other idea than a thorough removal and cleanup of the River and waste pit Site. If it costs 1 billion dollars to do it, so be it. The River should be cleaned and the waste removed. Everyone involved in the tragic contamination should be held accountable.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.30 Comment: Please remove the pits completely. This is the only sensible and permanent solution. This river and bay is Houston's natural playground, we do not have mountains, or white sandy beaches. We have the San Jacinto River and Galveston Bay for fishing and swimming and boating. Please for my kids' sake do the right thing and remove the waste. I am a geologist and the only thing Gulf Coast rivers know to do is to meander and move, they change direction and they cannot do otherwise. Time will see the river expose any waste pits left in the ground. The evidence for this exists underfoot in every direction you walk on the coastal plain. Complete removal is the only option available for anyone thoughtful about the environment.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.31 Comment: I support full removal of the toxins as it is the only pathway to restoring faith in water quality of our water wells; to insuring future generations of a resolved issue; and to maintaining future property values. Your continued support of complete removal is very much appreciated by all of the families who depend on water wells for our water source.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community. Removal of the source waste will eliminate the potential for a release to the environment and prevent the Site from becoming a large contaminated sediment site.*

2.1.32 Comment: Galveston Bay and its tributaries have suffered due to the release of dioxin from this Site and the major carcinogenic toxin threat continues today, with apparently growing risk through cap damage and the continual threat of barge traffic, rough and rapid river flood conditions, tropical storm surge waters, and hurricanes. Those who consume regional seafood face a clear and present danger to their health due to the presence of dioxin at dangerous levels in fish and crab in the parts of the Bay, the San Jacinto River, Buffalo Bayou/Houston Ship Channel and associated tidal waters. This source of dioxin needs to be removed so it no longer poses this significantly dangerous health threat to our region. Trying to cap the wastes in this location has already proven to be a very ineffective method, with multiple and extensive failures of this cap method from the initial installation through current inspections. The location is simply unsuitable for this method of simply trying to cap the highly carcinogenic waste materials at this location.

Response: *The responsible parties have continually indicated the current cap is designed for a 100-year flood event but since its completion, the cap has had integrity issues during flood events below the 100-year flood level. EPA believes that a capping system without removal of the waste material will continue to be a maintenance issue and the repeated repair of damage can lead to the potential for a release of the waste material into the river and surrounding environment.*

2.1.33 Comment: The EPA's own Guidance for In-Situ Subaqueous Capping of Contaminated Sediments states that low-level, dioxin-bearing wastes can be capped and isolated in a low energy environment such as a protected harbor or low flow stream. The wastes in this pit are not low-level, and the San Jacinto River is not low energy, protected, or low flow. No one should try to permanently retain a persistent, toxic chemical, in a river, in this sort of environment. Keeping this waste contained would be a constant battle against the forces of nature, with continually cap failures and increased toxin leaks as have been documented via recent inspections at continually alarming numbers and frequency of findings.

Response: *The dioxin at the site is source material at very high concentrations and considered Principal Threat Waste. The San Jacinto River and the location of the pits is not located in a low energy environment. The San Jacinto River is dynamic and has been documented to abruptly change its flow paths. This has been dramatically shown after the 1994 flood by the creation of new channels and riverbank erosion. In addition, bottom currents can generate shear stresses that can act on the cap surface and may potentially erode the cap. In addition to ambient currents due to normal riverine or tidal flows, effects of storm-induced waves and other episodic events can act on the structural integrity of a cap. The selected alternatives remove the waste from the river and eliminates the potential for a release from a containment cap which will be subject to the forces of the river and weather events.*

The responsible parties have continually indicated the current cap is designed for a 100-year flood event but since its completion, it has had integrity issues during flood events below the 100-year flood level. EPA believes that a capping system without removal of the waste material will continue to be a maintenance issue and the repeated repair of damage can lead to the release of the waste material into the river and surrounding environment.

2.1.34 Comment: Hurricanes strike, floods rage, streams change course, waters rise, land sinks, and sediment moves will continue over time. This toxic contamination problem is ours to solve now, not one to pass on to our grandchildren. We have seen failures of too many man-made structures over much shorter periods to trust this cap as a long-term viable solution, when it has in fact already failed repeatedly, leaking toxins possibly for years, until inspections have found and hopefully repaired the continual damage points.

Response: *The overwhelming majority of received comments agree that the removal of the waste pits is the most responsible remedy for long-term health of the surrounding communities and the environment. EPA is also very concerned about the potential extreme weather conditions be it flooding or hurricane events. The responsible parties have continually indicated that the current cap is designed for a 100-year flood event but since its completion, the cap has had structural integrity issues during flood events below the 100-year flood level. EPA believes that a capping system without removal of the waste material will continue to be a maintenance issue and the repeated repair of damage can lead to the release of the waste material into the river and surrounding environment.*

2.1.35 Comment: Neither of the original companies responsible for disposing of waste at this location exist 50 years after initial placement of the waste. So, we have to ask, who will repair this cap up to 500 years from now? Will we place the burden on future taxpayers? The cap, purportedly designed to withstand a 100-year flood, has had repeated problems in the short 5 years it has been in place. Despite these problems, those responsible now want to convince EPA that they can make the cap permanent by adding more rock. Instead of forcing future generations to deal with this mess, we need to take care of it now. Methods to safely remove the waste from the Site exist today, and safe removal of dioxin and other persistent organic pollutants has been successfully completed at other sites in the country, e.g. Cumberland Bay, Lake Champlain, Plattsburgh, NY; Housatonic River ½ Mile and 1½ Mile sections, Pittsfield, MA; and Lower Passaic River Phase I, near Newark NJ. Just like in those locations, we can solve this problem on the San Jacinto River right now.

Response: *The responsible parties have continually indicated the current cap is designed for a 100-year flood event but since its completion, the cap has had integrity issues during flood events below the 100-year flood level. EPA believes that a capping system without removal of the waste material will continue to be a maintenance issue and the repeated repair of damage can lead to the release of the waste material into the river and surrounding environment. The removal of the waste material from the Site can be performed successfully through implemented best management practices and EPA oversight of construction activities.*

2.1.36 Comment: The companies argue that removing the waste from the Site is riskier than capping it in place. This is true if one uses the inadequate technology they analyzed in their risk assessment. We believe that by using the best available technology, e.g. cofferdams and sheet piling, the waste can be isolated from the river and safely removed, eliminating the problem for all time.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

2.1.37 Comment: I support the U.S. Environmental Protection Agency proposed removing the deadly dioxin-contaminated wastes from the San Jacinto River Waste Pits Superfund Site because removal is the only correct and permanent cleanup solution. Floods and hurricanes are common occurrences along the Texas Gulf coast and the only way to stop the seepage into Galveston Bay and the Gulf is to remove these poisons permanently. Seafood is harvested from the bay for human consumption. These toxins are not only a health hazard but also a disaster for commercial fishing and recreation industries. Please clean it up and out once and for all. Do not delay.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.38 Comment: I am in agreement with the EPA proposal to remove the contaminated soils. I am not in favor of further 'band aiding' this issue with remedies that will be subject to leaking or failure during floods, and removal should have been the option chosen several years ago. In reference to the southern plan, will there be a cofferdam or berms installed on the southern portion for dewatering and the removal of the soil? Also, the 19-month duration will expose potential for flooding; what precautions will be taken?

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

2.1.39 Comment: I agree with the proposed plan of full removal. I believe this is the best option that will protect our environment and the people in our community. This is long overdue, and the time is now to protect ourselves and future generations. Responsible parties should clean up the mess so that people will not have to suffer from higher cancer rates and health issues as a result of the toxic dioxin sludge just sitting in the river and contaminating the land and people in the area. Please take this seriously and understand that this is affecting people's lives. It's time to end this cycle and properly remove the waste from the San Jacinto River. We will continue to ensure this happens.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.40 Comment: My water source is a shallow well, only 50 feet deep, situated 32 feet above sea level. My water is pumped from the sediment layer only 20 feet below the Site, and not a deep aquifer. I used to fish and boat in the river until learning of the contamination. Now I am scared to even shower in this water, much less drink it. I still to this day see people fishing in the river on a daily basis even with all the warning signs in place. I feel it is imperative that the wastes be removed completely as the temporary cap has proven ineffective since implemented. I do not foresee this temporary cap lasting as long as the lifespan of the dioxins buried and abandoned in the river. The costs of maintaining and monitoring the cap for the next 750 years cannot be less than full removal. Living in this community for such a time, I have seen firsthand the ill effects on health in the people that live here. Many are sick, and many have died. I ask for full removal of the toxic waste pits.

Response: *Sampling has indicated that Site contaminants have not impacted drinking water supplies; removal of the source wastes will prevent any possible future contamination from occurring.*

2.1.41 Comment: I totally support the proposed Cleanup Plan for the San Jacinto Waste Pits. I am a "downstream" resident and feel very strongly that this is the correct course of action. Just covering the Site simply pushes the problem to future generations. Keep up the good work!

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.42 Comment: I support the removal of all waste sites. We need these cleaned up so that the river may have a chance to heal. I understand there is risk involved but there is high risk involved in leaving them where they are as well. We must attempt to correct this dangerous error.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.43 Comment: I support the Proposed Plan which selects Alternatives 6N (northern waste pit) and 4S (southern waste pit) to remove these toxic wastes period and that uses the recreational fisher dioxin sediment limit of 30 ng/kg as the risk-based remediation goal to remove contaminated material.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community. EPA is adopting the 30 ng/kg level for the northern waste pits, but the southern impoundment will remain at 240 ng/kg. The sediment cleanup level of 30 ng/kg for the northern pits was developed for protecting human health of the most vulnerable potentially exposed group or individual of the community. In this case a recreational child fisher was assumed to get exposed to contaminated sediment through incidental ingestion, dermal contact, and from the ingestion of fish/shellfish. The EPA is adopting a 30 ng/kg remediation level for the waste pits instead of the 200 ng/kg level presented in the Proposed Plan for several reasons. First, after removal the waste pits area will be in direct connection with the river and will be subject to the same potential exposure routes as the river sediment, which has a 30 ng/kg remediation level. Further, adopting something higher than 30 ng/kg for the waste pits area would require a protective cover over the residual materials; however, this cover would be subject to the same erosive forces that raised concerns about a permanent cap for containment of the entire waste pits area. Finally, adoption of the 30 ng/kg remediation level would negate the need to long term monitoring and maintenance of the waste pit area.*

The 240 ng/kg cleanup level applies to waste material and sub-surface soil for the Southern Impoundment and was only based on incidental ingestion and dermal contact. In this case a construction worker was assumed to get exposed to contaminated sub-surface soils in the area during construction activities.

2.1.44 Comment: In my opinion the waste pits were a flawed design from their inception. Who in their right mind would ever place a toxic waste dump on the banks of a flowing river anyway? But that now has become a moot point, the question now is what do we do with it? Obviously, it is still on a flowing river bank and it will continue to leak poison into our water for the next 50 to 100 years, no matter what stop-gap measures are taken in the interim. Unless we want to continue the flawed logic of the original decision. We must remove it totally, completely and immediately.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.45 Comment: I support the EPA's plan to completely remove the dioxin-contaminated materials from the San Jacinto River Waste Pits Superfund Site in Galveston Bay. The proposed plan will secure the long-term health of Galveston Bay and its many residents for generations to come. Thank you in advance for carefully analyzing the scientific evidence, reviewing historical documentation and heeding the community's overwhelming cry to eliminate this threat from Galveston Bay. Removing this threat says we are serious stewards of our state. It removes a dangerous source of toxins from potentially contaminating our entire Galveston bay and destroying the fishing, seafood and tourist based economy it supports. This Site has been a problem since I was a kid. It is time to stop ignoring it and get rid of it now.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.46 Comment: I support the EPA's plan to completely remove the dioxin-contaminated materials from the San Jacinto River Waste Pits Superfund Site in Galveston Bay. Few estuaries on the coast of the south 48 states of the United States were as productive of marine life or provided comparable habitat. It has been abused for many years. The crowning blow would be a hurricane which loosen the contents of the waste pits into the San Jacinto. The Proposed Plan will secure the long-term health of Galveston Bay and its many residents for generations to come. Thank you in advance for carefully analyzing the scientific evidence, reviewing historical documentation and heeding the community's overwhelming cry to eliminate this threat from Galveston Bay.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.47 Comment: I support the EPA's plan to completely remove the dioxin-contaminated materials from the San Jacinto River Waste Pits Superfund Site in Galveston Bay. The proposed plan will secure the long-term health of Galveston Bay and its many residents for generations to come. I believe that the total removal of waste will allow both pregnant women and children to be able to eat fish caught in this area without the fear of getting cancer.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community. Removal of the waste pits will remove a significant potential source of dioxin from the river. However, the San Jacinto River fish advisory is in place for other contaminants besides dioxin; specifically polychlorinated biphenyls (PCBs) (Texas Department of State Health Services, 2015). Furthermore, the University of Houston identified multiple other sources of contaminants in addition to the Site (University of Houston, December 2009).*

2.1.48 Comment: I was a resident of Smith Point for 21 years 1995-2015 and saw how the majority of people weren't aware of consumption guidelines. They are completely ineffective.

Response: *EPA in cooperation with other Federal, State, and local agencies have tried diligently to provide notice to communities in the surrounding areas concerning the fish consumption guidelines. This has been done through signage on and around the Site, public outreach literature, and through community meetings. It is EPA's and the State of Texas's intention to reach as many people as possible.*

2.1.49 Comment: Over the last 50 years I have seen a dramatic improvement to the Houston Ship Channel and the greater Galveston bay system. No longer do we see ships openly discharging waste and it appears that the days of industry waste being dumped into the bays have improved. There is a major noticeable difference in the water quality today in the entire bay system. That said, I want to thank you for your efforts in cleaning up the San Jacinto Waste Dump. This sight and the companies involve in creating it are one of the last remaining major projects that need to be addressed. I am a member of the Coastal Conservation Association Texas and I support the EPA's plan to completely remove the dioxin contaminated materials from the San Jacinto River Waste Pits Superfund Site in Galveston Bay. The proposed plan will secure the long-term health of Galveston Bay and its many residents for generations to come.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.50 Comment: I support the EPA's plan to completely remove the dioxin-contaminated materials from the San Jacinto River Waste Pits Superfund Site in Galveston Bay. Please do not let this plan become the victim of a delayed governmental process. The material needs to be removed sooner, rather than later to insure the health of the resource and the local inhabitants that continue being exposed on a daily basis.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community. The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) process that must be followed is very detailed and demanding and can take time to complete. EPA values your patience and understands your frustration.*

2.1.51 Comment: I support the EPA's plan to completely remove the dioxin-contaminated materials from the San Jacinto River Waste Pits Superfund Site in Galveston Bay. The health of Galveston Bay is critical to businesses and industries in Texas, particularly seafood and related businesses, recreation and sporting businesses and industries. A significant number of jobs depend upon good water quality in Galveston Bay. In addition, it's water quality is critical to the Gulf of Mexico and its fisheries, both commercial and recreational. In the strongest terms, I urge complete implementation of the plan.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.52 Comment: I am a former U.S. Coast Guard officer with experience with CERCLA, RCRA, OPA-90 and other pollution response programs including management activities for this and five other Federal Regions, including dioxin disposal and remediation of several Superfund sites. I also have experience with those programs in this region in the private sector. The proposed removal plan is the best option.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.53 Comment: Harris County strongly supports the decision by the EPA to totally remediate the Site as a preferred alternative. We believe this is the only option that will ensure that area residents will be protected long-term from a catastrophic cap failure in the years to come. Additionally, residents far downstream along Galveston Bay also in Precinct 2 will benefit knowing that the bay is protected from the consequences of cap failure at this Site. The EPA decision has the unquestioned support and broad coalition of county officials. This includes all elected officials in key county departments such as Harris County Flood Control District, the Health Department, Public Infrastructure Department, and of course our county attorney's office which has led the way in this effort.

Response: *EPA appreciates the support of local elected officials and community leaders and looks forward to continuing our relationship to protect the long-term health of the San Jacinto River and surrounding communities.*

2.1.54 Comment: If the pits were removed, the risk to our health and our water resources is also removed. For five years capping the pits has been unsuccessful, so it's time for a permanent solution. The only permanent solution is to remove the pits. This would reinstate my peace of mind and hopefully my health and it is time for those responsible to become good stewards of our environment and rectify the mistakes of the past so we can have a future.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.55 Comment: For too long the communities of eastern Harris County have been put at risk by the hazardous material found in the San Jacinto Waste Pits Superfund Site. The plan presented by the EPA is the culmination of a decade of calls by community members and local officials to fully remove the waste and protect families and children from public health risks."

Response: *EPA appreciates the support of local elected officials and community leaders and looks forward to continuing our relationship to protect the long-term health of the San Jacinto River and surrounding communities.*

2.1.56 Comment: I along with Harris County, the Galveston Bay Foundation and the San Jacinto Coalition support the EPA's proposal to fully dredge the waste pits over permanently capping the waste because the plan adheres to federal law, which prefers cleanups that 'permanently and significantly' reduce contamination. Capping would provide a short-term solution that could fail in the case of a natural disaster or equipment malfunction or deterioration.

Response: *EPA appreciates the support of local elected officials and community leaders and looks forward to continuing our relationship to protect the long-term health of the San Jacinto River and surrounding communities.*

2.1.57 Comment: BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF BAYTOWN, TEXAS: Section 1: That the City of Baytown fervently supports the following U.S. Environmental Protection Agency's recommended remedies for the San Jacinto Waste Pits:
1. Alternative 6N: Full Removal of Materials Exceeding Cleanup Levels and Institutional Controls for the north area and the sand separation area; and 2. Alternative 4S: Removal and Offsite Disposal for the south area.

Response: *EPA appreciates the support of local elected officials and community leaders and looks forward to continuing our relationship to protect the long-term health of the San Jacinto River and surrounding communities.*

2.1.58 Comment: Looking at similar estuarine Superfund sites across the United States, the EPA required removal of the highest concentrations of contaminated sediment at all seven sites (Garland 2015). The community members of Harris County, just as anywhere else in the United States, deserve clean air, clean water and clean soil. It is time to fully remediate this once pristine and highly sought after river. The EPA's Proposed Plan is one that would allow the surrounding communities and ecosystem to sustain and flourish and not be subject to further contamination.

Response: *EPA appreciates the support of local advocacy groups concerning our proposed long-term solution to protect the community.*

2.1.59 Comment: I live on the river and the waste pits need to be removed to make our neighborhood and communities safe for the future.

Response: *The overwhelming majority of received comments agree that the removal of the waste pits is the most responsible remedy for long-term health of the surrounding communities and the environment. In addition, removal of the source waste will eliminate the* *potential for a release to the environment and will prevent the Site from becoming a large contaminated sediment site.*

2.1.60 Comment: It's time for the only permanent solution: full removal of the toxic waste pits!

Response: *The overwhelming majority of received comments agree that the removal of the waste pits is the most responsible remedy for long-term health of the surrounding communities and the environment. In addition, removal of the source waste will eliminate the potential for a release to the environment and the creation of a large contaminated sediment site.*

2.1.61 Comment: This mess needs to be cleaned up, not covered up as it is now.

Response: *The overwhelming majority of received comments agree that the removal of the waste pits is the most responsible remedy for long-term health of the surrounding communities and the environment. In addition, removal of the source waste will eliminate the potential for a release to the environment and the creation of a large contaminated sediment site.*

2.1.62 Comment: Removal will ensure, once and for all, that these dioxin wastes no longer pose a threat to the San Jacinto River and Galveston Bay.

Response: *The overwhelming majority of received comments agree that the removal of the waste pits is the most responsible remedy for long-term health of the environment and communities. EPA shares your opinion that the removal of the waste will be a great start to a cleaner San Jacinto River and Galveston Bay.*

2.1.63 Comment: Complete removal is the only option to ensure the safety of all inhabitants and the environment. The extreme weather changes make storage in place highly unsafe.

Response: *The overwhelming majority of received comments agree that the removal of the waste pits is the most responsible remedy for long-term health of the surrounding communities and the environment. EPA is also very concerned about the potential extreme weather conditions be it flooding or hurricane events.*

2.1.64 Comment: EPA's CERCLA spreadsheet includes more than 100 sites, of which about half include contaminants with properties that can be considered similar to dioxins. The spreadsheet lists 18 sites with one or more of the similar contaminants, at which 50,000 cubic yards of material was, or will be, removed or otherwise remediated. EPA's site records illustrate that similar size remedial projects in waterways have been successfully performed.

Response: *The removal of the waste material from the Site can be performed successfully through implemented best management practices and EPA oversight of construction activities.*

2.1.65 Comment: The EPA's proposed cleanup plan, including the full removal of the toxic waste in the San Jacinto Waste Pits will further efforts in preserving, protecting, and improving water quality of the public water. In addition, the selected alternatives are the only ones that will adequately address the toxic waste dump in the San Jacinto River located in the center of on the largest metropolitan areas in the United States which is prone to hurricanes, tropical storms, flooding, and tidal surges.

Response: *The EPA concurs with your sentiments concerning the proposed Alternatives 6N and 4S. EPA is also concerned about the history of the Site being impacted by flooding and hurricane events, which are anticipated to continue in the future putting the Site at risk if the waste material is not removed from its current location.*

2.1.66 Comment: Between 2012 and 2016, flooding events and/or barge strikes appear to have caused damage to the San Jacinto Waste Pits temporary cap on multiple occasions, potentially exposing the river to additional waste. Despite that the cap was designed to withstand a 100-year flood, damage has occurred during much smaller storms.

Response: *The Time Critical Removal Action (TCRA) Cap was completed in 2011 and since its completion, documented events have shown that the current cap has suffered repeated damages and deficiencies from floods that were less than a 100-year flood event, even though the northern impoundment was designed for a 100-year flood. Repairs to the cap have been performed in July 2012, January 2013, January 2014, December 2015, February 2016, March 2016, and June 2016 since its completion in July 2011. The goal of the selected alternative, including removal, is to eliminate the potential of a cap being breached and releasing contaminated material into the environment. Leaving the waste in place at the Site will continue to be susceptible to damage by future hurricanes and flooding events and allow the environment to potentially continue to be impacted by waste being released. The implementation of Alternatives 6N and 4S will remove this potential for further releases.*

2.1.67 Comment: There is a concern with digging up the waste and removing it because there is the risk that some waste will be re-suspended in the process. The concern with leaving the waste in place is that there is not guarantee that it will stay there; the pits in the area are highly susceptible to flooding and storm surge from a hurricane. Flooding has impacted the cap, and we know our area will be hit by a hurricane at some point.

Response: *With the implementation of best management practices during removal activities, the potential for resuspension of waste is greatly decreased and EPA will direct the responsible parties to develop proven best management practices to protect against this situation. EPA also agrees that the Site is susceptible to major weather events and that the potential exists for damage to a cap system and release to the environment over a long period. Removal of the source waste will eliminate the potential for a release to the environment and prevent the Site from becoming a large contaminated sediment site.*

2.1.68 Comment: The EPA has concluded that removing the waste provides greater permanence and offers less risk that capping the waste in place forever.

Response: *The removal of the waste is the most reliable long-term method to eliminate the potential for future releases to the environment from the Site.*

2.1.69 Comment: We must start thinking what is best for our future generations and full removal is a start.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.70 Comment: The history of repeated compromise to the current cap is more than just upkeep.

Response: *The current temporary cap is designed for a 100-year flood event but since its completion, it has had integrity issues during flood events below the 100-year flood level. EPA believes that a capping system without removal of the waste material will continue to be a maintenance issue and the repeated need for repair of damage can lead to the release of the waste material into the river and surrounding environment and the creation of a large contaminated sediment site.*

2.1.71 Comment: The EPA's own Guidance for In-Situ Subaqueous Capping of Contaminated Sediments states that low-level, dioxin-bearing wastes can be capped and isolated in a low energy environment such as a protected harbor or low flow stream.

Response: *The dioxin at the site is source material at very high concentrations and considered Principal Threat Waste. The San Jacinto River and the location of the pits is not located in a low energy environment. The San Jacinto River is dynamic and has been documented to abruptly change its flow paths as occurred when new channels were created and the riverbank eroded. In addition, bottom currents can generate shear stresses that can act on the cap surface and may potentially erode the cap. In addition to ambient currents due to normal riverine or tidal flows, effects of storm-induced waves and other episodic events can act on the structural integrity of a cap. By removing the waste from the river the selected remedy eliminates the potential for future releases resulting from the forces of the river and weather events.*

The responsible party has continually indicated the current cap is designed for a 100-year flood event but since its completion, it has had integrity issues during flood events below the 100-year flood level. EPA believes that a capping system without removal of the waste material will continue to be a maintenance issue and the repeated repair of damage can lead to the release of the waste material into the river and surrounding environment.

2.1.72 Comment: I agree with EPA that containment alternatives cannot be shown to reliably contain the waste over a long-term basis, subjecting the community to the continued risk of a catastrophic release of dioxin.

Response: *Upgrading the current cap will not ensure the containment of the waste on a long-term basis. Removal of the waste will eliminate the potential for a release to the river and downstream receptors.*

2.1.73 Comment: I understand there is risk involved with removal of the waste but there is a higher risk involved in leaving them where they are as well.

Response: *The risks associated with removing the waste can be mitigated through proper use of best management practices versus leaving the waste in place for the long-term.*

2.1.74 Comment: I applaud the EPA for this recommendation and strongly support a full cleanup of this dangerous waste dump site.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.1.75 Comment: Dioxin is a serious problem for human health and the environment and should be removed and hauled to a permanent location where it is safely contained.

Response: *The Proposed Plan calls for the safe and managed transportation of excavated waste from the Site to a permitted landfill that is authorized for disposal of the Site waste and has the necessary controls in place to ensure that the waste is safely disposed of.*

2.1.76 Comment: This has been a continuing problem and worrisome for all who live near the San Jacinto River and we want it taken care of.

Response: *The selected alternatives identified in the Proposed Plan will be the first step in rehabilitating the area and is the long-term solution.*

2.1.77 Comment: My neighbors and I are concerned about the weight of the added material of the cap forcing the toxins out from under any cap or destabilizing the side berms. When you place anything heavy on mud, the mud is pushed out.

Response: *EPA shares your concern about adding weight to the cap as described in Alternative 3N. During the 2015 cap inspection, the identified damaged area was not underlined by geotextile material and rock was found to have sunk several feet or more into the waste material. This occurrence points to the need to carefully consider the load bearing capacity of the waste, especially with the potential addition of weight from the addition of several feet of larger armor stone over much of the cap.*

2.1.78 Comment: The Steering Committee of the Gulf-Houston Regional Conservation Plan herein supports the EPA's Proposed Plan for Clean Up of the San Jacinto Waste Pits Superfund Site.

Response: *EPA appreciates your support of our proposed long-term solution to protect the community.*

2.2 Support for Cap Containment

EPA received over 200 comments from the Potentially Responsible Parties (PRPs), industry, industry associations, professional organizations, non-governmental organizations, and individuals in the surrounding communities and various regions of the United States voicing their disagreement of the proposed Alternative 6N (Removal of Materials Exceeding Cleanup Levels, Monitored Natural Recovery, and Institutional Controls) for the northern impoundments and Alternative 4S (Removal and Offsite Disposal with Institutional Controls) for the southern impoundment. The most common comment arose from concerns that releases would occur during the implementation of the proposed alternatives and the view that the construction of an engineered containment cap will provide long-term protection.

2.2.1 Comment: Keep it capped. The San Jacinto has too much of a propensity for flooding and storm surges to wash the toxins throughout residential homes in the surrounding area. Unending lawsuits would follow due to needlessly exposing citizens to toxins.

Response: *EPA disagrees with the idea of a permanent cap as the selected alternative for the Site. The San Jacinto River has a propensity for flooding and storm surge, which is why EPA's proposed alternatives of removal will be the most effective against future releases caused by potential weather events. In addition, removal of the source waste will eliminate the potential for a release to the environment and prevent the Site from becoming a large contaminated sediment site.*

2.2.2 Comment: I live on Highland Bayou just above West Galveston Bay. I want to voice my concern over the San Jacinto Waste Pits cleanup plan. From my understanding, your plan increases the potential risk for discharge and contamination downstream to the area of my home and the surrounding wetland and marine systems. I urge you to consider other alternatives, such as permanent replacement of caps to prevent further discharge.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

There is no guarantee that a cap or an enhanced cap can reliably maintain structural integrity for the long term that dioxin would remain toxic. The current temporary cap has required repairs multiple times in its short life due to relatively low-level weather events.

2.2.3 Comment: Data collected in 2016 at Region 6's direction demonstrates the effectiveness of the existing armored cap. The test results unequivocally show the effectiveness of the existing armored cap. No target dioxin compounds were detected in porewater or groundwater, and the data show substantial decreases of dioxins and furans in surface water and sediment. These new data were provided to Region 6 prior to the issuance of the Proposed Plan, but were not considered in evaluating the effectiveness of capping alternatives.

Response: *Data from current sampling shows that waste is contained, except for surface water samples, which indicate an increase in dioxin adjacent to the waste pits compared to upstream samples. EPA considered the results of these samples in assessing the current effectiveness of the cap and plans to assess the need for restructuring the current operation and maintenance plan. However, none of this sampling addresses the long-term effectiveness of the cap during severe storms and hurricanes because the sampling relates only to the ability of the cap to contain the waste under current conditions. It does not address the strength or ability of the cap to withstand storms or hurricanes in the future.*

The Time Critical Removal Action (TCRA) Cap was completed in 2011 and since its completion, documented events have shown that the current cap has suffered repeated damages and deficiencies from floods that were less than a 100-year flood event, even though the northern impoundment was designed for a 100-year flood. Repairs to the cap have been performed in July 2012, January 2013, January 2014, December 2015, February 2016, March 2016, and June 2016 since its completion in July 2011. The goal of the selected alternative, including removal, is to eliminate the potential of a cap being breached and releasing contaminated material into the environment.

2.2.4 Comment: To justify the selection of Alternative 6N, Region 6 has mischaracterized routine cap maintenance, thereby presenting the existing cap as ineffective. The purposes of the existing armored cap were to stabilize the Northern Impoundments and prevent any releases to the environment. These purposes have been achieved. In fact, the existing armored cap has been effective in containing the waste material, as confirmed by extensive groundwater and porewater sampling, as well as surface sediment sampling performed adjacent to cap maintenance areas.

Response: *The repairs to the TCRA cap over the last six years have not been routine and within the scope of what was contemplated at the time the cap was completed in 2011. The 2011 Operations, Maintenance, and Monitoring Plan provided that inspections of the cap would be "performed quarterly for the first two years following completion of the TCRA construction, semiannually from years three to five, and annually starting at year six," with provision for additional inspections after 25-year or 100-year flow events. [Operations, Monitoring, and Maintenance Plan, San Jacinto River Waste Pits Superfund Site, October 2011, Section 2.1, p. 5]. This provision clearly envisions that the cap would require significantly less inspection and resulting maintenance after its first two years of operations, which has not in fact been the case. While cap inspections were at one point decreased from quarterly to semiannually, in February 2016 the frequency of the inspections had to be increased again to every quarter, due to the issues discovered by the EPA dive team in December 2015 as part of a sampling effort. The* *expectation that extensive maintenance to the cap would be limited to its first two years is also found in the cost estimates provided by Anchor QEA in its draft of the Feasibility Study, first submitted in August 2013 and resubmitted in April 2014. The cost for "Armored Cap Maintenance" was assumed only as "$100,000 cap maintenance in Year 1 and 2." [Draft Final Interim Feasibility Study, March 2014, Appendix C: Remedial Alternative Cost Development, Table 1.] The total estimated costs for cap maintenance as a net present value for Alternative 2N (the TCRA cap) and 3N (an enhanced cap) were both estimated as a net present value as only $181,000. The significant repairs in December 2015 and early 2016, the repair of the area with scour in November 2016, and the current efforts to repair the cap in 2017 demonstrate that the maintenance of the cap has not been routine and expected, but instead indicates an ongoing problem.*

The continuing maintenance and repairs of the current temporary cap in the six years since construction, have showed no signs of lessening based on past issues with its structural integrity after being subjected to floods. Past damage to the cap occurred under conditions that are much less severe than the design flood conditions (100-year flood), with the exception of the flooding associated with Hurricane Harvey in 2017. EPA's concern is that the larger design 100-year flood, or flooding and/or wave action from a severe hurricane, will result in more significant damage to the cap and will not result in a reliable containment remedy for the principal waste threat. This does not provide assurance that more significant cap damage will be avoided for the greater magnitude design storm or even more severe hurricanes and their associated storm surge and wave action effects. Riverbed scour which occurred in 2016 adjacent to the cap following less intense flooding below the design flood does not give the assurance that greater undermining of the cap will be avoided with more intense flooding over time. EPA does recognize that cap maintenance may be accomplished following receding of flood waters or hurricanes to repair any damage to the cap; however, any dioxin release to the river would have already occurred.

Further, cap effectiveness concerns were raised when the cap area where the armor stone was found to have sunk into the waste in 2015 resulted in the direct exposure of the dioxin containing waste to the San Jacinto River. EPA guidance for long-term monitoring and maintenance of cap remedies presume the cap is performing as intended for meeting remedial action objectives and cleanup criteria; therefore, if repairs are required to address exposed waste materials where the cap has been removed, these requirements have not been met, and addressing these conditions would not be considered "routine cap maintenance". EPA agrees that routine cap maintenance is required to maintain remedy effectiveness for any cap, but this does not address EPA concerns for avoiding future releases of waste materials resulting from extreme weather events.

The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the cap during the storm event modeled. However, the modeling did not consider the impact of a larger Category 4 or 5 hurricane, which may occur during the long time-frame that the dioxin waste would remain toxic.

2.2.5 Comment: US Army Corps of Engineers and EPA cap design guidance expressly presumes that routine and event monitoring will identify the need for possible cap maintenance. Design guidance issued by EPA and the US Army Corps of Engineers recommends that "event-based" monitoring be used to fine-tune an operation, monitoring, and maintenance program as part of the monitoring of the performance of the cap following specific storm events. Typically, in the first few years following cap construction, there is a period where monitoring and maintenance practices identify and address areas of the cap that need to be enhanced, if any, so that the long-term protectiveness of the cap can be ensured. The maintenance that has occurred at the Northern Impoundments has followed this pattern with modifications made to the operation, monitoring, and maintenance plan as necessary. The Alternative 3aN enhanced cap, to be constructed with much larger rock, is designed to be protective during future extreme storm events and will reduce the need for future maintenance. The enhancements to the existing armored cap as part of Alternative 3aN were developed by the US Army Corps of Engineers. They include adding two feet of much larger rock to most of the cap, and adjusting slopes to increase their long-term stability. This step should reduce the need for future maintenance. According to the US Army Corps of Engineers, it also will be protective against erosion during future extreme events of the kind that Region 6 asserts raise questions as to the cap's long-term effectiveness.

Response: *The design guidance presumes the cap is performing as intended for meeting remedial action objectives and cleanup criteria. The event-based monitoring/repair after a potentially weather event would be reactive and not proactive. Damage to the cap would have already occurred. Any dioxin release to the river would have already caused impact and the response time for maintenance/repair would be delayed based on the timeframe for flood waters to recede and the ability to access to the cap by water or land. Alternative 3aN is a more robust design based on the use of larger rock but with the use of larger rock comes the potential for the cap to subside due to the weight of the larger rock which has the potential to cause structural failures and the release of waste to the environment. This has already occurred in 2015 with smaller armor stone.*

The Corps of Engineers has performed a model simulation to investigate the performance of the upgraded cap, Alternative 3aN, which included a two-feet thicker cap. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during this extreme storm event. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. Unfortunately, these stronger hurricanes could not be reliably modeled because no relevant databases were available for use. The implementation of Alternatives 6N and 4S would eliminate these potentially cap failures and releases of waste to the environment.

In 2014 the Interstate Technical and Regulatory Council published a guidance document which indicates site conditions that increase cap stability include deep water, low erosive forces including low flow, limited wave effects, and limited navigation related prop wash (Interstate Technical and Regulatory Council, 2014). The Site cannot be described as having low erosive *forces and limited wave effects on a consistent basis. Further, the Site is in an active navigation area.*

2.2.6 Comment: The toxic pits need to be properly contained now, no matter who pays for this.

Response: *The use of containment measures to store the highly toxic and potentially mobile waste does not remove the waste from its current location within the San Jacinto River, whereas the selected alternatives in the Proposed Plan does. The removal of the waste material will provide the long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

2.2.7 Comment: Please safely contain this toxin as soon as possible.

Response: *The use of containment measures to store the highly toxic and mobile waste does not remove the waste from its current location within the San Jacinto River, whereas, the selected alternatives in the Proposed Plan does. The removal of the waste material will provide the long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

2.2.8 Comment: I support enhanced capping due to factors such as sediment disturbance, delayed natural recovery, potential exposure, and increase of concentration in fish.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

The potential for ongoing releases from an engineered cap presents long-term risk given the propensity of the Houston area and the San Jacinto River to experience hurricanes, floods, storm surges and wave action. The removal of the waste material will provide a reliable long-term solution to protect the community.

2.2.9 Comment: I support capping due to factor such as river current, quantity, toxin decay, inadequate equipment, and no proof one remedy will yield better results than capping.

Response: *The reason EPA has proposed removal is based on your mentioned factors. The dynamic nature of the current in the San Jacinto River and the propensity of the Houston area to experience hurricanes, floods, storm surges and wave action are reasons why removal is necessary instead of relying on a cap to sustain structural integrity for centuries. The quantity and toxic levels of the waste, as well as the slow rate of decay of the dioxin waste is also why removal is necessary. The waste can be properly removed and disposed at a land-based facility engineered to safely contain such wastes. The removal process design, which will include all equipment to be utilized and best management practices, will evaluate all available techniques to safeguard the removal process. The selected remedial action will produce better results than capping because it removes the principal threat waste from the environment and will provide the long-term reliability to protect the environment.*

2.2.10 Comment: To be credible, EPA's analysis of the risks associated with the enhanced cap needs significantly more robust technical demonstration and less unfounded assumptions.

Response: *Both EPA and the Potentially Responsible Parties have made statements about the expected life span and expected structural integrity of an enhanced cap. These statements are based on the expectant lifespan and structural integrity of an enhanced cap for hundreds of years to protect against the release of dioxin contaminated waste. Documented events have shown that the current cap has suffered damages and deficiencies from floods that were less than the 100-year design flood event. Since its completion in July 2011, repairs to the cap have been performed in July 2012, January 2013, January 2014, December 2015, February 2016, March 2016, and June 2016 since its completion in July 2011. The goal of the selected alternative, removal, is to eliminate the potential of a cap being breached and releasing contaminated material into the environment. The commenter suggests that EPA's risk analysis is based on unfounded assumptions that future flooding may be more intense; however, the commenter offers no proof that future flooding will not be more intense and does not take into account sea level rise and other natural occurrences over a period of hundreds of years, which an enhanced cap will need to remain structurally sound. Finally, climate models (Knutson and others, 2010) predict an increase in the intensity of tropical cyclones and hurricanes in the Gulf, meaning greater risk of flooding and storm surges over the long time frame that the dioxin waste would remain hazardous.*

In 2014 the Interstate Technical and Regulatory Council published a guidance document which indicates site conditions that increase cap stability include deep water, low erosive forces including low flow, limited wave effects, and limited navigation related prop wash (Interstate Technical and Regulatory Council, 2014). The Site cannot be described as having low erosive forces and limited wave effects on a consistent basis. Further, the Site is in an active navigation area.

Alternative 3aN is an enhanced capping alternative with armor cap improvements (larger 15" armor stone, 24" of additional cap thickness on top of the Alternative 3N cap) to address the deficiencies of Alternative 3N. Alternative 3aN would be better able to withstand a future severe storm, although the Corps of Engineers model study did find that a future extreme storm would result in cap erosion over most of the Alternative 3aN cap. This modeling considered the wave *impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. Unfortunately, these stronger hurricanes could not be reliably modeled because no relevant databases were available for use. Regardless, there still remains the uncertainties related to changes in channel planform morphology that may occur due to bank erosion, shoreline breaches, etc. during a high flow event caused by a major flood or hurricane, which is beyond the ability of existing sediment transport models to reliably simulate, as well as the uncertainty of making predictions that would have to remain relevant for hundreds of years into the future.*

2.2.11 Comment: Region 6 ignores evidence of the Alternative 3aN enhanced cap's effectiveness and has no credible basis for rejecting it.

Response: *With Alternative 3aN, the principal threat waste and the potential for release of dioxin containing waste is not eliminated as it is with Alternative 6N. Per the 2016 US Army Corps of Engineers' report, the most severe event simulated was the hypothetical synoptic occurrence of Hurricane Ike (Category 2 hurricane) and the October 1994 flood, with a peak discharge of approximately 115,000 cubic feet per second occurring during the peak storm surge height at the Site. The results during the peak of the storm surge showed that the sections using Armor A (3-inches diameter) were completely eroded, while the sections using Armor D (10-inches diameter) were eroded more than 12 inches in approximately 33 percent of those sections. The sections using Armor B and C (6-inches diameter) incurred a net erosion of more than 9 inches in approximately 75 percent of those areas. Overall about 80 percent of the cap experienced significant erosion with scour reaching approximately 2.4-feet through the cap and into the waste material. The cap used for this simulation has an upgraded design compared to the currently existing temporary cap. The scenario defined above may cause significant erosion of the paper mill waste. The Corps of Engineers also performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during this extreme storm event.*

The releases from catastrophic events can potentially be addressed by additional cap improvements, including upgrading the blended filter in the Northwestern Area to control sediment migration into the cap, increasing the size of the armor stone size to 15 inches in diameter and adding 2 feet of additional armor stone over the existing cap across the waste pits to minimize the potential for disturbance during very severe hydrologic and hydrodynamic events. However, the uncertainty inherent in any quantitative analysis technique used to estimate the long-term (500 years or more) reliability of the cap is very high. The US Army Corps of Engineers report did not consider changing river conditions. New channels eroding during flooding as well as changes in channel cross section due to bank erosion, shoreline breaches, etc. during a high flow event caused by a major flood or hurricane is beyond the ability of existing sediment transport models to simulate. The US Army Corps of Engineers report does not fully account for local scour of the river bed immediately adjacent to the armored cap where turbulent flow effects may exceed model predictions during floods, leading to rapid erosion and undermining of cap slopes. In addition, the report's evaluation of excavation and removal often *focuses on risks which will be reduced and/or eliminated through use of best management practices.*

In addition, EPA disagrees with the characterization of an ultra-extreme storm. History shows that between 1851 and 2004, 25 hurricanes have made landfall along the north Texas Gulf Coast, seven of which were major (Category 3 to 5) storms. Tropical Storm Allison, which hit the Texas Gulf Coast in June 2001, resulted in 5-day and 24-hour rainfall totals of 20 and 13 inches, respectively, in the Houston area, resulting in significant flooding. More recently, Hurricane Rita made landfall in September 2005 as a Category 3 storm with winds at 115 miles per hour. The storm surge caused extensive damage along the Louisiana and extreme southeastern Texas coasts. In September 2008, the eye of Hurricane Ike made landfall at the east end of Galveston Island. Ike made its landfall as a strong Category 2 hurricane, with Category 5 equivalent storm surge, and hurricane-force winds that extended 120 miles from the storm's center. With 25 landfall hurricanes being documented alone the north Texas Gulf Coast in a 153-year period, which is approximately one every six-years, it can be expected that additional large hurricanes will make landfall in the north Texas Gulf Coast between the time the cap is complete and the several hundred years that the waste will remain toxic. And the effects of the most recent hurricane- Harvey- which resulted in over 50 inches of rainfall in the Houston area are just now being analyzed. Finally, climate models (Knutson and others, 2010) predict an increase in the intensity of tropical cyclones and hurricanes in the Gulf, meaning greater risk of flooding, large waves, and storm surges.

2.2.12 Comment: The 2016 data demonstrate that the existing armored cap, which would be enhanced under Alternative 3aN in accordance with the US Army Corps of Engineers requirements, has effectively contained the waste.

Response: *Data from 2016 sampling shows the waste is contained, except for surface water samples which show an increase in dioxin adjacent to the waste pits. The EPA considered the results of this sampling in assessing the current effectiveness of the cap and plans to assess the need for restructuring the current monitoring and maintenance plan, including potential cap improvements to address any continuing releases of dioxin from the waste pits to the surface water. However, none of this sampling addresses the long-term effectiveness of the cap during severe storms and hurricanes because the sampling relates only to the ability of the cap to contain the waste under current conditions. It does not address the strength or ability of the cap to withstand storms or hurricanes in the future.*

The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the cap during the storm event modeled. However, the modeling did not consider the impact of a larger Category 4 or 5 hurricane, which may occur during the long time-frame that the dioxin waste would remain toxic.

2.2.13 Comment: Region 6 has mischaracterized routine cap maintenance as being unusual or unexpected, thereby presenting the existing cap (and Alternative 3aN) as being ineffective.

Response: *The repairs to the TCRA cap over the last six years have not been routine and within the scope of what was contemplated at the time the cap was completed in 2011. The 2011 Operations, Maintenance, and Monitoring Plan provided that inspections of the cap would be "performed quarterly for the first two years following completion of the TCRA construction, semiannually from years three to five, and annually starting at year six," with provision for additional inspections after 25-year or 100-year flow events. [Operations, Monitoring, and Maintenance Plan, San Jacinto River Waste Pits Superfund Site, October 2011, Section 2.1, p. 5]. This provision clearly envisions that the cap would require significantly less inspection and resulting maintenance after its first two years of operations, which has not in fact been the case. While cap inspections were at one point decreased from quarterly to semiannually, in February 2016 the frequency of the inspections had to be increased again to every quarter, due to the issues discovered by the EPA dive team in December 2015 as part of a sampling effort. The expectation that extensive maintenance to the cap would be limited to its first two years is also found in the cost estimates provided by Anchor QEA in its draft of the Feasibility Study, first submitted in August 2013 and resubmitted in April 2014. The cost for "Armored Cap Maintenance" was assumed only as "$100,000 cap maintenance in Year 1 and 2." [Draft Final Interim Feasibility Study, March 2014, Appendix C: Remedial Alternative Cost Development, Table 1.] The total estimated costs for cap maintenance as a net present value for Alternative 2N (the TCRA cap) and 3N (an enhanced cap) were both estimated as a net present value as only $181,000. The significant repairs in December 2015 and early 2016, the repair of the area with scour in November 2016, and the current efforts to repair the cap in 2017 demonstrate that the maintenance of the cap has not been routine and expected, but instead indicates an ongoing problem.*

While cap inspections were at one point decreased from quarterly to semiannually, in February 2016 the frequency of the inspections had to be increased again to every quarter, due to the issues discovered by the EPA dive team in December 2015 as part of a sampling effort. The expectation that extensive maintenance to the cap would be limited to its first two years is also found in the cost estimates provided by Anchor QEA in its draft of the Feasibility Study, first submitted in August 2013 and resubmitted in April 2014. The cost for "Armored Cap Maintenance" was assumed only as "$100,000 cap maintenance in Year 1 and 2." [Draft Final Interim Feasibility Study, March 2014, Appendix C: Remedial Alternative Cost Development, Table 1.] The total estimated costs for cap maintenance as a net present value for Alternative 2N (the TCRA cap) and 3N (an enhanced cap) were both estimated as a net present value as only $181,000. The significant repairs in December 2015 and early 2016, the repair of the area with scour in November 2016, and the current efforts to repair the cap in 2017 demonstrate that the maintenance of the cap has not been routine and expected, but instead indicates an ongoing problem.

The continuing maintenance and repairs of the current temporary cap in the six years since construction, have showed no signs of lessening based on past issues with its structural integrity after being subjected to floods. Past damage to the cap occurred under conditions that are much less severe than the design flood conditions (100-year flood), with the exception of the flooding associated with Hurricane Harvey in 2017. EPA's concern is that the larger design 100-year *flood, or flooding and/or wave action from a severe hurricane, will result in more significant damage to the cap and will not result in a reliable containment remedy for the principal waste threat. This does not provide assurance that more significant cap damage will be avoided for the greater magnitude design storm or even more severe hurricanes and their associated storm surge and wave action effects. Riverbed scour which occurred in 2016 adjacent to the cap following less intense flooding below the design flood does not give the assurance that greater undermining of the cap will be avoided with more intense flooding over time. EPA does recognize that cap maintenance may be accomplished following receding of flood waters or hurricanes to repair any damage to the cap; however, any dioxin release to the river would have already occurred.*

Further, cap effectiveness concerns were raised when the cap area where the armor stone was found to have sunk into the waste in 2015 resulted in the direct exposure of the dioxin containing waste to the San Jacinto River. EPA guidance for long-term monitoring and maintenance of cap remedies presume the cap is performing as intended for meeting remedial action objectives and cleanup criteria; therefore, if repairs are required to address exposed waste materials where the cap has been removed, these requirements have not been met, and addressing these conditions would not be considered "routine cap maintenance". EPA agrees that routine cap maintenance is required to maintain remedy effectiveness for any cap, but this does not address EPA concerns for avoiding future releases of waste materials resulting from extreme weather events.

The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the cap during the storm event modeled. However, the modeling did not consider the impact of a larger Category 4 or 5 hurricane, which may occur during the long time-frame that the dioxin waste would remain toxic.

2.2.14 Comment: Direction by Region 6 for reassessment of the armored cap design and construction even though the US Army Corps of Engineers November 2013 Reassessment confirmed the overall validity of the armor cap's design.

Response: *Even though the November 2013 US Army Corps of Engineers Reassessment Report found the 2012 cap was sufficient, much more extensive evaluation and modelling was performed in 2016. The evaluation and modelling showed that the cap with additional upgrades in addition to the 2012 upgrades (Alternative 3N) was still predicted to incur up to 80 percent erosion during a hurricane scenario.*

2.2.15 Comment: USEPA has exaggerated the potential benefits of the full removal and off-site disposal remedy (Proposed Plan) and underestimated potential harm to the environment during implementation of the remedy. The proposed plan offers the false hope of completely removing dioxins from the river and ignores the potential for a catastrophic release of dioxins during the potentially long and difficult construction period.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. The removal of the waste material will provide reliable long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

2.2.16 Comment: The in-place containment alternative is the best solution for the San Jacinto River Waste Pits Superfund Site. It does not risk catastrophic impacts to the long-term health of the community and environment by digging into and trying to remove the highly-contaminated waste pits.

Response: *The only long-term alternative which reliably secures the Site from potential future releases is the removal of the dioxin containing waste material. There is no guarantee that the cap will maintain structural integrity for centuries and avoid future releases of waste materials. The current temporary cap has required repairs multiple times in its short life due to lower-level weather events. Engineering control measures and best management practices will be employed to safely remove the waste.*

2.2.17 Comment: Because of the unique nature of this area (e.g., subjected to sub-tropical storm events and flash flooding) and the fact that the waste pits are submerged in the river, the full removal remedy is simply too risky. A catastrophic event during construction would cause significant, irreparable harm to the environment and the recreational and commercial fisheries.

Response: *During implementation of Alternative 6N, engineering control measures such as containment of removal operations inside cofferdams, best management practices, and placing requirements on the approach and schedule (e.g., excavation and dredging for removal of the waste will be done incrementally to avoid exposing the entire impoundment surface, reducing the risk of release if flooding does overtop the protective barrier) will be employed to limit the potential for releases of waste materials; both which will be developed during the Remedial Design.*

2.2.18 Comment: After almost two years, the US Army Corps essentially agreed with all of the underlying scientific and engineering analyses used to select the in-place containment remedial alternative. Only a few weeks after the US Army Corps of Engineers report was released, EPA issued a proposed plan that called for the full removal, discounted or disputed the analysis provided by the US Army Corps of Engineers, and ignored or did not seek the advice of sediment remediation experts in the private and public sector.

Response: *EPA did not disregard the US Army Corps of Engineers report. As documented in the US Army Corps of Engineers Report, there is the potential for loss of waste due to barge strikes or weather events. The US Army Corps of Engineers evaluation and modelling showed that a cap with upgrades to the current temporary cap (Alternative 3N) was still predicted to incur up to 80 percent erosion during a hurricane scenario. In addition, the report's evaluation of removal considered risks associated with dredging, while the actual removal will be performed in the "dry" without dredging. In response to comments received, EPA worked with USACE to further refine BMPs for removal in the "dry". EPA sought the assistance of outside sources and governmental agencies (including EPA experts, the United States Geological Survey, and the US Army Corps of Engineers) in selecting the remedy. EPA also considered the concerns of the community and the concerns of the potentially responsible parties and their experts in selecting the remedy.*

The Corps of Engineers has performed a model simulation to investigate the performance of the upgraded cap, Alternative 3aN, which included a two-feet thicker cap. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during this extreme storm event. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. Unfortunately, these stronger hurricanes could not be reliably modeled because no relevant databases were available for use. The implementation of Alternatives 6N and 4S would eliminate these potentially cap failures and releases of waste to the environment.

2.2.19 Comment: Does the USEPA believe past performance of a hastily constructed interim remedy should be used as evidence to reject all in -place containment remedial alternatives?

Response: *The description of the temporary cap as "hastily constructed" is a poor characterization of the temporary cap. The cap was designed and constructed in accordance with relevant guidance, under EPA oversight, and was reviewed by the US Army Corps of Engineers several times following completion. Since completion of the cap in July 2011, EPA has considered how well the temporary cap has performed under the actual conditions experienced in the San Jacinto River. The temporary cap has required repeated repairs and has resulted in the dioxin waste coming into direct contact with the San Jacinto River. The removal of the waste material will provide the long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

In 2014 the Interstate Technical and Regulatory Council published a guidance document which indicates site conditions that increase cap stability include deep water, low erosive forces including low flow, limited wave effects, and limited navigation related prop wash (Interstate Technical and Regulatory Council, 2014). The Site cannot be described as having low erosive *forces and limited wave effects on a consistent basis. Further, the Site is in an active navigation area.*

2.2.20 Comment: The natural resources of the San Jacinto River and Galveston Bay are too important to conduct a full removal experiment that is not expected to make things significantly better and could very well make conditions significantly worse. For the safety of our community, the armored, in-place containment remedial alternative should be selected as the preferred remedy.

Response: *Description of the cleanup action as an "experiment" is not a good characterization of the selected remedy. The Passaic River Phase I Removal Action provides a successful precedent for removal of dioxin waste materials in a tidal river system using robust engineering control measures has occurred with the Passaic River Phase I Removal Action. Additionally, dredging inside cofferdams within river systems has been performed for numerous projects. The removal of the waste materials will require sound construction practices based on remedial design incorporating appropriate engineering control measures and best management practices. EPA's selected alternative provides greater long-term protectiveness for the San Jacinto River and surrounding communities than a capping remedy because the waste will be removed from the river.*

As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.

2.2.21 Comment: The risks to the public, the environment, and the workers of a large-scale, mass removal remedy are large and consequences could be catastrophic.

Response: *During implementation of Alternative 6N, engineering control measures such as containment of removal operations inside cofferdams will be employed to control the potential for releases of waste. In addition, excavation for removal of the waste will be done incrementally to avoid exposing the entire impoundment surface and to reduce the risk of releases. These and other best management practices will be developed during the Remedial Design. Alternative 6N removes the waste material, thus eliminating the any issue of a failing cap.*

EPA disagrees with the idea of a permanent cap as the selected alternative for the Site. The San Jacinto River has a propensity for flooding and storm surge, which is why EPA's proposed alternatives of removal will be the most effective against future releases caused by potential *weather events. In addition, removal of the source waste will eliminate the potential for a release to the environment and prevent the Site from becoming a large contaminated sediment site.*

2.2.22 Comment: The hypothetical benefit of the full removal remedy is the purported elimination of all contamination, but this is unlikely to be realized and, in fact, this approach is likely to make conditions in the river worse for a considerable time.

Response: *The benefits of removal are not hypothetical and EPA does not imply that this alternative is designed to completely remove all dioxins from the river. The proposed selected alternative removes the waste material that exceeds the Preliminary Remediation Goal. As discussed in the Proposed Plan of Action, EPA and the US Army Corps of Engineers indicated that a potential small release of the waste material may occur during removal activities under alternative 6N.*

As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.

2.2.23 Comment: The in-place containment alternative has a more consistent track record of success and minimizes the risks associated with construction.

Response: *Subaqueous capping remedies have been implemented successfully for numerous sites, though the track record for long-term effectiveness and permanence for these sites has only been established for 2 to 3 decades. Removal provides a long term reliability because there is no issue with potential storm damage and long term maintenance.*

2.2.24 Comment: The in-place containment alternative can be implemented quickly, eliminating the current risk of exposure.

Response: *The capping alternative does have a shorter construction timeframe but does not achieve the goal of safely eliminating the long-term risk to the environment and community. Implementation of Alternative 6N removes the waste and eliminates the long-term risk.*

2.2.25 Comment: The in-place containment alternative is more cost-effective, less disruptive to the community, and is consistent with the goals to protect human health and the environment.

Response: *During the remedy selection process, nine evaluation criteria are considered in distinct groups which play specific roles in working toward the selection of a remedy that satisfies the following five principal statutory requirements:*

1) Protect human health and the environment;
2) Comply with applicable or relevant and appropriate requirements (ARARs) unless a waiver is justified;
3) Be cost-effective;
4) Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and
5) Satisfy a preference for treatment as a principal element, or provide an explanation in the Record of Decision (ROD) why the preference was not met.

The nine evaluation criteria include two "threshold" criteria, five "balancing" criteria (including cost), and two "modifying" criteria (state and community acceptance). The alternatives are also separately evaluated against a subset of the criteria to make the determination of which option(s) satisfy statutory cost-effectiveness. A remedial alternative is cost-effective if its "costs are proportional to its overall effectiveness" (40 CFR 300.430(f)(1)(ii)(D)). Overall effectiveness of a remedial alternative is determined by evaluating the following three of the five balancing criteria:

- *long-term effectiveness and permanence;*
- *reduction in toxicity, mobility and volume (TMV) through treatment;*
- *and short-term effectiveness. Overall effectiveness is then compared to cost to determine whether the remedy is cost-effective.*

As discussed below, EPA did not merely "chose the most-expensive of the proposed remedies".

For Alternative 3aN, the net present worth for Alternative 3aN is $24.8 million based on a 7% discount rate and 30-years of operation and maintenance costs in accordance with EPA policy.

For Alternative 6N, the cost estimate has been modified somewhat in response to the public comments, namely to employ the use of a cofferdam and to perform the excavation in the "dry" so that no material release is expected during the removal. These conditions are for the cost estimate only because the actual Best Management Practices (BMPs) to be employed will be determined during the Remedial Design. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. The cost estimate was further modified to include costs for the additional excavation required (about 10,000 cubic-yards) associated with lowering the cleanup level from 200 ng/kg as presented in the Proposed Plan to 30 ng/kg. Based on the additional capital cost for a cofferdam and additional excavation volume, the net present worth for Alternative 6N is $105 million.

Although the costs for Alternative 6N are higher than those for the other alternatives, a comparison of the overall effectiveness (evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, *and volume through treatment; and short-term effectiveness)) to the cost of each alternative lead to the determination that Alternative 6N is more cost-effective.*

Removal of waste under Alternative 6N will eliminate the potential for the costs associated with cleaning up a large contaminated sediment site that may result from a failure of a cap, and will eliminate the potential for future environmental and human health impacts should a release occur. The history of the need for repeated cap repairs, the exposure of waste materials, the riverbed erosion that occurred adjacent to the cap, all of which occurred during storms with much less intensity than the hurricanes to which the area is prone, do not support capping as a cost-effective remedy. It should be further noted that the recent occurrence of Hurricane Harvey did not impact the Site with storm surge or wind driven waves typical of hurricanes. Storm surge and hurricane wind driven waves create more extensive damage than flooding alone. This is shown by a comparison of the 2016 modelling done by the Corps of Engineers for flood conditions similar to the 1994 flood, as opposed to the USACE modelling for both storm and hurricane conditions (equivalent to both the 1994 flood and Hurricane Ike occurring together).

The enhanced capping of the waste may be less expensive and less disruptive in the short-term, but it also results in less protection of human health and the environment for the long-term. Cap failure due to severe or extreme storm events or a lack of sustained effective maintenance would result in the release of the dioxin contaminated waste from the site.

Given the position of the Site in the San Jacinto River, the frequent storms, and the history of repeated damage to the cap, O&M of the cap is likely to be required even beyond the normal 30-year period that is the estimate for most capped sites. The true cost of a capping remedy at this Site may be significantly larger than expected.

The Selected Remedy, removal of the waste pits, is protective of human health and the environment, complies with applicable or relevant and appropriate requirements, and provides the best balance of tradeoffs among the balancing criteria. It reduces risks within a reasonable time frame, provides for long-term reliability of the remedy, and minimizes reliance on institutional controls. It will achieve substantial risk reduction by removing the contaminated materials, unlike capping, which would always be susceptible to a future release following a severe storm event, or due to a failure of maintenance over a period of centuries. The selected remedy is also cost-effective because its costs are proportional to its overall effectiveness, with overall effectiveness being determined by an evaluation of its long term effectiveness and permanence, reduction in toxicity, mobility or volume through treatment, and short-term effectiveness.

2.2.26 Comment: EPA has based its selection of Alternative 6N as the preferred alternative citing excessive concerns over containment approaches, while accepting the full removal alternative with hand waving to dismiss the downside of the removal approaches.

Response: *The continuing maintenance and repairs of the current temporary cap in the six years since construction, have showed no signs of lessening based on past issues with its structural integrity after being subjected to floods. Past damage to the cap occurred under* *conditions that are much less severe than the design flood conditions (100-year flood), with the exception of the flooding associated with Hurricane Harvey in 2017. EPA's concern is that the larger design 100-year flood, or flooding and/or wave action from a severe hurricane, will result in more significant damage to the cap and will not result in a reliable containment remedy for the principal waste threat. This does not provide assurance that more significant cap damage will be avoided for the greater magnitude design storm or even more severe hurricanes and their associated storm surge and wave action effects. Riverbed scour which occurred in 2016 adjacent to the cap following less intense flooding below the design flood does not give the assurance that greater undermining of the cap will be avoided with more intense flooding over time. EPA does recognize that cap maintenance may be accomplished following receding of flood waters or hurricanes to repair any damage to the cap; however, any dioxin release to the river would have already occurred.*

Further, cap effectiveness concerns were raised when the cap area where the armor stone was found to have sunk into the waste in 2015 resulted in the direct exposure of the dioxin containing waste to the San Jacinto River. EPA guidance for long-term monitoring and maintenance of cap remedies presume the cap is performing as intended for meeting remedial action objectives and cleanup criteria; therefore, if repairs are required to address exposed waste materials where the cap has been removed, these requirements have not been met, and addressing these conditions would not be considered "routine cap maintenance". EPA agrees that routine cap maintenance is required to maintain remedy effectiveness for any cap, but this does not address EPA concerns for avoiding future releases of waste materials resulting from extreme weather events.

In 2014 the Interstate Technical and Regulatory Council published a guidance document which indicates site conditions that increase cap stability include deep water, low erosive forces including low flow, limited wave effects, and limited navigation related prop wash (Interstate Technical and Regulatory Council, 2014). The Site cannot be described as having low erosive forces and limited wave effects on a consistent basis. Further, the Site is in an active navigation area.

The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during an extreme storm event.

The benefit of removal is not hypothetical and EPA does not imply that this alternative is designed to completely remove all dioxins from the river. The proposed selected alternative removes the waste material that exceeds the Preliminary Remediation Goal. As discussed in the Proposed Plan of Action, EPA and the US Army Corps of Engineers indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices to prevent or minimize the release of waste material during removal. To this end, the EPA incorporated into the cost estimate the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual Best Management Practices *to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation.*

2.2.27 Comment: EPA dismisses the fact that a containment remedy approach can be designed and implemented at this Site to provide secure and permanent isolation of the waste.

Response: *EPA disagrees that the waste can be reliably secured and isolated for the long-term in a containment remedy scenario at the Site. The Site is in a dynamic river way, which is exposed to forces such as flooding, hurricanes, storm surge, wave action, and erosion. The current cap was designed to withstand a 100-year flood event and has required repeated repairs for floods with lesser intensity. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during an extreme storm event. The only reliable, permanent solution is to remove the waste.*

2.2.28 Comment: Alternative 3aN contains provisions that would ensure stability against very extreme events. This alternative was essentially dismissed by EPA for the same reasons they rejected Alternative 3N, even though 3aN is a significantly more robust containment alternative.

Response: *Even though Alternative 3aN consists of an upgraded cap, it is still subject to the uncertainties of severe floods, a dynamic river, and adequate maintenance over the centuries that the waste will remain toxic. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the cap during the storm event modeled. However, the modeling did not consider the impact of a larger Category 4 or 5 hurricane, which may occur during the long time-frame that the dioxin waste would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

2.2.29 Comment: The Proposed Plan indicates that the preferred remedy was selected based on the Final Interim Feasibility Study as supported by the US Army Corps of Engineers Report. But, the details on long-term effectiveness and implementability for the alternatives in both the Final Interim Feasibility Study and Proposed Plan were selectively cited from the US Army Corps of Engineers Report to support a removal alternative. In plain language, the Proposed Plan cherry picked statements from the US Army Corps of Engineers Report to support removal, while largely ignoring considerations in the US Army Corps of Engineers Report that clearly supported a containment alternative.

Response*: The EPA considered the entire US Army Corps of Engineers Report, as well as all of the other available Site information, in determining the selected remedy using the CERCLA remedy selection criteria. The US Army Corps of Engineers report contains information on the shortcomings and strengths of all of the alternatives without providing a recommendation or preference for the selection of an alternative. Capping would yield very low* *short-term releases while leaving the potential for failure under extreme events or stream bed morphological changes as experienced in the past. Removal could also yield low short-term releases with the most stringent best management practices and eliminate the potential for failure in the future. Removal with less than the most stringent best management practices would likely yield considerable short-term releases, however that is not the approach that was selected.*

As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.

2.2.30 Comment: In general, Alternative 6N is a very inefficient remedy. It has a much higher cost, much higher short term risk, significant implementation issues, and longer construction time.

Response: *EPA disagrees that Alternative 6N has a "much higher" cost than Alternative 3aN. The FS assumed only 2 years of O&M would occur in the first two years of the project under Alternative 3aN. The current cap has required repairs in the 6 years following completion due to riverbed erosion. To further assess the cost of Alternative 3aN, EPA used a project life of 100 years with annual O&M costs of $800,000 per year. The use of an annual operation and maintenance cost, as opposed to only the first two years as was done in the Feasibility Study, allows a more appropriate assessment of the costs associated with cap repairs in the 6 years following completion of the cap, and also includes a provision for future repairs that may be necessary following severe storm events. As discussed more completely in response to Comment 2.2.25, comparing the costs for Alternatives 3aN and 6N, Alternative 6N is approximately $25 million, or 31%, higher total cost than Alternative 3aN.*

During implementation of Alternative 6N, potential releases can and will be controlled through engineering control measures and best management practices (excavation and dredging for removal of the waste will be done incrementally to avoid exposing the entire impoundment surface, reducing the risk of release if flooding does overtop the protective barrier), both of which will be developed during the Remedial Design. The placement of a cap system to contain the waste is also potentially catastrophic to the environment, community, and workers for a long-term period. Alternative 6N removes the waste material, thus eliminating the issue of a failing cap.

2.2.31 Comment: Alternative 3aN holds significant advantages over Alternative 6N since it has no short-term impacts, a lower risk of a catastrophic release of dioxin, and no implementability issues.

Response: *EPA understands that the removal alternative does come with some risks and those risks will be mitigated using best management practices, controlled and incremental removal, robust remedial design with contingencies for flooding, and construction oversight. EPA disagrees that containment has a lower risk of a release of dioxins. Alternative 6N and 4S eliminate the risk of future releases in the long-term. Remedial design will evaluate approaches that reduce opportunities for residual waste materials following removal, such as in-dry construction within a cofferdam. Containment of the waste through a cap system does not remove the waste so the potential for a release will be present for centuries. EPA also disagrees that there are no implementability issues with capping, given numerous factors for subaqueous caps that require consideration during remedial design, such as the added weight and geometry potentially resulting in waste material releases during construction, or from consolidation of underlying sediment expelling dioxin-contaminated colloids within porewater. Finally, the Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during this extreme storm event.*

2.2.32 Comment: I recommend that EPA select Alternative 3aN for this Site. The Remedial Design for Alternative 3aN should include the appropriate evaluations and modeling to determine the cap armor design and containment features necessary to ensure long-term effectiveness and reliability to resist ultra-extreme flow events and forces associated with potential channel migration processes that may impact the Site.

Response: *Alternative 3aN is an enhanced capping alternative with armor cap improvements (larger 15" armor stone, 24" of additional cap thickness on top of the Alternative 3N cap) to address the deficiencies of Alternative 3N. Alternative 3aN would be better able to withstand a future severe storm, although the Corps of Engineers model study did find that a future extreme storm would result in cap erosion over most of the Alternative 3aN cap. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. Unfortunately, these stronger hurricanes could not be reliably modeled because no relevant databases were available for use. Regardless, there still remains the uncertainties related to changes in channel planform morphology that may occur due to bank erosion, shoreline breaches, etc. during a high flow event caused by a major flood or hurricane, which is beyond the ability of existing sediment transport models to reliably simulate, as well as the uncertainty of making predictions that would have to remain relevant for hundreds of years into the future. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

2.2.33 Comment: This US Army Corps of Engineers modeling effort was focused on the Alternative 3N cap (with a range of median stone sizes from 3 to 10 inches), and was designed to simulate the 1994 flood event. But EPA essentially raised the bar with respect to an extreme event as part of its decision to revise and complete the Feasibility Study.

Response: *The US Army Corps of Engineers Report found that the Alternative 3N cap suffered significant erosion over 80% of the cap with Hurricane Ike, which is a Category 2 hurricane, and the 1994 flood. A more extreme Category 4 hurricane, with its associated higher winds, storm surge, and wind driven waves, although not modeled, would be expected to produce even more damage and erosion to a cap. The goal of the remedy for the Site is to be protective of human health and the environment, among other things. While a 100-year flood is certainly an extreme event, the Site will likely be exposed to even more extreme storms and hurricanes over the centuries that the dioxin waste would remain toxic, and consideration of these more extreme events is necessary to assess the long term ability of a remedy to remain protective. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic.*

2.2.34 Comment: Implementation of Alternative 3aN is straightforward and holds the advantage of a shorter construction time as compared to Alternative 6N.

Response: *Although the implementation of Alternative 3aN holds some advantages such as shorter construction time, it does not remove the principal waste threat and does not provide for a reliable long-term solution to protect the community and the environment. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

2.2.35 Comment: There will be residual sediments left in the lower horizons below the impoundments, even following waste removal. Alternative 6N calls for a capping remedy component for these residuals, and similar issues hold for this cap as for any of the containment alternatives. It therefore will not be the case that the waste material will be "permanently removed from the river" or that there is "no potential" for future releases.

Response: *EPA is lowering the cleanup level to 30 ng/kg 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) toxicity equivalent (TEQ). By lowering the remediation goals, a significant portion of the dioxin is permanently removed from the San Jacinto River system. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received* *during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. It is not anticipated that a backfill or cover layer will be required because the cleanup level has been lowered to 30 ng/kg 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) toxicity equivalent (TEQ).*

2.2.36 Comment: If EPA does not consider a containment alternative can reliably contain the waste for a 500-year timeframe, the same should be applied regarding potential releases from any off-site landfill where excavated material is placed. For this timeframe, there will be potential for releases and there will be issues for the effectiveness of a monitoring program for any off-site landfill. EPA completely ignores these issues in the Final Interim Feasibility Study and Proposed Plan.

Response: *Under Alternative 6N, excavated waste material would be dewatered (decanted) and stabilized by addition of Portland cement or other additive, as necessary, to eliminate free liquids for transportation and disposal. Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during the remediation will be tested to comply with the applicable requirements. Material that is removed would be transported in compliance with applicable requirements and permanently managed in an approved permitted facility in accordance with the Environmental Protection Agency's offsite rule. A permitted landfill, if that will be the final disposition location, is not subject to the natural and manmade forces as a cap in a dynamic river such as the San Jacinto River. In addition, a permitted landfill is occupied daily by workers, monitored daily, and controlled daily whereas the cap is monitored on a highly reduced schedule.*

2.2.37 Comment: EPA's comparison of alternatives was pre-disposed toward removal as a remedy approach and so inequitably exaggerated the disadvantages of a containment approach and dismissed the disadvantages of the removal approach. EPA refers to the erosion modeled for Alternative 3N Upgraded Cap for the duel extreme event in the Final Interim Feasibility Study and Proposed Plan and associates this result with the Alternative 3aN Enhanced Cap. This is an unequitable comparison. EPA does this repeatedly, referring to the 80 percent erosion finding for Alternative 3N a total of 13 times in the Final Interim Feasibility Study and Proposed Plan.

Response: *EPA considered all of the available Site information, in determining the selected remedy using the CERCLA remedy selection criteria. The US Army Corps of Engineers report contains information on the shortcomings and strengths of all of the alternatives without* *providing a recommendation or preference for the selection of an alternative. Capping would yield very low short-term releases while leaving the potential for failure under extreme events or stream bed morphological changes as experienced in the past. Removal could also yield low short-term releases with the most stringent best management practices and eliminate the potential for failure in the future. Even though Alternative 3aN consists of an upgraded cap, it is still subject to the uncertainties of severe floods, a dynamic river, and adequate maintenance over the centuries that the waste will remain toxic. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike). However, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

2.2.38 Comment: EPA is willing to accept a mass release of 0.34 % of the dioxin mass from the Site during implementation of a full removal under Alternative 6N with best management practices to control releases. No allowable release for containment and 0.34% mass release for removal is an inequitable comparison.

Response: *The 0.34% mass release stated in the comment was based on removal of a part of the waste material by underwater dredging, which is not a part of the final remedial action. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. The removal of wastes identified in Alternatives 6N and 4S will eliminate the risk of future releases over the centuries that the dioxin would remain toxic.*

2.2.39 Comment: EPA states in the Proposed Plan that Alternative 3aN Enhanced Cap does not include additional measures to reduce toxicity, mobility, or volume. But, by definition, a containment remedy does in fact reduce mobility of the waste. Alternative 3aN significantly reduces mobility through a robust cap design. Further, Alternative 3aN will reduce the volume of the waste as a result of consolidation under the additional load of an enhanced cap.

Response: *A containment remedy does not reduce the toxicity, mobility, or volume of contaminants through treatment. A robust cap may reduce mobility of a contaminant provided* *the site has stable environmental conditions. River and sediment bed conditions at this Site raise substantial questions regarding the long-term effectiveness of a cap. More specifics are provided below in the technical section dealing with capping comments. Alternative 3aN would not necessarily reduce the volume of waste because the material was placed under additional load. If the waste were further compressed it could be the result of voids in the material or expulsion of liquids. Compressing a void would not reduce the volume of material. Expulsion of liquids could result in a reduction of volume in place but dissolved and colloidal contaminants would be released as a result and enter the ecosystem.*

The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion would likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike). However, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

Under Alternative 6N, excavated waste material would be dewatered (decanted) and stabilized by addition of Portland cement or other additive, as necessary, to eliminate free liquids for transportation and disposal. These steps would reduce the mobility of the contaminants. In addition, Alternative 6N has the greatest volume of removal – 162,000 cubic yards. Therefore, Alternative 6N more fully meets Primary Balancing Criteria – Reduction of Toxicity, Mobility, or Volume through Treatment. Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during the remediation will be tested to comply with the applicable requirements. Treatment of a portion of the paper mill waste by solidification with cement was successfully performed during the Time Critical Removal Action (TCRA) on a portion of the Western Cell materials.

2.2.40 Comment: EPA tries to take credit for reduction in volume under Alternative 6N simply due to the removal of the material. But, Alternative 6N Full Removal does not reduce volume, it simply moves volume from one place to another. In fact, there would be an increase in volume under Alternative 6N due to the stabilization treatment prior to transport and disposal in the landfill.

Response: *The dioxin contaminated material will be removed from the San Jacinto River system, and therefore the volume and potential for release of waste to the river will be permanently reduced. The commenter correctly points out that the material will be moved to another location. However, the new location will be a permitted landfill with minimal exposure resulting in human and ecological risks. There is no question that landfills are more easily monitored and observed for corrective measures than are underwater locations in a river dynamic as the San Jacinto River.*

2.2.41 Comment: EPA commented in the Final Interim Feasibility Study on the cost-effectiveness of Alternative 6N with respect to releases, but this comment is a clear example of overreach in an attempt to justify a removal remedy. EPA states: "The cost of Alternative 6N ($87 million) is about 21 times more than the cost of the upgraded capping Alternative 3N ($4.1 million), but is about 3.5 times more than the cost of enhanced capping Alternative 3aN ($24.8 million). However, the potential future dioxin release for the temporary cap with the upgrades described for the Upgraded Cap (Alternative 3N) during a future severe storm results in a release of approximately 29% of the dioxin in the waste pits." (Final Interim Feasibility Study, p. ES-17). Use of such wording in the Proposed Plan is very frustrating. It is disingenuous of EPA to cite the release for Alternative 3N Upgraded Cap instead of the zero release for a properly enhanced and effective Alternative 3aN Enhanced Cap, and equally if not more disingenuous to tie that to a comparison of the cost of Alternative 3aN to Alternative 6N, and so implying that for 3.5 times the cost we avoid a potential 29% release. The comparison of the alternatives in the Proposed Plan, exemplified by the use of the tactics in the above examples, was inequitable and inconsistent with EPA policy as described in the EPA principals.

Response: *There are a number of significant technical concerns which are discussed in section 2.5 below which are the primary reasons that capping is not the preferred alternative for a long-term effective solution. In certain environmental settings, capping is very effective. However, at this particular Site in the San Jacinto River system, capping would be less effective. Although cost is an important factor, the overriding reasons removal is appropriate here is because Houston is prone to hurricanes, severe storms and storm surges, which lessen the long-term effectiveness of a capping remedy.*

Regarding cost-effectiveness, removal will eliminate the potential for the costs associated with cleaning up a large contaminated sediment site that may result from the failure of a cap. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

2.2.42 Comment: The selection of Alternative 6N Full Removal in the Proposed Plan is largely based on assumed ultra-extreme flow events or possible channel migration processes, perceived uncertainty surrounding such ultra-extreme events, and perceived uncertainty in the ability to design Alternative 3aN Enhanced Cap to resist such events. In reality, Alternative 3aN Enhanced Cap can be designed as a robust containment remedy which will provide long-term effectiveness and permanence in the face of such ultra-extreme events and processes.

Response: *Even though Alternative 3aN consists of an upgraded cap, it is still subject to the uncertainties of severe floods, a dynamic river, and adequate maintenance over the centuries that the waste will remain toxic. Climate models (Knutson and others, 2010) predict an increase in the intensity of tropical cyclones and hurricanes in the Gulf, meaning greater risk of flooding and storm surges over the long time frame that the dioxin waste would remain toxic. The cap design uncertainty arises from the potential increase in storm intensity over the extended period that a cap would need to maintain its effectiveness. The storm intensity uncertainty, coupled with the inherent uncertainties of the models used to predict the future performance result in a highly uncertain prediction of the ability of a cap to reliably contain the waste. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

2.2.43 Comment: U.S. EPA has inappropriately selected a remedy that requires an existing, approved and properly performing cap to be precipitously removed at great expense and with no incremental benefit.

Response: *As stated in the "Request for a Time Critical Removal Action at the San Jacinto River Waste Pits Site", the removal action is to stabilize the site, temporarily abating the release of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (and possibly PCBs) into the waterway, until the site is fully characterized and a remedy is selected. Documented events have shown that the current cap has suffered damages and deficiencies from floods that were less than the 100-year design flood event. Since its completion in July 2011, repairs to the cap have been performed in July 2012, January 2013, January 2014, December 2015, February 2016, March 2016, and June 2016 since its completion in July 2011. Dioxin waste was actually exposed to the river in 2015. The goal of the selected removal alternative is to eliminate the potential of an enhanced cap being breached and releasing contaminated material into the environment. EPA understands that the removal alternative comes with risk. Potential releases can and will be controlled through engineering control measures and best management practices, construction oversight, and a robust removal design. The removal of wastes identified in Alternatives 6N and 4S eliminates the risk of future releases in the long-term. A containment of the waste through a cap system does not remove the waste so the potential for a release will be present for centuries.*

2.2.44 Comment: Capping at upland sites, as well as at sediment sites, is a widely used and accepted remedial technology. In the context of contaminated sediment sites capping has been successfully used to manage contaminated sediments for more than 20 years. Experience has shown that, although a certain amount of monitoring and maintenance is required for any cap, capping technology is both safe and effective. In fact, we are not aware of any instance in which an armored cap, such as that currently in place at the San Jacinto River Waste Pits Site, has ever failed resulting in a release of contained contaminants to the environment.

Response: *In 2014 the Interstate Technical and Regulatory Council published a guidance document which indicates site conditions that increase cap stability include deep water, low erosive forces including low flow, limited wave effects, and limited navigation related prop wash (Interstate Technical and Regulatory Council, 2014). The Site cannot be described as having low erosive forces and limited wave effects on a consistent basis. Further, the Site is in an active navigation area. After an extensive literature review, the U.S. Corps of Engineers found that there have been many occurrences of breaches and slope failures of armored dikes, jetties, and breakwaters, with some of those structures confining dredged material.*

The existing temporary cap was constructed as an interim measure to stabilize the waste pits until a final remedy could be developed. The cap has undergone a number of repairs that shows some of the weaknesses of containment. First, repairs were made on the western berm due to sloughing of the armor stone. Second, a 400 to 500-sq ft section of the cap failed, which exposed dioxin wastes in the Northwestern Area. This failure appeared to have been caused by a bearing capacity failure from a poor filter layer and soft waste materials. Third, numerous locations in the Eastern Cell were repaired because the geotextile was exposed from apparent shifting or movement of the armor cap. Lastly, an area of scour nearly adjacent to the Eastern Cell was filled and armored from the edge of the cap to the outer limit of the scour hole. Additional riverbed scour is expected, and in fact occurred due to excessive rainfall and flooding during Hurricane Harvey. The impacts associated with Hurricane Harvey at the Site are not due to wave impacts associated with tidal surge, but were a result of flooding associated with the hurricane. The exact dimensions of this scour zone are unknown at this time. Consequently, the temporary cap is a less than secure containment.

Further, The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

2.2.45 Comment: The maintenance activities between 2012 and 2015 cited in the Proposed Plan do not support the conclusion that the existing cap is inadequate. Over this nearly 5-year period, less than 0.6% of the cap surface area required any maintenance. The maintenance activities described on page 4 of the Proposed Plan depict minor and routine maintenance activities involving small areas of cap that appear to have been quickly corrected. Moreover, potentially responsible parties support enhancements to the cap as provided in Alternative 3aN. These enhancements would be expected to further improve cap integrity and performance, providing a large additional design safety factor. It is inappropriate to evaluate the performance of a capping alternative (Alternative 3aN), based on the performance of a cap that has not yet been fully constructed and armored.

Response: *There are environmental conditions that raise significant concerns regarding the long-term effectiveness of a cap, even an enhanced cap at this Site. EPA disagrees with the assertions in the comment, both considering the adequacy of the existing cap in the San Jacinto River system, and that repeated cap repairs can be defined as routine maintenance. In 2015, an area was discovered where the dioxin waste was directly exposed to the river. This performance does not improve confidence that the waste can be reliably contained for much more severe storms to come over a timeframe of centuries. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike). However, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

2.2.46 Comment: The Principal Threat Waste Guidance was created "to streamline and focus the Remedial Investigation/Feasibility Study on appropriate waste management options", not to supersede or pre-empt the NCP's nine remedy selection criteria. The Principal Threat Waste Guidance focuses the scope of the preference for treatment, but is not a preference for removal and does not override the NCP's remedy selection criteria, as follows: "The selection of an appropriate waste management strategy is determined solely through the remedy selection process outlined in the National Contingency Plan (i.e., all remedy selection decisions are site-specific and must be made on a comparative analysis of the alternatives using the nine criteria). At this Site, the National Contingency Plan's mandatory criteria on protectiveness, short-term and long-term effectiveness, implementability and cost-effectiveness support an enhanced cap, as demonstrated by the Army Corps Report.

Response: *CERCLA Section 121(b)(1) states in part:*

- *Remedial actions in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances, pollutants, or contaminants is a principal element, are to be preferred over remedial actions not involving such treatment.*

- *The President shall conduct an assessment of permanent solutions and alternative treatment technologies or resource recovery technologies, that in whole or in part, will result in a permanent and significant decrease in the toxicity, mobility, or volume of the hazardous substance, pollutant, or contaminant.*

- *The President shall select a remedial action that is protective of human health and the environment, that is cost effective, and that utilizes permanent solutions*

> *and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. If the President selects a remedial action not appropriate for preference under this subsection, the President shall publish an explanation as to why a remedial action involving such reductions was not selected.*

Reflecting these provision in CERCLA Section121(b), EPA established program management principals and certain expectations in the NCP regarding types of remedies that EPA has found to be most appropriate for different types of waste.[1] *Although remedy selection decisions are ultimately site-specific determinations based on an analysis of the remedial alternatives using the nine criteria, these expectations are intended to streamline and focus the RI/FS on appropriate waste management options. They reflect EPA's belief that certain source materials are addressed best through treatment because of technical limitations to the long-term reliability of containment technologies, or the serious consequences of exposure should a release occur.*[2] *For example, EPA's experience that highly mobile waste generally requires treatment may help guide EPA to focus the detailed analysis in the FS on treatment alternatives, as compared to containment alternatives.*[3]

Under the NCP at 40 CFR § 300.430(a)(iii)(A), EPA expects to use treatment to address the principal threats posed by a site, wherever practicable. Principal threats for which treatment is most likely to be appropriate include liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile materials.[4] *The EPA Guide to Principal Threat and Low-level Threat Waste further explains that principal threat wastes are those source materials considered highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur.*[5] *Principal Threat Waste (PTW) includes liquids and other highly mobile materials (e.g. solvents) or materials having high concentrations of toxic compounds.*[6] *No threshold of toxicity/risk has been established to equate to "principal threat." However, where toxicity and mobility of source material combine to pose a potential risk of 10-3 or greater, generally treatment alternatives should be evaluated.*[7] *Also, treatment that destroys or reduces hazardous properties of*

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1 Preamble to the Final NCP Rule, 55 Fed. Reg. 8666, 8702 (Mar. 8, 1990) and Preamble to the Proposed NCP Rule, 53 Fed. Reg. 51394, 51422 (Dec. 21, 1988).

2 "A Guide to Principal Threat and Low Level Threat Wastes", U.S. EPA, November 1991 (OSWER 9380.3-06FS) [hereinafter *PTW Guidance*] at p.1. "Source material" is defined as material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration on contaminants to ground water, to surface water, to air, or act as a source for direct exposure.

3 55 Fed. Reg. at 8702.

4 40 C.F.R. § 300.430(a)(iii)(A).

5 *PTW Guidance* at p.2, *see also 55 Fed. Reg. at 8703 and 53 Fed. Reg. at 51422.* Principal threats are characterized as waste that cannot be reliably controlled in place such as liquids, highly mobile materials (e.g., solvents), and high concentrations of toxic compounds (e.g., several orders of magnitude above levels that allow for unrestricted use and unlimited exposure).

6 Id.

7 Id.

contaminants (e.g., toxicity or mobility) frequently will be required to achieve solutions that afford a high degree of permanence.[8] *EPA also recognizes that "although no threshold level of risk has been established to identify principal threat waste, a general rule of thumb is to consider as a principal threat those source materials with toxicity and mobility characteristics that combine to pose a potential risk several orders of magnitude greater than the risk level that is acceptable for the current or reasonably anticipated future land use, given realistic exposure scenarios."*[9]

Examples of PTW include but are not limited to:

- *Liquids – wastes contained in drums, lagoons, or tanks, free product (NAPL or DNAPL)*

- *Mobile source materials – surface soil or subsurface soil containing high concentrations of contaminants of concern that are (or potentially are) mobile due to wind entrainment, volatilization (e.g., VOCs), surface runoff, or subsurface transport.*

- *Highly toxic source material – buried drummed non-liquid wastes, buried tanks containing non-liquid wastes, or soils containing significant concentrations of highly toxic materials. For PCB contamination or PCB waste at Superfund sites, principal threats will generally include material contaminated at concentrations exceeding 100ppm for sites in residential areas and concentrations exceeding 500 ppm for sites in industrial areas reflecting concentrations that are 1 to 2 orders of magnitude higher than the preliminary remediation goals.*[10]

Under the NCP at 40 C.F.R. § 300.430(e) Feasibility Study, the primary objective of the feasibility study (FS) is to ensure that appropriate remedial alternatives are developed and evaluated such that relevant information concerning the remedial action options can be presented to the decision-maker and an appropriate remedy be selected. EPA's RI/FS guidance on developing and screening remedial alternatives further provides that alternatives should be developed ranging from one that would eliminate or minimize the extent feasible the need for long-term management (including monitoring) at a site to one that would use treatment as a primary component of an alternative to address principal threats at the site.[11] *EPA's PCB Guidance states that the Superfund program expectations should be considered in developing appropriate response options for the identified area over which some action must take*

[8] 53 Fed. Reg. at 51422.

[9] "Rules of Thumb for Superfund Remedy Selection", U.S. EPA, August 1997, (OSWER Pub. 9355.0-69) at p.11.

[10] "Guidance on Remedial Actions for Superfund Sites with PCB Contamination", U.S. EPA, August 1990, (EPA/540/G-90/007) [hereinafter *PCB Guidance*] at p. iv. *See also PCB Guidance* p. 6, p. 39, and p. 40.

[11] "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA - Interim Final", U.S. EPA October 1988 (OSWER Dir. 9355.3-01) [hereinafter *RI/FS Guidance*] at p. 4-7.

place.[12] *In particular, the expectation that principal threats at the site should be treated, wherever practicable, and that consideration should be given to containment of low-threat material, forms the basis for forming alternatives.*[13]

A detailed analysis in the FS at this Site has evaluated remedial alternatives using the nine criteria specified in the NCP, including the criterion Reduction of toxicity, mobility, or volume through treatment, which addresses how treatment is used to address principal threats at the site.[14] *This evaluation criterion addresses the statutory preference for selecting remedial actions that employ treatment that permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances as their principal element. This preference is satisfied when treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, reduction of total mass of toxic contaminants, irreversible reduction in contaminant mobility, or reduction in the total volume of contaminated media.*[15] *In evaluating this criterion an assessment should be made as to whether treatment is used to reduce principal threats, including the extent to which toxicity, mobility, or volume are reduced either alone or in combination.*[16] *Additionally, alternatives were using the Long-term effectiveness and permanence criterion which focuses on the degree to which an alternative reduces, toxicity, mobility, or volume through treatment, minimizes residual risks and affords long-term protection.*[17]

Pursuant to 40 C.F.R. § 300.430(e)(3), for source control actions, the lead agency shall develop, as appropriate: (i) A range of alternatives in which treatment that reduces the toxicity, mobility, or volume of the hazardous substances, pollutants, or contaminants is a principal element. As appropriate, this range shall include an alternative that removes or destroys hazardous substances, pollutants, or contaminants to the maximum extent feasible, eliminating or minimizing, to the degree possible, the need for long-term management. The lead agency also shall develop, as appropriate, other alternatives which, at a minimum, treat the principal threats posed by the site but vary in the degree of treatment employed and the quantities and characteristics of the treatment residuals and untreated waste that must be managed." (Emphasis added)

Consistent with CERCLA, the NCP, and EPA guidance, PTW was identified at this Site as discussed below in this section.

Furthermore, consistent with the statutory mandate to utilize permanent solutions and alternative treatment or resource recovery technologies to the maximum extent practicable and the preference for remedies that to the maximum extent practicable employ treatment that permanently and significantly reduces the toxicity, mobility, or volume of hazardous substances,

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[12] *PCB Guidance* at p. iv.
[13] *Id*.
[14] *See* 40 C.F.R. § 300.430(e)(9) *Detailed Analysis of Alternatives*.
[15] *RI/FS Guidance* at p. 6-8.
[16]*Id*. at p. 6-8 and p. 6-9
[17] 40 C.F.R. § 300.430(e)(7)(i) and § 300.430(e)(9)(iii).

pollutants or contaminants, the Agency has evaluated potential treatment options for the dioxin prior to disposal. These options are designed to address the toxicity and mobility of the PTW at this site so that it will not be further released into the environment after disposal. Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during the remediation will be tested to comply with the applicable requirements. Treatment of a portion of the paper mill waste by solidification with cement was successfully performed during the Time Critical Removal Action (TCRA) on a portion of the Western Cell materials. EPA will implement the best technology to meet the statutory requirements discussed above after further evaluation in the remedial design.

The purpose of discussing PTW is not to set cleanup levels. The purpose is to reflect EPA's belief that certain source materials are addressed best through treatment because of technical limitations to the long-term reliability of containment technologies, or the serious consequences of exposure should a release occur.

Dioxin is highly toxic and persistent (will not break down for hundreds of years) in nature. With the regular occurrence of severe storms and flooding in the area, there is uncertainty that the waste material can be reliably contained over the long term and therefore should be considered potentially highly mobile due to its location in a dynamic river environment. Because the dioxin waste in the northern impoundments and southern impoundment at the Site is both highly toxic and potentially highly mobile, it is considered a Principal Threat Waste.

2.2.47 Comment: USEPA should withdraw the Proposed Plan while it reconsiders the very significant implementability issues posed by the proposed remedy.

Response: *The implementability issues raised are not unusual for Superfund sites and have been adequately addressed in the responses to other comments. The EPA does not plan to withdraw the Proposed Plan and further delay the implementation of the final cleanup of the Site.*

2.2.48 Comment: The closure in place represents not only a reduction in exposure risk to the area near the Site, it represents zero risk to communities and residents beyond the Site. It is imperative that anyone potentially affected by the proposed removal action or the associated material handling, transportation and disposal be informed of the risks associated with the movement from the Site to whatever final destination is selected of the estimated 162,000 cubic yards of contaminated material and the 13,300 truck trips that will required to affect the suggested Site closure.

Response*: Even though Alternative 3aN consists of an upgraded cap, it is still subject to the uncertainties of severe floods, a dynamic river, and adequate maintenance over the centuries that the waste will remain toxic. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the* *cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike). However, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

The Site remediation is required to meet applicable or relevant requirements and, as such, the waste and sediment testing and disposal will meet the standards required by State and Federal regulations. The spill plan, a standard component of a Superfund cleanup, includes a notification and response plan for any transport spills as well as contingencies to address spills, leaks and accidents. Transport vehicles will be lined, covered, or sealed to minimize losses during transport.

2.2.49 Comment: Neither Region 6's Feasibility Study nor the Proposed Plan demonstrated that the waste pit materials could not be reliably contained on-site. Rather, Region 6 substituted subjective judgment in ignoring containment cap engineering design and the large amount of information available from other sites where these remedies have been used in similar situations.

Response: *Capping is an acceptable remedy given the right environmental conditions. As discussed more fully in section 2.5 below there are a number of technical concerns which impact the long-term effectiveness of the capping solution. These concerns include the uncertainties of severe flooding, location in a dynamic river, adequate maintenance, and potentially increasing storm severity over the centuries that the waste will remain toxic. The current cap with enhancements as simulated by US Army Corps of Engineers experienced significant cap erosion over 80% of the cap. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike). However, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

2.2.50 Comment: There is no underestimating the importance of engineering design on any containment remedy. On EPA's Clu-In website, Reible (2004) has noted that "Retention of contaminants for decades, centuries, or longer may be expected if the cap can be properly placed and retained over these time periods…It is likely to be feasible to design a cap to be stable under almost any hydraulic forces". This is as true for the Site as it is in general and it appears that Region 6 has given insufficient attention to engineering in evaluation of remedial alternatives. Most of the existing uncertainties in the containment alternatives are a matter of simple environmental and civil engineering practice that can easily be managed through the remedial design process that is implemented following issuance of the ROD.

Response: *EPA agrees that capping can be an effective long-term technology given the appropriate setting. However, the EPA is concerned that the setting of the San Jacinto River Site is not suitable for capping as a long-term solution for the dioxin contaminated waste materials. The inability to accurately predict the intensity of future storms and hurricanes, which is projected to increase (Knutson and others, 2010), creates an unknown amount of uncertainty regarding the conditions to be engineered for. The current temporary cap was designed for a hundred-year flood, yet in the last five years there have already been problems with the cap resulting in exposure of dioxin contaminated waste to the San Jacinto River following floods less that the design flood.*

2.2.51 Comment: Region 6 appears to assume without evidence that operation and maintenance (O&M) of the cap will fail and the Proposed Plan devotes a substantial amount of discussion to what Region 6 believes are failures in operation and maintenance. What Region 6 fails to recognize here is that operation and maintenance of any significant civil engineering project is a dynamic and iterative process. One would be hard pressed to find any major structural project in the U.S. that did not have modifications to its maintenance over years of operation as more information became known about the structure and its relationship to its environment. What is important is that there is a legal commitment to inspection and maintenance that evolves as time passes.

Response: *The maintenance of typical civil engineering projects does not involve the potential for exposure of the surrounding community on an abrupt basis to a highly toxic material before the need for maintenance may even be identified. The comment suggests that inspection and maintenance are the solution to all technical ills of a subaqueous cap. But this is not necessarily true. In 2014 the Interstate Technical and Regulatory Council published a guidance document which indicates site conditions that increase cap stability include deep water, low erosive forces including low flow, limited wave effects, and limited navigation related prop wash (Interstate Technical and Regulatory Council, 2014). The Site cannot be described as having low erosive forces and limited wave effects on a consistent basis. Further, the Site is in an active navigation area. During the past five years, the temporary cap has not demonstrated performance of a long-term stable nature. Similar to ITRC, EPA guidance for subaqueous capping identifies similar site conditions factors in selecting a capping remedy. Finally, maintenance does not address the concern that cap repairs following a release of waste materials is reactive after exposure of the environment and surrounding community have been exposed to contaminants. This issue is not addressed through implementing a robust operation and maintenance approach.*

It should be noted that in the Final Interim FS Report submitted by the PRPs, the report states, "Monitoring and maintenance be required for as long as the dioxin/furan represents an unacceptable risk should exposure occur. Dioxins and furans are persistent contaminates that will not readily break down. While there is much uncertainty regarding how long the waste materials will represent an unacceptable risk should exposure occur, but by one estimate approximately 750 years would be required for the waste to break down to the PRG level. The FS only included Long Term Cap Maintenance costs of $ 181,000 (Net Present Value). Given the repairs that have already been conducted at the Site since the removal action, the PRPs have *severely underestimated the long term maintenance cost associated with leaving the waste in place.*

2.2.52 Comment: Regardless of the exact releases, the best practice alternatives will result in adding complexity to a remedial alternative that is already highly complex. Increasing complexity breeds the probability of increasing failure. Given these and other related conclusions in the US Army Corps of Engineers analysis, there is little justification for selecting Alternative 6N in preference to Alternative 3aN.

***Response**: EPA disagrees that the proposed alternative is adding inappropriate complexity to a remedial alternative that is already highly complex. Removal of the material reduces complexity of the San Jacinto River Site over the long-term. Alternative 6N will remove the waste from the San Jacinto River, so there will not be a need for future maintenance as would likely be involved with Alternative 3aN. Further, there will be no concern that sometime in the future a severe hurricane will result in an abrupt release of highly toxic dioxin into the environment. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

2.3 Risk Assessment

This section includes comments regarding risk assessment. The most common comments were associated with: (1) the use of the biota-sediment-accumulation-factor (BSAF) from EPAs Combustion Guidance as opposed to site-specific BSAFs; (2) the appropriateness of the fish ingestion pathway for the determination of risks and ultimately the Principal Threat Waste limit, and (3) the determination of the Principal Threat Waste limit based on ten times the remediation goal established based on non-cancer dioxin and furan risks in lieu of cancer risks.

2.3.1 Comment: The U.S. Government including the National Institutes of Health and the EPA has not proved that dioxin is a hazardous material by the standards of the science on causation or by any ruling that met the tests for causation.

Response: *The contaminants at the Site include dioxin (specifically 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD), one of the most toxic members of the class of dioxins) and dioxin-like compounds (DLCs) (including polychlorinated dibenzo-dioxins in addition to TCDD), polychlorinated dibenzofurans, and polychlorinated biphenyls. These hazardous substances are structurally and toxicologically related halogenated di-cyclic aromatic hydrocarbons. Dioxin and DLCs are released into the environment from several sources, including industrial sources such as chemical manufacturing, combustion, and metal processing; from the bleached chlorine pulp at paper mills, from personal activities including the burning of household waste (backyard burning); and from natural processes such as forest fires and volcanoes. Dioxin and DLCs are widely distributed throughout the environment, and because they do not readily degrade their levels persist in the environment. As discussed further below, the type of dioxin most prevalent in the paper mill waste disposed at the Site is TCDD, unlike other, more widespread,“background” sources of dioxin such as diesel exhaust and backyard burning.*

The human health effects from exposures to dioxin and DLCs have been documented extensively in epidemiologic (human) and toxicological (animal) studies. TCDD is one of the most toxic members of this class of compounds and has a robust toxicological database. The USEPA thoroughly and publicly reviewed the toxicity of TCDD and published a reference dose (RfD) for TCDD in 2012 (EPA’s Reanalysis of Key Issues Related to Dioxin Toxicity and Response to NAS Comments, Volume 1, EPA/600/R-10/038F, February 2012). The USEPA is not currently assessing the carcinogenicity of TCDD. The World Health Organization's International Agency for Research on Cancer (IARC) and the U.S. National Toxicology Program have both independently concluded that TCDD is a known human carcinogen.

EPA gathers evidence from a variety of sources regarding the potential for a substance to cause adverse health effects (carcinogenic and noncarcinogenic) in humans. These sources include controlled epidemiologic investigations, clinical studies, and experimental animal studies. Supporting information may be obtained from sources such as in-vitro test results and comparisons to structure-activity relationships. Taken together, EPA then develops a quantitative analysis and reports qualitatively the confidence in the study from which toxicity values were derived. In most cases one type of study does not provide conclusive evidence on its *own, so researchers usually look at both human and lab-based studies and other supporting information when trying to determine if something causes cancer.*

EPA recognizes that several epidemiological investigations involved Vietnam veterans. One of those studies was completed by the Centers for Disease Control, Atlanta, on U.S. Army Vietnam veterans who were likely to be exposed to the herbicide Agent Orange. Serum levels of TCDD, a toxic contaminant in Agent Orange, were obtained for 646 ground combat troops who served in heavily sprayed areas of Vietnam, and for 97 veterans who did not serve in Vietnam. TCDD medians for Vietnam veterans (median = 3.8 ppt) and non-Vietnam veterans (median = 3.9 ppt) were virtually the same. This study is consistent with later studies and suggests that most U.S. Army ground troops who served in Vietnam were not heavily exposed to TCDD. (JAMA 1988;260:1249-1254).

The EPA also looked at studies done on other groups of people: 1) herbicide manufacturing workers, herbicide applicators and farmers who often had much higher blood dioxin levels than Vietnam veterans; 2) people exposed to dioxin after industrial accidents in Seveso (Italy) and Germany; and 3) people after chronic exposures at work and in the environment. The EPA considered this information in developing its toxicity value for TCDD.

EPA followed the National Contingency Plan or NCP (a rule implementing the Superfund program) and other guidance in developing a site-specific baseline risk assessment for the San Jacinto River Waste Pits Superfund Site. EPA's selection of toxicity values for dioxin was based on EPA's December 5, 2003, directive Human Health Toxicity Values in Superfund Risk Assessments. This directive provides a hierarchy, based on best science available, of human health toxicity values generally recommended for use in risk assessments at Comprehensive Environmental Response Compensation and Liability Act (CERCLA, or Superfund) sites. The hierarchy consists of three tiers:

- *Tier 1. EPA's Integrated Risk Information System (IRIS) toxicity values*

- *Tier 2. In the absence of IRIS values, selection of EPA's Provisional Peer-Reviewed Toxicity Values (PPRTVs). The Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center (STSC) develops PPRTVs on a chemical specific basis when requested by EPA's Superfund program.*

- *Tier 3. In the absence of PPRTVs, selection of Other Toxicity Values, which includes additional EPA and non-EPA sources of toxicity information. Priority should be given to those sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer reviewed.*

EPA selected a Tier 1 toxicity value as the reference dose for noncancer effects. The reference dose for TCDD is 7E-10 mg/kg-day (EPA's Reanalysis of Key Issues Related to Dioxin, 2012). The noncancer toxicity value for TCDD was based on two epidemiologic studies that associated TCDD exposures with adverse health effects. The first study reports decreased sperm concentration and sperm motility in men who were exposed to TCDD during childhood *during the Seveso accident (Mocarelli et al., 2008), and the second reports increased thyroid-stimulating hormone levels in newborns born to mothers who were exposed to TCDD during the Seveso accident (Baccarelli et al., 2008). Adverse health effects were observed in sensitive susceptible very young members of the population during their development in utero and identified the first 10 years of life as a critical window of susceptibility for TCDD induced sperm effects in young children. IRIS also gives the confidence level associated with the toxicity value. The degree of confidence ascribed to a toxicity value is a function of both the quality of the individual study from which it was derived and the completeness of the supporting data base. IRIS gave a confidence level of "High" to the non-cancer toxicity value for dioxin. Toxicity values published in IRIS are classified as Tier 1 toxicity values and are preferred over other classified tiered toxicity values.*

Currently there is no cancer toxicity value or slope factor for dioxin published in IRIS. However, whenever possible and appropriate EPA evaluates chemicals for both cancer and non-cancer effects for chemicals that exert these types of effects. Dioxin is known to have both cancer and non-cancer health effects. Therefore, EPA evaluated the risk from both types of adverse health effects in its site specific baseline risk assessment. Complying with EPA's Dec. 5, 2003 directive, EPA used a Tier 3 cancer toxicity value in its cancer risk evaluation in the site specific risk assessment. EPA used the California EPA Cancer Slope Factor (CSF) for TCDD of 1.3E+5 (mg-kg-day)-1 (at Cal EPA's 2002 Air Toxics Hot Spots Program, Risk Assessment Guidelines, Part II, Technical Support Document for Describing Available Cancer Potency Factors. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment (OEHHA), Sacramento, CA). As a result of its evaluation, EPA relied on the Tier 1 toxicity value for noncancer effects in its decision regarding the risk and cleanup development for the Site, but not the cancer effects of dioxin. EPA included a discussion of the cancer effects in its risk assessment to show that by cleaning the site to the non-cancer effects level, EPA is also protecting for cancer effects.

2.3.2 Comment: It is unclear if groundwater beneath the waste impoundments is protective of the Texas Surface Water Quality Standard (TSWQS) of 7.97E-8 ug/L for dioxins/furans (TCDD equivalents) as the detected concentrations in groundwater beneath the northern and southern impoundments was reported to be 2.64E-6 ug/L and 60.2E-6 u/L respectively. Additionally, the TSWQS for dioxins/furans (TCDD equivalents) is based on the total concentration of dioxins/furans in water. Total dioxins/furans concentrations include both dissolved and suspended dioxins/furans. Due to their hydrophobicity, low solubility, and low volatility, dioxins/furans in groundwater are expected to preferentially partition to suspended solids, including colloidal particles. The analytical results reported in the September 2016 Data Summary Report for samples collected using a solid phase micro extraction method only represents the concentrations of dissolved dioxins/furans and cannot be used to demonstrate compliance with TSWQS.

Response: *Removal of the dioxin waste will remove the source of dioxin contamination to ground water, while capping the waste will leave the source material in place. The sampling and analysis methods will be determined during the remedial design/long-term monitoring phase of the project. Both the total and dissolved fraction will be evaluated. It is anticipated that the* *selected alternative would reduce dioxin/furan concentrations in groundwater directly below the impoundments due to removal of the source. Long-term ground water monitoring may be performed if required to demonstrate compliance with the Texas Surface Water Quality Standard for dioxins and furans.*

2.3.3 Comment: It is unclear what the scientific/risk assessment basis is for the calculation of the Principal Threat Waste value, as well as what it means for cleanup at this Site. The Principal Threat Waste cleanup value is described as being calculated by multiplying the sediment Preliminary Remediation Goal (PRG) of 30 ng/kg by a factor of 10. However, there is no explanation of the reasoning behind the factor of 10. EPA should provide the scientific/risk assessment basis for calculation of the principal threat waste value. EPA should also explain how principal threat waste is to be used in the context of the other calculated PRGs for the Site.

Response: *The purpose of discussing Principal Threat Waste is not to set cleanup levels. The purpose is to reflect EPA's belief that certain source materials are best addressed through treatment because of technical limitations to the long-term reliability of containment technologies, or the serious consequences of exposure should a release occur. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. They include liquids and other highly mobile materials (e.g., solvents) or materials having high concentrations of toxic compounds. No "threshold level" of toxicity/risk has been established to equate to "principal threat." However, where toxicity and mobility of source material combine to pose a potential risk of 10^{-3} ("A Guide to Principal Threat and Low Level Threat Wastes", Superfund Publication: 9380.3-06FS November 1991) or greater, generally treatment alternatives should be evaluated. EPA policy sets a precedent for defining principal threat waste based on a multiple of a risk based level. For example, waste demonstrating a carcinogenic risk of 10^{-3}. which is 10 times higher than the upper end of the acceptable risk of 10^{-4}, is considered a principal threat. Based on this precedent, the PRG of 30 ng/kg based on non-carcinogenic health effects was multiplied by 10. Using a factor of 10 ensures that the waste could be released over the area of exposure with only limited dilution without causing exceedance of risk levels. The basis for the Principal Threat Waste value is included in the Record of Decision.*

2.3.4 Comment: Ultimately, the goal is removal of the fishing advisory in the area. The Toxicity Equivalency Quotient (TEQ) fish tissue Health Assessment Comparison (HAG) of 2.33 ng/kg is the value DSHS uses for dioxin fishing advisories. In review of EPA's August 29, 2016, Memorandum, "Human Health Risk Evaluation and Recommended Sediment Cleanup Level for Site Specific Exposure to Sediment at the San Jacinto River Superfund Site," the calculation of the sediment PRG of 30 ng/kg for dioxin is somewhat explained. EPA calculated PRGs individually for sediment ingestion, dermal exposure to sediment, and fish/shellfish ingestion, as well as a sediment PRG for fish consumption. EPA then calculated a total PRG associated with a hazard index of 1 from exposure to sediment through the ingestion of sediment, dermal contact with the sediment, ingestion of finfish, and ingestion of shellfish. The total sediment PRG is calculated to be 28.9 ng/kg, which EPA then rounds to 30 ng/kg. However, EPA does not provide the calculation for this PRG, so it is unknown how this final value was calculated from the individual PRGs.

Exposure Pathway	Calculated Non-Cancer PRG
Sediment ingestion	7.86E-4 mg/kg = 786 ng/kg
Dermal exposure to sediment	2.77E-4 mg/kg = 277 ng/kg
Fish tissue ingestion	3.13E-6 mg/kg = 3.13 ng/kg
Shellfish ingestion	7.3E-5 mg/kg = 73 ng/kg
Total sediment: ingestion, dermal, ingestion offish/shellfish	30 ng/kg (rounded up)
Sediment-to-fish consumption	35 ng/kg

The fish tissue PRG EPA calculated, which is used in the calculation of the total sediment PRG, is 3.1E-6 mg/kg, or 3.1 ng/kg. This fish tissue PRG is 1:33 fold higher than the DSHS dioxin fish tissue HAC of 2.33 ng/kg. Similarly, EPA uses the fish tissue PRG in the calculation of the sediment-to-fish consumption PRG of 35 ng/kg. By using a fish tissue PRG 1.33 fold higher than the DSHS dioxin fish tissue HAC, the resulting total sediment PRG and sediment-to-fish consumption PRG are higher than what would be needed to address the Site's contribution to the fishing advisory. In order to sufficiently address the Site's ongoing contribution to the fishing advisory in the area, the DSHS fish tissue HAC value for dioxin should be used. The TCEQ does not support actions/remedies that do not fully address the ultimate goal of allowing the removal of fishing advisories by DSHS (e.g., DSHS uses a Toxicity Equivalency Quotient fish tissue HAC of 2.33 ng/kg based on a hazard quotient of 1.)

Response: *One of the Remedial Action Objectives for the remedial action at the Site is to reduce human exposure to dioxins from consumption of fish. While the Site is a significant source of dioxin, it is not the only dioxin or PCB source (TMDL, University of Houston, 2006 & 2009), both of which contribute to the fish advisory. Because remediation of the Site will not affect the other sources in the San Jacinto River it cannot be expected that the fish advisories are likely to be removed.*

The total PRG number evaluated the cumulative risk from sediment exposure. This includes PRG calculations for sediment ingestion, dermal exposure to sediment and the sediment to fish and shellfish consumption. You have first to correlate the fish and shellfish levels to sediment levels by using biota-sediment accumulation factor (BSAF) values for fish of 0.09 pg/g tissue per pg/g sediment and shellfish of 0.07 pg/g tissue per pg/g sediment (3.13 ppt/0.09 = 34.8 ppt = 35 ppt and for shellfish 73/0.07 = 1043 ppt). The BSAF value for fish was adopted from EPA Combustion Guidance (EPA, 2005) and the BSAF for shellfish was taken from the BHHRA for the site. If you add the reciprocal of these values, and then take the reciprocal of the sum you get the total PRG number (see equation below). This procedure is a common practice used by risk assessors when calculating a PRG from exposure to multiple exposure pathways.

To calculate a combined sediment PRG for a recreational fisher child coming into direct contact with shore sediment through the inadvertent ingestion and dermal contact plus indirect contact with sediment through ingestion of fish and shellfish we use the following equation:

$$Total\ PRG = \frac{1}{\frac{1}{PRG\ from\ sediment\ ingestion (786\ ppt)} + \frac{1}{PRG\ from\ sediment\ dermal (277 ppt)} + \frac{1}{PRG\ from\ sediment\ to\ fish\ ingestion\ (35\ ppt)} + \frac{1}{PRG\ from\ sediment\ to\ shellfish\ ingestion\ (1043\ ppt)}}$$

Total PRG = 28.9 ppt rounded up to 30 ppt

Development of the PRGs for the Site is described in the Record of Decision. Based upon the factor of 1.33 difference between the DSHS HAC and the EPA calculated PRG, both fish tissue concentrations would essentially result in a non-cancer hazard of 1, assuming only one significant figure (EPA 1989). The EPA calculated fish tissue PRG would not result in a high sediment PRG. The selected sediment PRG is based upon the cumulative risk effects of ingestion, dermal contact, and ingestion of fish. BSAFs can vary quite significantly across the Site. Therefore, the 1.33 higher factor for EPA calculated fish tissue PRG is reasonable given the inherent uncertainty in the risk assessment process (e.g., fish ingestion rates, exposure durations, toxicity values).

2.3.5 Comment: The TCEQ requests that the EPA to annotate the tables provided under Human Health Risks section on pages 17 and 18 to include the meaning of the numbers in bold font. One might assume the bold is highlighting the numbers above the Hazard Index of 1, except that 0.11 is bold under the last entry for Scenario DS-5 in the table on page 18.

Response: *The Record of Decision will include the following corrections: the table on page 18 will be revised to remove the bold font for the HQ=0.11. A footnote will be added to denote the bold font identifies those exposure pathways with non-cancer hazards greater than the acceptable level of 1.*

2.3.6 Comment: Based on the Proposed Plan, it does not appear that EPA is planning to address the sediment areas outside the armored cap with dioxins/furans concentrations greater than the PRG of 30 ng/kg. Regarding the sediment cleanup areas, the following statement is made on Page 20. For the river areas outside of the armored cap, the surface area-weighted average dioxin concentration in sediment located just south of the waste pits (Figure 11) is 16.1 ng/kg, and the surface area-weighted average dioxin concentration in sediment in areas located adjacent to and upstream of the waste pits is 11.2 ng/kg. Because the average dioxin concentrations in sediment both upstream and downstream of the waste pits are less than the 30 ng/kg Preliminary Remediation Goal [PRG] for sediment, remediation of the sediment is not required. This seems in contrast with Figure 9, which shows surface sediment areas with concentrations greater than the 30 ng/kg PRG outside the armored cap. Also, Figure 11 seems to be referring to fish collection areas and tissue sampling transects and not the sediment. If the EPA is not planning to address areas with dioxins/furans concentration above 30 ng/kg outside the armored cap, please explain the rationale for this decision.

Response: *The rationale for not remediating areas outside the armored cap is explained in the Record of Decision. The PRG for sediment is based upon risk concerns. These risk* *concerns are evaluated over the Site as enumerated in the exposure point concentration (EPA 1989). Figure 9 in the Proposed Plan does show some sediment areas that are greater than the PRG of 30 ng/kg, however, when considering the overall Site, the sediment concentration, at 16.1 ng/kg, is significantly less than the PRG at 30 ng/kg. The assessment of the weighted average sediment concentration outside the armored cap is reasonable and consistent with the risk assessment. Notwithstanding the previous statements, the sediment in the Sand Separation Area will be addressed with Monitored Natural Attenuation as discussed in the Record of Decision.*

2.3.7 Comment: The abbreviation PRG was used in the document, but was not associated with the term "preliminary remediation goal."

Response: *Noted. The "PRG" used on page 12 of the Proposed Plan is an acronym for Preliminary Remediation Goal. This is clarified in the Record of Decision.*

2.3.8 Comment: EPA chose dredging of the northern disposal Site. In doing so, however, EPA did not consider the "short-term potential for adverse health effects from human exposure" and "the potential threat to human health and the environment associated with excavation, transportation, and redisposal" 42 U.S.G. § 9621(b)(1)(D), (G). The US Army Corps of Engineers specifically found that EPA's preferred dredging remedy (namely, alternative 6N) "would be expected to significantly increase short-term exposures to contaminants." Feasibility Study App. A Section 5 and the US Army Corps of Engineers specifically found that dredging under alternative 6N would have dramatically worse short-term impacts than the capping remedies. EPA failed to provide a reasoned justification for rejecting the USAGE analysis.

Response: *The US Army Corps of Engineers evaluation documents trade-offs between the long-term and short-term risks of release, both of which are dependent upon the effectiveness of engineering controls. The ability of Alternative 6N to control release is reliant on the ability of best management practices to control resuspension of sediments during removal. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. Therefore, the selected remedy will not result in a significant increase in short-term exposures as may result from underwater dredging. The selected remedy provides a more certain, quantifiable outcome than the containment alternatives, with a lower overall potential for release of mass.*

2.3.9 Comment: The EPA indicated that the analytical results for dioxins/furans at the sand separation area may not be representative of the concentrations in that area and concluded that additional sampling may be necessary to obtain representative data. The TCEQ agrees with the EPA's conclusion and suggest collection of additional samples in the sand separation area, prior to issuance of the ROD.

Response: *Two samples over 300 ng/kg were found in the Sand Separation Area, but based on other samples the EPA does not believe these two results are representative of the area. The Sand Separation Area will be sampled during the Remedial Design to confirm the current sediment dioxin level as well as the limits of the dioxin affected area, and to establish a baseline for the Monitored Natural Recovery there. EPA decided not to perform additional sampling of sediment before selecting a remedy in a Record of Decision because such additional sampling would have further delay the Site cleanup, and because the average dioxin level in the Site sediment (12.5 ng/kg) does not exceed the sediment cleanup level of 30 ng/kg.*

2.3.10 Comment: The Proposed Cleanup Plan utilized a recreational fisher receptor to develop its Primary Remediation Goal (PRG) for the Dioxin Pits. The EPA based this decision on a 2013 Texas Department of State and Health Services (DSHS) risk assessment that "could not identify subsistence fishers in the area" of the Dioxin Pits. For the reasons set forth below, Harris County urges the EPA to include subsistence fishers in development of the Preliminary Remediation Goal for the Dioxin Pits. To do otherwise potentially exposes residents to unacceptable levels of dioxin.

Response: *EPA understands the concern set forth by Harris County's concern about subsistence fishers. However, as noted in the comment, subsistence fishers were not identified in the area. The fish tissue PRG considers a child recreational user, which is identified as a sensitive population. The selected alternative will result in a reduction of potential human health concerns for all receptor populations in the area.*

2.3.11 Comment: Harris County researched cleanup levels for dioxins at other Superfund sites and requests the EPA order a cleanup of the Dioxin Pits that is consistent with these other sites. The three most recent sites are in tidal rivers where there is fishing activity (Diamond Alkali Lower Passaic River, Portland Harbor Willamette River, and Lower Duwamish Waterway). For the Lower Passaic River, the cleanup level for 2,3,7,8-TCDD is 8.3 ng/Kg. For the Willamette River, the site-wide cleanup level for 2,3,7,8-TCDD is 0.6 to 2 ng/Kg. For the Lower Duwamish River, the site-wide cleanup level for Dioxin TEQ is 2 ng/Kg in the top 10 centimeters (cm) of surface sediment and 13 to 3 7 ng/Kg in the top 45 cm of sediment. Therefore, Harris County requests that EPA re-calculate the sediment PRG using the site specific BSAF values and considering subsistence fishing in the San Jacinto River. With these factors, we expect that a re-calculation of the sediment PRG would yield a value lower than the local background dioxin TEQ level of 7 ng/Kg in the San Jacinto River. Therefore, the PRG for this Site should be set at the local background level or below as ordered by the EPA at similar dioxin Superfund sites.

Response: *Background levels of dioxin in the area surrounding the Site range between 4 and 20 ng/kg. The human health risk assessment has demonstrated that the selected PRG of 30* *ng/kg is sufficient to protect the most sensitive receptor (child fisher). EPA believes that remediation of the majority of the Site to the PRG will protect human health and the environment, yet provide an achievable goal.*

2.3.12 Comment: The Proposed Cleanup Plan does not provide for remedial measures to address contaminated sediment above the PRG outside of removal of the Site waste. The rationale for this is that when all surface sediments within the preliminary Site perimeter are averaged together, the average concentration does not exceed the PRG. This is concerning because it leaves several areas where contaminants mobilized from the Dioxin Pits are present at concentrations far in excess of the dioxin PRG (including, but not limited to the Sand Separation Area, the area west of the Dioxin Pits, and the area south of the South Impoundments as shown on Figure 2-8 of the Interim Final Feasibility Study Report). We recommend that these areas be remediated. Decisions on where to remediate should not be based on the dimensions of the preliminary site perimeter, but on the extent of actual contamination.

Response: *Risk associated with exposure to contaminated media are based on conservative measures of exposure. Reasonable Maximum Exposure (RME) concentration estimates were used across various areas of the Site, specifically a 95 percent Upper Confidence Limit of the Mean (95UCLM). In addition, a statistical assessment of the variability of Site COCs was used to establish appropriate exposure areas (Beach A, B/C, D, and E). Use of conservative estimates of exposure are consistent with guidance, and were utilized. Because statistical methods are used to estimate exposure (and resultant risks) it is not uncommon that some sample areas may have higher concentrations than the exposure point concentration. However, exposure to these higher concentration areas are not expected to result in unacceptable risk, and consequently remediation is not necessary.*

2.3.13 Comment: I am concerned that residents have an unrealistic expectation regarding safe drinking water, river sediment, and tissue levels during their lifetimes post-excavation. I am curious if the EPA is forthcoming with estimates like these, if these estimates are unknown and incalculable, or if the truth would cause uproar and is therefore not being discussed.

Response: *Remediation of the Site will eliminate the dioxin source to the environment. Consequently, the sediment remediation goal of 30 ng/kg should be achieved in the river system, which should protect the most sensitive receptors. In addition, Long-term Monitoring (LTM) is required post excavation. Five Year Reviews (FYRs) will be conducted to determine whether the remedial action has achieved the required level of protection. Consequently, if there were unexpected developments or the Remedial Action is not successful the FYRs should document such developments.*

2.3.14 Comment: Has there been testing of the water, soil, or fish in the surrounding area since the temporary cap was placed; and if so, what are those results?

Response: *Yes, sampling was performed post-cap placement, and the Baseline Human Health Risk Assessment (BHHRA) assessed risk post-capping as well as pre-capping. The investigation revealed that while the temporary cap has reduced exposure to the dioxin/furans in* *the area; the cap itself has required repeated repairs and maintenance beyond that originally expected. Further, a cap would most likely fail under an extreme weather event such as a major hurricane which have hit the area many times in the past. Consequently, the EPA has selected Alternative 6N which requires removal of the source material.*

2.3.15 Comment: We request that the EPA lower the Preliminary Remediation Goal for paper mill waste material to 30 ng/kg. This level is protective of recreational fishers and ecological risks. This would also be consistent with the EPA's Preliminary Remediation Goal for dioxin in sediment.

Response: *The PRG for paper mill waste was calculated based upon the results from the BHHRA which is risk-based and protective of the most sensitive potential receptors. Based upon the concentration of dioxins/furan in the paper mill waste, the selection of 30 ng/kg would not result in a significantly larger footprint of removal from the impoundments. The cleanup level of 30 ng/kg for the waste pits will be specified in the Record of Decision because the same route of exposure will exist for the waste pits area and the riverbed sediment, which is already 30 ng/kg, and because cleanup to 30 ng/kg will negate the need for a protective cover and its long term maintenance.*

2.3.16 Comment: We would like to ask what protocols will be in place to ensure the Preliminary Remedial Goal is met. We would like to request a conservative approach is taken with multiple split samples individually analyzed. The San Jacinto River Waste Pits are located in a tidally influenced waterway of high recreational use. The San Jacinto River flows into Galveston Bay, one of the most delicate and productive estuaries in the United States. Almost 30% of Galveston Bay's fresh water is supplied from the San Jacinto River. The San Jacinto River and Galveston Bay provide a unique habitat for a myriad of different species to spawn and flourish. Limiting fishing and crabbing in the immediate vicinity has proven difficult. Furthermore, the Waste Pits are in close proximity to residential properties and the nearby population is expected to double by 2040. The Proposed Plan states that the Pits will be covered with two layers of clean-fill after excavation of Principal Threat Waste. However, the River has immense erosive power and is subject to future flooding, storm surge, and wave action. It is not reasonable to predict that the clean-fill will serve as a protective measure of the waste material below 200ng/kg. The recent erosion on the eastern edge of the TCRA serves as an example of the unpredictable nature and force of the San Jacinto River.

Response: *Commenters requested that EPA utilize a clean-up goal of 30 ng/kg for the northern waste pits instead of the 200 ng/kg presented in the Proposed Plan. The EPA adopted the 30 ng/kg clean-up goal for the northern waste pits because it is protective of the child fisherman exposure scenario used for the rest of the San Jacinto River, it would not require the placement of a residuals cover with its questionable effectiveness given the history of cap damage and need for repairs following the installation of the temporary cap, maintenance would not be required, and because institutional controls would not be required to include the waste pit area. As part of the development of the ROD and development/oversight of the remedial design, EPA will evaluate quality assurance measures designed to ensure that verification sampling is representative and demonstrates the level of protectiveness which will be identified in the ROD.*

2.3.17 Comment: The Coalition supports the EPA's classification of the waste material in the Pits as Principal Threat Waste due to the waste being highly toxic and potentially highly mobile in future storm and flood events. However, we feel the EPA's calculation for the concentration of Principal Threat Waste to be arbitrary. EPA states that material at the Site with concentrations greater than 300ng/kg dioxin to be Principal Threat Waste. EPA calculated this by multiplying the Preliminary Remediation Goal of 30ng/kg by a factor of 10 (Proposed Plan, p. 10). The factor of 10 appears to be a simplistic way of coming up with a concentration and not a method which is based off of the best of science and cancer risk factors. For the above reasons, we strongly encourage the EPA to lower the Preliminary Remediation Goal and concentration classification for Principal Threat Waste. We understand that this request would require the Agency to consider remediation at the Upland Sand Separation Area. However, for the reasons stated above as well as the increasing nearby industrial activity, we feel this too is critical to the clean-up process and future of our environments and public health. We ask that the EPA require additional sampling at the Sand Separation Area as we are aware that this area has the "highest concentrations of dioxin outside of the Waste Pits" (Proposed Plan, p. 11).

Response: *CERCLA Section 121(b)(1) states in part:*

- *Remedial actions in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances, pollutants, or contaminants is a principal element, are to be preferred over remedial actions not involving such treatment.*

- *The President shall conduct an assessment of permanent solutions and alternative treatment technologies or resource recovery technologies, that in whole or in part, will result in a permanent and significant decrease in the toxicity, mobility, or volume of the hazardous substance, pollutant, or contaminant.*

- *The President shall select a remedial action that is protective of human health and the environment, that is cost effective, and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. If the President selects a remedial action not appropriate for preference under this subsection, the President shall publish an explanation as to why a remedial action involving such reductions was not selected.*

Reflecting these provision in CERCLA Section121(b), EPA established program management principals and certain expectations in the NCP regarding types of remedies that EPA has found to be most appropriate for different types of waste.[18] *Although remedy selection decisions are ultimately site-specific determinations based on an analysis of the remedial alternatives using*

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[18] Preamble to the Final NCP Rule, 55 Fed. Reg. 8666, 8702 (Mar. 8, 1990) and Preamble to the Proposed NCP Rule, 53 Fed. Reg. 51394, 51422 (Dec. 21, 1988).

the nine criteria, these expectations are intended to streamline and focus the RI/FS on appropriate waste management options. They reflect EPA's belief that certain source materials are addressed best through treatment because of technical limitations to the long-term reliability of containment technologies, or the serious consequences of exposure should a release occur.[19] *For example, EPA's experience that highly mobile waste generally requires treatment may help guide EPA to focus the detailed analysis in the FS on treatment alternatives, as compared to containment alternatives.*[20]

Under the NCP at 40 CFR § 300.430(a)(iii)(A), EPA expects to use treatment to address the principal threats posed by a site, wherever practicable. Principal threats for which treatment is most likely to be appropriate include liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile materials.[21] *The EPA Guide to Principal Threat and Low-level Threat Waste further explains that principal threat wastes are those source materials considered highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur.*[22] *Principal Threat Waste (PTW) includes liquids and other highly mobile materials (e.g. solvents) or materials having high concentrations of toxic compounds.*[23] *No threshold of toxicity/risk has been established to equate to "principal threat." However, where toxicity and mobility of source material combine to pose a potential risk of 10-3 or greater, generally treatment alternatives should be evaluated.*[24] *Also, treatment that destroys or reduces hazardous properties of contaminants (e.g., toxicity or mobility) frequently will be required to achieve solutions that afford a high degree of permanence.*[25] *EPA also recognizes that "although no threshold level of risk has been established to identify principal threat waste, a general rule of thumb is to consider as a principal threat those source materials with toxicity and mobility characteristics that combine to pose a potential risk several orders of magnitude greater than the risk level that is acceptable for the current or reasonably anticipated future land use, given realistic exposure scenarios."*[26]

Examples of PTW include but are not limited to:

Preamble to the Final NCP Rule, 55 Fed. Reg. 8666, 8702 (Mar. 8, 1990) and Preamble to the Proposed NCP Rule, 53 Fed. Reg. 51394, 51422 (Dec. 21, 1988).
al" is defined as material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration on contaminants to ground water, to surface water, to air, or act as a source for direct exposure.

[20] 55 Fed. Reg. at 8702.

[21] 40 C.F.R. § 300.430(a)(iii)(A).

[22] *PTW Guidance* at p.2, *see also 55 Fed. Reg. at 8703 and 53 Fed. Reg. at 51422.* Principal threats are characterized as waste that cannot be reliably controlled in place such as liquids, highly mobile materials (e.g., solvents), and high concentrations of toxic compounds (e.g., several orders of magnitude above levels that allow for unrestricted use and unlimited exposure).

[23] Id.

[24] Id.

[25] 53 Fed. Reg. at 51422.

[26] "Rules of Thumb for Superfund Remedy Selection", U.S. EPA, August 1997, (OSWER Pub. 9355.0-69) at p.11.

- *Liquids – wastes contained in drums, lagoons, or tanks, free product (NAPL or DNAPL)*

- *Mobile source materials – surface soil or subsurface soil containing high concentrations of contaminants of concern that are (or potentially are) mobile due to wind entrainment, volatilization (e.g., VOCs), surface runoff, or subsurface transport.*

- *Highly toxic source material – buried drummed non-liquid wastes, buried tanks containing non-liquid wastes, or soils containing significant concentrations of highly toxic materials. For PCB contamination or PCB waste at Superfund sites, principal threats will generally include material contaminated at concentrations exceeding 100ppm for sites in residential areas and concentrations exceeding 500 ppm for sites in industrial areas reflecting concentrations that are 1 to 2 orders of magnitude higher than the preliminary remediation goals.*[27]

Under the NCP at 40 C.F.R. § 300.430(e) Feasibility Study, the primary objective of the feasibility study (FS) is to ensure that appropriate remedial alternatives are developed and evaluated such that relevant information concerning the remedial action options can be presented to the decision-maker and an appropriate remedy be selected. EPA's RI/FS guidance on developing and screening remedial alternatives further provides that alternatives should be developed ranging from one that would eliminate or minimize the extent feasible the need for long-term management (including monitoring) at a site to one that would use treatment as a primary component of an alternative to address principal threats at the site.[28] *EPA's PCB Guidance states that the Superfund program expectations should be considered in developing appropriate response options for the identified area over which some action must take place.*[29] *In particular, the expectation that principal threats at the site should be treated, wherever practicable, and that consideration should be given to containment of low-threat material, forms the basis for forming alternatives.*[30]

A detailed analysis in the FS at this Site has evaluated remedial alternatives using the nine criteria specified in the NCP, including the criterion Reduction of toxicity, mobility, or volume through treatment, which addresses how treatment is used to address principal threats at the site.[31] *This evaluation criterion addresses the statutory preference for selecting remedial actions that employ treatment that permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances as their principal element. This preference is satisfied when*

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[27] "Guidance on Remedial Actions for Superfund Sites with PCB Contamination", U.S. EPA, August 1990, (EPA/540/G-90/007) [hereinafter *PCB Guidance*] at p. iv. *See also PCB Guidance* p. 6, p. 39, and p. 40.

[28] "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA - Interim Final", U.S. EPA October 1988 (OSWER Dir. 9355.3-01) [hereinafter *RI/FS Guidance*] at p. 4-7.

[29] *PCB Guidance* at p. iv.

[30] *Id*.

[31] *See* 40 C.F.R. § 300.430(e)(9) *Detailed Analysis of Alternatives*.

treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, reduction of total mass of toxic contaminants, irreversible reduction in contaminant mobility, or reduction in the total volume of contaminated media.[32] *In evaluating this criterion an assessment should be made as to whether treatment is used to reduce principal threats, including the extent to which toxicity, mobility, or volume are reduced either alone or in combination.*[33] *Additionally, alternatives were using the Long-term effectiveness and permanence criterion which focuses on the degree to which an alternative reduces, toxicity, mobility, or volume through treatment, minimizes residual risks and affords long-term protection.*[34]

Pursuant to 40 C.F.R. § 300.430(e)(3), for source control actions, the lead agency shall develop, as appropriate: (i) A range of alternatives in which treatment that reduces the toxicity, mobility, or volume of the hazardous substances, pollutants, or contaminants is a principal element. As appropriate, this range shall include an alternative that removes or destroys hazardous substances, pollutants, or contaminants to the maximum extent feasible, eliminating or minimizing, to the degree possible, the need for long-term management. The lead agency also shall develop, as appropriate, other alternatives which, at a minimum, treat the principal threats posed by the site but vary in the degree of treatment employed and the quantities and characteristics of the treatment residuals and untreated waste that must be managed." (Emphasis added)

Consistent with CERCLA, the NCP, and EPA guidance, PTW was identified at this Site as discussed below in this section.

Furthermore, consistent with the statutory mandate to utilize permanent solutions and alternative treatment or resource recovery technologies to the maximum extent practicable and the preference for remedies that to the maximum extent practicable employ treatment that permanently and significantly reduces the toxicity, mobility, or volume of hazardous substances, pollutants or contaminants, the Agency has evaluated potential treatment options for the dioxins prior to disposal. These options are designed to address the toxicity and mobility of the PTW at this site so that it will not be further released into the environment after disposal. Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during the remediation will be tested to comply with the applicable requirements. Treatment of a portion of the paper mill waste by solidification with cement was successfully performed during the Time Critical Removal Action (TCRA) on a portion of the Western Cell materials. EPA will implement the best technology to meet the statutory requirements discussed above after further evaluation in the remedial design.

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[32] *RI/FS Guidance* at p. 6-8.

[33]*Id*. at p. 6-8 and p. 6-9

[34] 40 C.F.R. § 300.430(e)(7)(i) and § 300.430(e)(9)(iii).

The purpose of discussing PTW is not to set cleanup levels. The purpose is to reflect EPA's belief that certain source materials are addressed best through treatment because of technical limitations to the long-term reliability of containment technologies, or the serious consequences of exposure should a release occur.

Dioxin is highly toxic and persistent (will not break down for hundreds of years) in nature. With the regular occurrence of severe storms and flooding in the area, there is uncertainty that the waste material can be reliably contained over the long term and therefore should be considered potentially highly mobile due to its location in a dynamic river environment. Because the dioxin waste in the northern impoundments and southern impoundment at the Site is both highly toxic and potentially highly mobile, it is considered a Principal Threat Waste.

2.3.18 Comment: The risk assessments and public health assessment documents for this Site were based on theoretical exposure values tied to testing data. The risks shown in the Proposed Plan are based upon the Waste Pits being covered by the temporary cap. Despite this, beach E (the northern pit) presents an elevated risk of cancer (Proposed Plan, p. 17). Although the Proposed Plan is to remove the temporary cap in sections, this would temporarily increase the exposure risks. Therefore, we request further consideration for cancer risks. We believe a further consideration would lead the EPA to lowering the classification of Principal Threat Waste.

Response: *Goals based on non-cancer risks are expected to achieve reductions that would also address cancer risks. Temporary risks can be mitigated by best management practices, including removal in the "dry" behind a cofferdam, which may include engineering controls during removal and institutional controls.*

2.3.19 Comment: In 2015, the Texas Department of State Health Services issued its assessment of the occurrence of cancer in East Harris County. This investigation and report "was not intended to determine the cause of observed cancers or identify possible associations with any risk factors." However, we believe some of the results raised concerns potentially associated with the SJRWP Site. "Observed numbers of several of the 17 cancers analyzed were statistically significantly greater than expected." (TDSHS 2015) The number of cancer / census tract combinations that were statistically significantly high exceeded the number that were statistically significantly low by a ratio of 3:1. The following types of childhood cancer had Standardized Incident Ratios (SIR) of greater than 2 in at least one of the census tracts in East Harris County: brain, leukemia, glioma, melanoma, and retinoblastoma. SIRs of greater than 2 were found in some census tracts for the following cancers for all ages: brain, male breast, cervix (5 different tracts between 2.02 and 4.81) and liver. Of particularly concern is the incidence of childhood retinoblastoma, a rare eye cancer, with an SIR of 16.40 in the census tract closest to the SJRWP Site, and SIR of 14.35 in another census tract in the study area. Incidence rates for cancer of the cervix and kidney for "all ages" also were high in the census tract nearest the Site. Determining how to further investigate the results of this report has been problematic. Conducting a full epidemiological study of the community was rejected, and other alternatives aren't being actively pursued as far as we can determine. While a direct cause-and-effect relationship with the SJRWP Site can't be confirmed at this time, neither can it be excluded.

Response: *EPA understands the concern with cancer occurrences in East Harris County. It is expected that the selected alternative will result in lower dioxin concentrations in the river and potential uptake to fish tissue. However, a direct correlation of the Site to cancer occurrences in East Harris County is difficult to complete. Any comments or questions on Texas Department of State Health Services reports regarding the San Jacinto River Waste Pits Site should contact* epitox@dshs.state.tx.us *or 1-800-588-1248.*

2.3.20 Comment: Distributed throughout a 5-mile radius of the SJRWP are demographics particularly vulnerable to dioxin exposure; elderly and children. The community directly east of the Site has a disproportionate amount of children under the age of 5 years old. Between 14.3-18.9% of this community is under the age of 5 years old. Not only are the elderly and children "most sensitive to dioxin exposure, but also have the most difficult time evacuating and recovering from a flood event, further exacerbating the adverse impacts to this segment of the community. That said, exposure to the dioxins could potentially occur without the presence of a major storm due to the documented potential for chemical leakage" (Brody, 2014).

Response: *Commenters requested that EPA utilize a clean-up goal of 30 ng/kg for the northern waste pits instead of the 200 ng/kg presented in the Proposed Plan. The EPA adopted the 30 ng/kg clean-up goal for the northern waste pits because it is protective of the child fisherman exposure scenario used for the rest of the San Jacinto River. These PRGs will be protective of this sensitive population and other receptors throughout the area.*

2.3.21 Comment: Numerous questions were submitted concerning the frequency of cancer in the area of the Site.

Response: *It has proven virtually impossible to correlate the presence of a contaminant source with cancer frequency in the vicinity despite many attempts at many sites. Therefore, the EPA chose to base the PRG on conservative risk-based principals. Any comments or questions on Texas Department of State Health Services reports regarding the San Jacinto River Waste Pits Site should contact* epitox@dshs.state.tx.us *or 1-800-588-1248.*

2.3.22: Comment: Region 6s Final Interim Feasibility Study deficient in a number of significant respects, resulting in an arbitrary and capricious Proposed Plan.

Response: *EPA disagrees that the Feasibility Study is deficient; however, EPA has requested the US Army Corps of Engineers to perform additional modeling in response to several requests to further support the selected remedial action. The fact that extreme erosion can and will occur was documented after the 1994 flood and to a lesser extent by the 8-foot scour that occurred adjacent to the cap in 2016. The scouring occurred at lesser river flood levels and without the occurrence of a hurricane.*

Further, The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane

(Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

2.3.23 Comment: The EPA Region 6's calculation of a threshold concentration of 300 ng/kg toxicity equivalent as the basis for its Principal Threat Waste determination deviates substantially from relevant guidance, is flawed and ignores site-specific information in favor of information not in the Administrative Record.

Response: *The EPA disagrees with this statement. EPA used site-specific information including exposure frequencies, exposure duration, and ingestion rates for a variety of scenarios used in the baseline human health risk assessment were used in the EPA risk assessment. Minor changes were made to be consistent with EPA guidance and other national risk assessments. The EPA changed the child body weight from 19 Kg to 15 Kg as recommended in the EPA exposure factors handbook. EPA also changed the lifetime averaging value from 78 years to 70 years, again consistent with EPA guidance and other national risk assessments.*

Regarding conversion of risk-based PRGs to a Principal Threat Waste value, EPA policy sets a precedent for defining principal threat waste based on a multiple of a risk based level. In specific, waste demonstrating a carcinogenic risk of 10^{-3} is considered principal threat, which is 10 times higher than the upper end of the acceptable risk range of 10^{-4}. Based on this precedent, the PRG of 30 ng/kg based on non-carcinogenic was multiplied by 10.

2.3.24 Comment: The EPA Region 6's calculation of a threshold concentration of 300 ng/kg toxicity equivalent as the basis for its Principal Threat Waste determination deviates in a number of material respects from the requirements contained in EPA's Principal Threat Waste and risk assessment guidance, and Region 6's determination and application of a Principal Threat Waste threshold is not consistent with EPA's guidance. The result is that a cornerstone of EPA Region 6's rationale for its proposed remedy is arbitrary and capricious.

Response: *The EPA disagrees with this statement. EPA's risk evaluation is not arbitrary and capricious. It is a standalone scientific document that used EPA's acceptable risk assessment procedures, methodologies and guidance. The assessment went through internal reviews and was reviewed by EPA's headquarters risk assessors and scientists to make sure the assessment is consistent with guidance and other regional risk assessments evaluations.*

EPA policy sets a precedent for defining principal threat waste based on a multiple of a risk based level. In specific, waste demonstrating a carcinogenic risk of 10^{-3} is considered principal threat, which is 10 times higher than the upper end of the acceptable risk range of 10^{-4}. Based on this precedent, the PRG of 30 ng/kg based on a non-carcinogenic endpoint was multiplied by 10. EPA guidance defines Principal Threat Waste as source material of such mobility and toxicity that it bears potential to re-contaminate surrounded areas if re-distributed/released. Using a factor of 10 assumes that waste would be diluted 10-fold during release over the area of *exposure without causing exceedance of risk levels; this is not unreasonable. These points demonstrate that the definition of principal threat waste is neither arbitrary nor capricious.*

2.3.25 Comment: The Risk Evaluation and the Principal Threat Waste determination based on it are not transparent and reach conclusions that cannot be replicated. It should be disregarded for that reason alone, and the Principal Threat Waste determination based on it should also be disregarded.

Response: *EPA disagrees with this statement. EPA's Risk Evaluation report provided all the equations and all the input parameters that went into the equations. All the input parameters provided in the BHHRA were used except for child body weight and lifetime averaging time. It also included exposure point concentrations reported in the BHHRA. By using these values and equations provided, the calculations and conclusions can easily be replicated.*

2.3.26 Comment: The Risk Evaluation ignores the Region 6-approved risk assessment and data from the Site and does not follow EPA guidance. It is not transparent and not in the Administrative Record. A preliminary remediation goal was calculated using a biota-sediment accumulation factor (BSAF). For the BSAF, EPA relies on a source of information unrelated to the Site even though (1) Site-specific BSAFs are available and (2) Region 6 required Respondents to develop that information because "[t]he calculation of Site-specific BSAFs is important in order to be able to determine the acceptable sediment concentration to be protective of the human consumption of edible fish and shellfish."

Response: *EPA disagrees with this statement. EPA requested a Site-specific BSAF value because of its importance in developing an appropriate Site-specific sediment cleanup level. However, the Site specific BSAF values, reported in the Remedial Investigation and BHHRA, varied significantly and concluded that using these Site specific BSAF values to develop sediment preliminary remediation goals would give unreliable results. The BSAF in EPA's HHRA came from EPA's Combustion guidance.*

2.3.27 Comment: Region 6 inappropriately uses EPA's results to calculate a much lower (by a factor of ten) Principal Threat Waste threshold concentration than the Site-specific data and Principal Threat Waste Guidance would support; EPA offers no explanation for the decision to deviate from guidance by not using Site-specific data in his analysis.

Response*: The Site-specific data does not support a Principal Threat Waste which is larger by a factor of ten. EPA used non-cancer effects in its evaluation of adverse health effects presented by dioxin and dioxin-like compounds as toxicity equivalents. If non-cancer effects are used, then the Preliminary Remediation Goal developed by EPA is appropriate (see response to Comment 2.3.27). Moreover, EPA policy sets a precedent for defining principal threat waste based on a multiple of a risk based level. Specifically, waste demonstrating a carcinogenic risk of* 10^{-3} *is considered principal threat, which is 10 times higher than the upper end of the acceptable risk range of* 10^{-4}*. Based on this precedent, the PRG of 30 ng/kg based on non-carcinogenic health effects of dioxin was multiplied by 10 to calculate the principal threat waste.*

2.3.28 Comment: The following are the specific shortcomings in EPA's risk assessment approach. EPA calculates risk associated with recreational fishing using a noncancer reference dose. Using the noncancer reference dose, EPA calculates the toxicity equivalent in sediment that corresponds to an acceptable noncancer risk level (a hazard index of 1) for a hypothetical recreational fisher. The resulting preliminary remediation goal for sediments of 30 ng/kg toxicity equivalent accounts for both direct exposure and indirect exposure routes, including fish ingestion. The use of fish ingestion as an exposure pathway is inappropriate, for reasons discussed below. EPA states that the Preliminary Remediation Goal, 30 ng/kg toxicity equivalent, equates to a 2.1×10^{-5} excess lifetime cancer risk. Region 6 multiplies this value by 10 (without any explanation as to the basis for that calculation) to derive its Principal Threat Waste threshold of 300 ng/kg. Therefore, the Region 6 threshold value for designating wastes as Principal Threat Waste is equivalent to an excess lifetime cancer risk of 2.1×10^{-4} (calculated by multiplying 2.1×10^{-5} by a factor of ten). This is a lower risk than the excess lifetime cancer risk of 10^{-3} that EPA's Principal Threat Waste Guidance suggests be considered in determining whether a source material is Principal Threat Waste, and a lower risk than called for in EPA's 1997 guidance referred to as the "Rule of Thumb." The Principal Threat Waste Guidance, while not explicitly defining what threshold level of risk equates to principal threat, states that "where toxicity and mobility of source material combine to pose a potential risk of 10^{-3} or greater, generally treatment alternatives should be considered." EPA Region 6's use of 300 ng/kg as a Principal Threat Waste threshold is overly conservative in the sense that it sets an inappropriately low cancer risk threshold (below 10^{-3}) for considering waste to be Principal Threat Waste.

Response: *The definition of Principal Threat Waste provided by EPA guidance is not restricted to the basis of carcinogenic risk and the sediment PRG developed by EPA is based on non-cancer effects. EPA considered the scientifically verified and peer reviewed toxic value of dioxin for noncancer effects. As published in the EPA Integrated Risk Information System (IRIS), the toxicity value or reference dose developed for TCDD is based on human epidemiological data and not based on animal data. The noncancer toxicity values for TCDD were based on endocrine disruption observed in a sensitive susceptible young population. IRIS gave a confidence level of "High" to the non-cancer toxicity value for dioxin. Dioxin is known to have both cancer and non-cancer effects, therefore EPA evaluated the risk from both types of adverse health effects. EPA used a tier 3 cancer toxicity value in its cancer risk evaluation since there is no cancer toxicity value published in IRIS. Tier 3 cancer toxicity values did not go through rigorous proper peer review and are usually not verified for its proper scientific validity as usually is done for tier 1 toxicity values. Consequently, EPA relied on the tier 1 toxicity value for non-cancer effects in its decision regarding the Site and included the cancer effects to show that, by cleaning the Site down to the non-cancer effects level, EPA is also protecting for cancer effects.*

EPA in its quick reference fact sheet "A Guide to Principal Threat and Low Level Threat Wastes (PTW)" November 1991, Superfund Publication: 9380.3-06, states the following: "No "threshold level" of toxicity/risk has been established to equate to "principal threat". However, where toxicity and mobility of source material combine to pose a potential risk of 10^{-3} or greater, generally treatment alternatives should be evaluated." However, TCDD equivalents has been found to cause human non-cancer adverse health effects at levels below the upper end of the

EPA acceptable excess cancer risk range of 10^{-4}. Although the Principal Threat Waste guidance does not set a threshold level of toxicity/risk, it clearly leaves the door open to evaluating potential toxicity/risk of chemicals involved. Applying an order of magnitude for noncancer effects is equivalent to the use of 10^{-3} cancer levels to define Principal Threats. EPA not only relied on dioxin toxicity but also considered other factors in its evaluation of Principal Threat Waste. The other factors considered include the history of severe flooding in the San Jacinto River, the documented extensive erosion of the river, the high degree of uncertainty in predicting the effects of flooding for hundreds of years, the need for repeated cap maintenance, and by the discovery of a 400-square foot area of dioxin that was over 1,000 times more concentrated than the 30 ng/kg toxicity equivalent Preliminary Remediation Goal for sediment. A containment or capping remedy must be able to reliably contain the wastes, but the factors listed above do not support a conclusion that the dioxin waste could be consistently contained for hundreds of years.

2.3.29 Comment: EPA's Preliminary Remediation Goal is not derived using Site-specific information. EPA instead uses several factors, including a BSAF from EPA's Risk Assessment Guidance for Hazardous Waste Combustion Facilities. The BSAF values that EPA uses are from a document that is not in the Administrative Record and does not use Site-specific data or data for the San Jacinto estuary. The Combustion Guidance is not clear as to how and with what data set the reported BSAFs were derived, and the BSAF used by EPA could not be replicated by Respondents. As a result, this cornerstone of Region 6's analysis is not transparent.

Response: *EPA disagrees that the analysis lacks transparency. The Site specific BSAF values were not adequate to derive a reliable sediment Preliminary Remediation Goal value as the PRPs admitted in their own evaluation. Reference to the combustion guidance was provided in the references section of EPA's risk evaluation report. The methodology used to develop dioxin BSAF values is presented in Appendix A of the combustion guidance.*

2.3.30 Comment: To appropriately calculate a sediment PRG that accounts for fish ingestion, EPA should have instead used Site-specific BSAFs provided in Appendix B of the Remedial Investigation Report (which is in the Administrative Record). Those BSAFs were derived to reflect local exposure conditions for fish, which is consistent with EPA's BSAF Guidance and, from a technical perspective is much more appropriate than relying on the BSAFs that EPA used. During the Remedial Investigation for this Site, when Region 6 directed Respondents to develop Site-specific BSAFs, that appears to have been Region 6's perspective as well. Appendix B of the Remedial Investigation Report includes tables with the Site-specific BSAF values, and all relevant details on how they were derived.

Response: *EPA did not use the Site specific BSAFs developed by the PRPs because they varied over orders of magnitude, and were determined to be unreliable. Appendix B of the Remedial Investigation, specifically states that the Site-specific BSAF would "generate unreliable results" due to the high variability of the Site specific BSAF data. Instead, EPA used a BSAF value from the EPA Combustion guidance (US EPA, 2005) and was transparent in justifying its reasons for doing so. As EPA explained, EPA determined that a Combustion Guidance BSAF value of 0.09 pg/g tissue per pg/g sediment was reasonable in calculating the sediment PRG.*

2.3.31 Comment: Using EPA's analysis and rationale, but using Site-specific BSAF values from Appendix B, the sediment concentration corresponding to a 10^{-3} cancer risk would be 3,000 ng/kg. Putting aside other defects in Region 6's analysis, if Region 6 had used this as its Principal Threat Waste threshold, there would be no justification for removal of the Eastern Cell of the Northern Impoundments, since most of that part of those Impoundments (all but two surface samples) has toxicity equivalent concentrations below 3,000 ng/kg. Of the material that would be required to be removed under Alternative 6N, approximately 44,000 cubic yards of it (or about 29% of the total 162,000 cy to be removed) is located in the Eastern Cell.

Response: *EPA did not use the cancer effects in its risk evaluation to determine the Preliminary Remediation Goal for the Site sediment because EPA currently does not have a cancer toxicity value published in IRIS. Instead EPA used the current non-cancer effects that were published in IRIS in February 2012. The non-cancer effects are based on human health epidemiological studies that show protecting human health from non-cancer effects is at levels lower than levels protecting human health at the upper end of the EPA acceptable risk range of* 10^{-4}*. In other words, using current tier 3 toxicity values for protecting human health at dioxin levels associated with* 10^{-4} *excess cancer risk effects will not be protective for non-cancer adverse health effects at a HI of 1. Further, Site specific BSAF values determined by the PRPs exhibited a wide range of values spanning orders of magnitude, and the PRPs use of these Site specific BSAF values was deemed to be unreliable.*

2.3.32 Comment: Region 6 inappropriately derived a Principal Threat Waste threshold by multiplying EPA's Preliminary Remediation Goal by a factor of ten, thereby basing its Principal Threat Waste threshold on an indirect exposure pathway in contravention of applicable guidance. The EPA's Principal Threat Waste Guidance addresses risk management associated with "source material," which is defined by EPA as "…material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, to surface water, to air, or acts as a source for direct exposure." However, EPA Region 6's threshold concentration for Principal Threat Waste incorporates fish ingestion as an exposure pathway. This is inappropriate because the fish themselves are not source material, and the fish cannot be subjected to treatment or any other remedy. Although fish may be contaminated by exposure to source material, fish tissue is not source material with which humans may have direct contact and that could be addressed by treatment. Therefore, derivation of a Principal Threat Waste threshold on the basis of indirect exposure through fish ingestion is not consistent with EPA Principal Threat Waste Guidance.

Response: *The comment inaccurately assumes that fish are being considered as a source of dioxins. The waste and contaminated sediment are the sources of contamination. Fish are not considered here as a chemical source, but as a pathway for direct exposure. Sediment acts as a reservoir for dioxins that may migrate to fish tissue. Only sediment values were used in calculating sediment Preliminary Remediation Goals. Although not mentioned specifically in the quote above from the guidance, "…material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to* *groundwater, to surface water, to air, or acts as a source for direct exposure"; it is clear that the guidance includes source materials migration to other media including biota.*

2.3.33 Comment: EPA Region 6's approach to deriving a Preliminary Remediation Goal threshold is further contrary to the provision of EPA's Principal Threat Waste Guidance that "…this concept of principal and low level threat wastes should not necessarily be equated with risks posed by Site contaminants via various exposure pathways." EPA Region 6's analysis to derive a Principal Threat Waste threshold does exactly what the guidance instructs should not be done - it incorporates risk via an indirect exposure route, ingestion of fish that have bio accumulated dioxins and furans.

Response:
CERCLA Section 121(b)(1) states in part:

- *Remedial actions in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances, pollutants, or contaminants is a principal element, are to be preferred over remedial actions not involving such treatment.*

- *The President shall conduct an assessment of permanent solutions and alternative treatment technologies or resource recovery technologies, that in whole or in part, will result in a permanent and significant decrease in the toxicity, mobility, or volume of the hazardous substance, pollutant, or contaminant.*

- *The President shall select a remedial action that is protective of human health and the environment, that is cost effective, and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. If the President selects a remedial action not appropriate for preference under this subsection, the President shall publish an explanation as to why a remedial action involving such reductions was not selected.*

Reflecting these provision in CERCLA Section121(b), EPA established program management principals and certain expectations in the NCP regarding types of remedies that EPA has found to be most appropriate for different types of waste.[35] *Although remedy selection decisions are ultimately site-specific determinations based on an analysis of the remedial alternatives using the nine criteria, these expectations are intended to streamline and focus the RI/FS on appropriate waste management options. They reflect EPA's belief that certain source materials are addressed best through treatment because of technical limitations to the long-term reliability*

[35] Preamble to the Final NCP Rule, 55 Fed. Reg. 8666, 8702 (Mar. 8, 1990) and Preamble to the Proposed NCP Rule, 53 Fed. Reg. 51394, 51422 (Dec. 21, 1988).

of containment technologies, or the serious consequences of exposure should a release occur.[36] *For example, EPA's experience that highly mobile waste generally requires treatment may help guide EPA to focus the detailed analysis in the FS on treatment alternatives, as compared to containment alternatives.*[37]

Under the NCP at 40 CFR § 300.430(a)(iii)(A), EPA expects to use treatment to address the principal threats posed by a site, wherever practicable. Principal threats for which treatment is most likely to be appropriate include liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile materials.[38] *The EPA Guide to Principal Threat and Low-level Threat Waste further explains that principal threat wastes are those source materials considered highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur.*[39] *Principal Threat Waste (PTW) includes liquids and other highly mobile materials (e.g. solvents) or materials having high concentrations of toxic compounds.*[40] *No threshold of toxicity/risk has been established to equate to "principal threat." However, where toxicity and mobility of source material combine to pose a potential risk of 10-3 or greater, generally treatment alternatives should be evaluated.*[41] *Also, treatment that destroys or reduces hazardous properties of contaminants (e.g., toxicity or mobility) frequently will be required to achieve solutions that afford a high degree of permanence.*[42] *EPA also recognizes that "although no threshold level of risk has been established to identify principal threat waste, a general rule of thumb is to consider as a principal threat those source materials with toxicity and mobility characteristics that combine to pose a potential risk several orders of magnitude greater than the risk level that is acceptable for the current or reasonably anticipated future land use, given realistic exposure scenarios."*[43]

Examples of PTW include but are not limited to:

- *Liquids – wastes contained in drums, lagoons, or tanks, free product (NAPL or DNAPL)*

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36 "A Guide to Principal Threat and Low Level Threat Wastes", U.S. EPA, November 1991 (OSWER 9380.3-06FS)
[hereinafter *PTW Guidance*] at p.1. "Source material" is defined as material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration on contaminants to ground water, to surface water, to air, or act as a source for direct exposure.

37 55 Fed. Reg. at 8702.

38 40 C.F.R. § 300.430(a)(iii)(A).

39 *PTW Guidance* at p.2, *see also 55 Fed. Reg. at 8703 and 53 Fed. Reg. at 51422.* Principal threats are characterized as waste that cannot be reliably controlled in place such as liquids, highly mobile materials (e.g., solvents), and high concentrations of toxic compounds (e.g., several orders of magnitude above levels that allow for unrestricted use and unlimited exposure).

40 Id.

41 Id.

42 53 Fed. Reg. at 51422.

43 "Rules of Thumb for Superfund Remedy Selection", U.S. EPA, August 1997, (OSWER Pub. 9355.0-69) at p.11.

- *Mobile source materials – surface soil or subsurface soil containing high concentrations of contaminants of concern that are (or potentially are) mobile due to wind entrainment, volatilization (e.g., VOCs), surface runoff, or subsurface transport.*

- *Highly toxic source material – buried drummed non-liquid wastes, buried tanks containing non-liquid wastes, or soils containing significant concentrations of highly toxic materials. For PCB contamination or PCB waste at Superfund sites, principal threats will generally include material contaminated at concentrations exceeding 100ppm for sites in residential areas and concentrations exceeding 500 ppm for sites in industrial areas reflecting concentrations that are 1 to 2 orders of magnitude higher than the preliminary remediation goals.*[44]

Under the NCP at 40 C.F.R. § 300.430(e) Feasibility Study, the primary objective of the feasibility study (FS) is to ensure that appropriate remedial alternatives are developed and evaluated such that relevant information concerning the remedial action options can be presented to the decision-maker and an appropriate remedy be selected. EPA's RI/FS guidance on developing and screening remedial alternatives further provides that alternatives should be developed ranging from one that would eliminate or minimize the extent feasible the need for long-term management (including monitoring) at a site to one that would use treatment as a primary component of an alternative to address principal threats at the site.[45] *EPA's PCB Guidance states that the Superfund program expectations should be considered in developing appropriate response options for the identified area over which some action must take place.*[46] *In particular, the expectation that principal threats at the site should be treated, wherever practicable, and that consideration should be given to containment of low-threat material, forms the basis for forming alternatives.*[47]

A detailed analysis in the FS at this Site has evaluated remedial alternatives using the nine criteria specified in the NCP, including the criterion Reduction of toxicity, mobility, or volume through treatment, which addresses how treatment is used to address principal threats at the site.[48] *This evaluation criterion addresses the statutory preference for selecting remedial actions that employ treatment that permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances as their principal element. This preference is satisfied when treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, reduction of total mass of toxic contaminants, irreversible reduction in*

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[44] "Guidance on Remedial Actions for Superfund Sites with PCB Contamination", U.S. EPA, August 1990, (EPA/540/G-90/007) [hereinafter *PCB Guidance*] at p. iv. *See also PCB Guidance* p. 6, p. 39, and p. 40.

[45] "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA - Interim Final", U.S. EPA October 1988 (OSWER Dir. 9355.3-01) [hereinafter *RI/FS Guidance*] at p. 4-7.

[46] *PCB Guidance* at p. iv.

[47] *Id*.

[48] *See* 40 C.F.R. § 300.430(e)(9) *Detailed Analysis of Alternatives*.

contaminant mobility, or reduction in the total volume of contaminated media.[49] In evaluating this criterion an assessment should be made as to whether treatment is used to reduce principal threats, including the extent to which toxicity, mobility, or volume are reduced either alone or in combination.[50] Additionally, alternatives were using the Long-term effectiveness and permanence criterion which focuses on the degree to which an alternative reduces, toxicity, mobility, or volume through treatment, minimizes residual risks and affords long-term protection.[51]

Pursuant to 40 C.F.R. § 300.430(e)(3), for source control actions, the lead agency shall develop, as appropriate: (i) A range of alternatives in which treatment that reduces the toxicity, mobility, or volume of the hazardous substances, pollutants, or contaminants is a principal element. As appropriate, this range shall include an alternative that removes or destroys hazardous substances, pollutants, or contaminants to the maximum extent feasible, eliminating or minimizing, to the degree possible, the need for long-term management. The lead agency also shall develop, as appropriate, other alternatives which, at a minimum, treat the principal threats posed by the site but vary in the degree of treatment employed and the quantities and characteristics of the treatment residuals and untreated waste that must be managed." (Emphasis added)

Consistent with CERCLA, the NCP, and EPA guidance, PTW was identified at this Site as discussed below in this section.

Furthermore, consistent with the statutory mandate to utilize permanent solutions and alternative treatment or resource recovery technologies to the maximum extent practicable and the preference for remedies that to the maximum extent practicable employ treatment that permanently and significantly reduces the toxicity, mobility, or volume of hazardous substances, pollutants or contaminants, the Agency has evaluated potential treatment options for the dioxin prior to disposal. These options are designed to address the toxicity and mobility of the PTW at this site so that it will not be further released into the environment after disposal. Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during the remediation will be tested to comply with the applicable requirements. Treatment of a portion of the paper mill waste by solidification with cement was successfully performed during the Time Critical Removal Action (TCRA) on a portion of the Western Cell materials. EPA will implement the best technology to meet the statutory requirements discussed above after further evaluation in the remedial design.

The purpose of discussing PTW is not to set cleanup levels. The purpose is to reflect EPA's belief that certain source materials are addressed best through treatment because of technical

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[49] *RI/FS Guidance* at p. 6-8.

[50] *Id*. at p. 6-8 and p. 6-9

[51] 40 C.F.R. § 300.430(e)(7)(i) and § 300.430(e)(9)(iii).

limitations to the long-term reliability of containment technologies, or the serious consequences of exposure should a release occur.

Dioxin is highly toxic and persistent (will not break down for hundreds of years) in nature. With the regular occurrence of severe storms and flooding in the area, there is uncertainty that the waste material can be reliably contained over the long term and therefore should be considered potentially highly mobile due to its location in a dynamic river environment. Because the dioxin waste in the northern impoundments and southern impoundment at the Site is both highly toxic and potentially highly mobile, it is considered a Principal Threat Waste.

2.3.34 Comment: The manner in which EPA derived certain values and the rationale for deviating from applicable guidance cannot be determined. Given this lack of transparency, the EPA Risk Evaluation and conclusions based on it should be disregarded, as any reliance on it would be arbitrary and capricious. EPA's approach to calculating a Site-specific PRG for sediments is not transparent. The related calculations and conclusions cannot be replicated from information in the Administrative Record and EPA has not explained its rationale for deviating from applicable guidance. The lack of transparency is such that any reliance on the EPA Risk Evaluation or the conclusions reached in reliance on it would be arbitrary and capricious.

Response: *EPA disagrees that the risk evaluation is not transparent or that it is arbitrary and capricious. EPA followed EPA's risk assessment process by utilizing methodologies and procedures recommended in EPA risk assessment guidance. Equations were provided and each input parameter required for the equations. EPA used the same input parameter values that were used in the Baseline Human Health Risk Assessment, and noted that in footnotes to Tables 1 and 2 and throughout the report. With the exception of child body weight and life time, which were consistent with EPA guidance (See response to Comment 2.3.22), PRP exposure parameters were used.*

2.3.35 Comment: The EPA Evaluation is not transparent in a number of other respects. It appears to, in part, adopt the approach taken in the Baseline Human Health Risk Assessment for the Site, but does not clearly explain important departures from the Baseline Human Health Risk Assessment. For example, some of the exposure factors assumed by EPA and other considerations in EPA's exposure calculations are different from those adopted in the Baseline Human Health Risk Assessment (*e.g.*, child body weight, life time). Neither EPA nor Region 6 provide rationale for departing from exposure assumptions previously developed and documented by Respondents in collaboration with and approved by EPA Region 6. This is an additional reason why EPA Region 6's choice to rely upon the Risk Evaluation as the basis for its determination of a Principal Threat Waste threshold is arbitrary and capricious.

Response: *EPA disagrees that the Principal Threat Waste threshold is arbitrary and capricious. EPA used a child body weight and life time recommended by the EPA guidance (EPA, 2011). This child body weight and lifetime are used consistently throughout the nation by all EPA regions. If one uses a 6-year exposure duration for a young child, then an average body weight of 15 Kg should also be used (please see response to Comment 2.3.22).*

2.3.36 Comment: The EPA Risk Evaluation does not explain or present the data used to estimate exposure, and the exposure point concentrations the EPA calculates are not reproducible. EPA does not present or describe the specific environmental samples used to calculate exposure point concentrations used in his evaluation, how those data were treated (*e.g.,* averaging of duplicates), or how toxicity equivalents were calculated (*e.g*., using a value of one-half the detection limit, the full detection limit, or zero for non-detected congeners). EPA does not describe the statistical methods used for estimating exposure point concentrations, and does not present equations used for estimating Preliminary Remediation Goals for individual exposure pathways or for all exposure pathways combined.

Response: *EPA did not develop a new Baseline Human Health Risk Assessment but relied heavily on the risk information provided in the Remedial Investigation and the Baseline Human Health Risk Assessment. EPA used the same Exposure Point Concentrations that were developed and used in the Baseline Human Health Risk Assessment (Integral, 2013). EPA reviewed the Exposure Point Concentrations reported in the Baseline Human Health Risk Assessment and found them to be adequate since calculations follow all appropriate guidance. The Exposure Point Concentrations used were the same as Exposure Point Concentrations reported in the Baseline Human Health Risk Assessment. The Exposure Point Concentrations for Beach Areas A, B/C, D, and E reported in Table 1 and Table 2 in EPA's report are the same as Exposure Point Concentrations in Table 5-2 in the Baseline Human Health Risk Assessment (Integral, 2013). The Exposure Point Concentrations for Fish Collection Areas reported in EPA's Tables 3 and 4 are the same Exposure Point Concentrations in Table 5-3 in the Baseline Human Health Risk Assessment (Integral, 2013). In situations where the Baseline Human Health Risk Assessment did not follow the guidance, they were modified: e.g., the guidance requires that dioxin-like PCBs be added to the total dioxin Exposure Point Concentrations. Such modifications were reported in EPA's report in the footnotes to Tables 3 and 4.*

2.3.37 Comment: In a significant departure from EPA's risk assessment guidance, DEPA fails to recognize and discuss the sources and impacts of uncertainties on the calculated risk estimates and PRGs. EPA guidance on completing risk assessments, establishing PRGs, and selecting remedies clearly states that uncertainties must be evaluated, and their impacts considered in the context of decision making. EPA's 1991 Guidance for Establishing PRGs states "[r]isk based PRGs are associated with varied levels of uncertainty depending on many factors … To place risk based PRGs that have been developed for a site into perspective, an assessment of the uncertainties associated with the concentrations should be conducted." EPA's Rules of Thumb states that evaluating and discussing uncertainties is a key component of the risk characterization process that is critical for the selection of a remedy. EPA recognizes and addresses only a single uncertainty - that resulting from using a Tier 3 cancer slope factor for dioxin. He ignores other sources of uncertainty inherent in the risk assessment process including uncertainties in the data used, data processing, and exposure assessment.

Response: *EPA was not trying to develop a new Baseline Human Health Risk Assessment, rather the goal was to complement the Baseline Human Health Risk Assessment by correcting areas where it was deficient or lacking support. The Baseline Human Health Risk*

Assessment addressed sources of uncertainties and their impact on the risk assessment. Those uncertainties were considered by EPA in its risk management decision.

2.3.38 Comment: The analysis presented by EPA is completely deficient relative to the Region 6 approved, Site-specific risk assessment documents and protective concentration levels, and is not consistent with EPA's own guidance. Region 6's use of EPA's analysis as the basis for its Principal Threat Waste threshold of 300 ng/kg is arbitrary and capricious, given its ambiguities and shortcomings, its lack of transparency, and the fact that its results cannot be reproduced.

Response: *On the contrary, EPA developed a balanced well thought risk analysis keeping with all EPA recommendations and guidance. All equations and input parameters were provided in detail to easily reproduce the same risk and cleanup numbers. EPA evaluations relied heavily on the Baseline Human Health Risk Assessment input exposure parameters and Exposure Point Concentrations. The Principal Threat Waste determination was not only based on toxicity but also on potential mobility, weather conditions, and dynamics of the river.*

2.3.39 Comment: Dioxins and furans from within the waste impoundments have not been significantly transported outside of the original 1966 perimeter of the waste impoundments.

Response: *The sediment fingerprint analysis and the surface water analysis results showed a different dioxin/furan chemical signature in the vicinity of the areas outside of the waste impoundments from the background areas. Specifically, the waste impoundments and areas in the vicinity of the impoundments showed a strong signature of 2,3,7,8-TCDD and 2,3,7,8-TCDF which was absent in all of the other fingerprinted areas. This shows that dioxin/furan has been released beyond the limits of the original waste impoundment boundaries. The waste impoundments thus act as a source of dioxin/furans that are being released to the surrounding environment and elimination of this source will mitigate this release.*

2.3.40 Comment: Implementation of the TCRA and the existing cap have already achieved significant risk reduction.

Response: *EPA agrees the TCRA construction has resulted in reduction of the current risk; however, EPA disagrees that future risk reduction can be reliable achieved over the long-term. In addition, the continuing maintenance of the temporary cap in the six years since construction has showed no signs of lessening based on past issues with its structural integrity. Further, the maintenance performed was in response to low intensity flooding than the designed flood. This does not provide assurance that more significant cap damage will occur for the design storm or hurricanes, or larger more intense storms, and their associated wave action. This is also documented in the riverbed scour which occurred in 2016 adjacent to the temporary cap following flooding less intense than the design flood and does not give the assurance that greater undermining of the cap will not occur with more intense flooding over time. Moreover, US Army Corps of Engineers modeling indicates that under severe weather events, dioxin release from the cap with future enhancements (Alternative 3N) could be as high as 170 g. EPA does recognize that cap maintenance may be accomplished following receding of flood waters or hurricanes to repair any damage to the cap; however, any dioxin release to the river would have* *already caused impact. Finally, EPA disagrees that the potential releases during implementation of alternative 6N were not considered. In fact, these were specifically discussed in the US Army Corps of Engineers report and in the Proposed Plan.*

2.3.41 Comment: Site specific data, including 2016 data that Region 6 declined to consider, demonstrates that the wastes in the southern impoundment are contained and do not present an unacceptable risk to people or the environment.

Response: *EPA disagrees that the 2016 data was not considered. This data was evaluated to assess whether the southern impoundment is currently containing the waste material. However, this data does not address the long-term reliability of the pits in the environment of the San Jacinto River. Experience and documentation of past flooding indicates that new channels have been created by the fast flowing water as reported by the National Transportation Safety Board. Past experience and documentation has also shown that flooding travels in both the San Jacinto River channel and the Old River channel (travels on both sides of the southern impoundment).*

2.3.42 Comment: Region 6 has no credible basis for asserting that buried waste in the southern impoundment could become mobile.

Response: *Experience and documentation indicates past flooding and fast flowing water have created new channels as reported by the National Transportation Safety Board. Past experience and documentation has also shown that flooding travels in both the San Jacinto River channel and the Old River channel (i.e., travels on both sides of the southern impoundment). There is no assurance that the waste can be reliably contained over the long-term.*

2.3.43 Comment: If the remedy is implemented as USEPA envisions, when will the fish consumption advisory for dioxin be removed from the area?

Response: *One of the Remedial Action Objectives for the remedial action at the Site is to reduce human exposure to dioxins from consumption of fish. While the Site is a significant source of dioxin, it is not the only dioxin or PCB source (TMDL, Univ of Houston, 2006 & 2009), both of which contribute to the fish advisory. Because remediation of the Site will not affect the other sources in the San Jacinto River it cannot be expected that the fish advisories are likely to be removed.*

2.3.44 Comment: If the remedy is implemented as USEPA envisions, when will local groundwater be restored to pristine condition?

Response: *EPA does not anticipate that removal of the dioxin waste will impact local ground water. Site ground water sampling suggests that dioxin has not migrated from the waste pit area. Although dioxin has been detected in some local wells, the level detected was below the federal Maximum Contaminant Level for dioxin in drinking water, and the type of dioxin detected in residential wells has different chemical fingerprint than the type of dioxin found in the waste pits.*

2.3.45 Comment: What are the risks to the community associated with diesel exhaust and dust particles during operations and transportation?

Response: *The Remedial Design will address and identify risks associated with the removal and transport of waste material and will develop best management practices to limit impacts and inconveniences to the surrounding communities. Best management practices could include limits on hours of operation, dust suppression measures, monitoring weather conditions, etc. Access to I-10 is only about 1½ miles from the Site via the East Freeway Service Road, which is primarily used for non-residential, commercial/industrial traffic and trucking. The number of trips per day depends on the size of the trucks used. If small trucks are used for disposal, the maximum round trips per day would be about 200, including disposal trucks, deliveries and workers. For a 12-hour work day, it would be a vehicle about every four minutes. If 20 cubic yard trucks were used, there would be one truck every 10 to 15 minutes, or about one vehicle every six minutes including worker traffic and deliveries. There is little other traffic over most of the route. The traffic volume is inconsequential for I-10 and its ramps, representing about 0.1 percent of the average daily traffic on I-10 and less than three percent of the ramp capacity. Because the incremental traffic on I-10 is very small, the incremental diesel exhaust would also be expected to be very small.*

2.3.46 Comment: What are the health and safety risks to the workers and the public associated with operation of heavy equipment and increased truck traffic on the highways between the Site and the selected off-site landfill?

Response: *The location and type of final disposition for the waste has not been determined but will be determined during the Remedial Design. Construction activities associated with onsite activities will follow Occupational Safety and Health Administration requirements under the Hazardous Waste Operations and Emergency Response Standard once the final design has been approved. Offsite vehicle movement will follow Department of Transportation regulations and a transportation plan will be developed to promote safety. Because the incremental traffic on I-10 is very small, at least in the vicinity of the Site, the incremental health and safety risks from increased truck traffic would also be expected to be very small.*

2.3.47 Comment: EPA mentions a target of "reliability" over a time period of 500 years. EPA's use of a 500-year benchmark for reliability is, in my view, extreme. EPA's rationale for selection of such an extreme benchmark is presumably tied to the length of time dioxin may remain toxic.

Response: *The longevity of dioxins in the environment drives the need for consideration of a long time frame regarding the reliability of a containment system for the Site.*

2.3.48 Comment: Alternative 6N does remove a mass of waste from the aquatic environment, but there will be significant residual waste and associated contaminants, so essentially for

Alternative 6N we would be left with two containments for the same waste, a cap over deep inventory and residuals and an off-site landfill.

Response: *The remedial goal for the waste pits area is 30 ng/kg for dioxins. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. It is not anticipated that a backfill or cover layer will be required as was the case with the former 200 ng/kg remedial goal because all of the waste will be removed.*

2.3.49 Comment: Compared to the baseline risks calculated for the Site, will risks to human health and the environment increase due to the expected loss of dioxin during construction of the remedy?

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

2.3.50 Comment: How much dioxin is expected, even under ideal conditions, to migrate downstream due to ineffective control measures, especially in a large river like the San Jacinto River?

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs* *proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

2.3.51 Comment: Does USEPA expect to see higher levels of dioxins in fish following construction of the remedy, as have been observed at other sediment remediation sites?

Response: *Experience at other sites, such as the Hudson River, has shown a short-term increase in fish tissue concentrations followed by a long-term decrease to levels below pre-remedy conditions due to resuspension of sediment while dredging. The selected remedy does not include "wet" dredging as a principle component.*

As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.

2.3.52 Comment: What is the risk of unintended contamination of recreation and commercial fisheries in downstream areas such as Galveston Bay due to residual contamination and/or potential catastrophic loss of contamination during implementation of the full removal plan?

Response: *EPA does not expect that risks to human health and the environment will increase above the baseline risks calculated in the BHHRA due to construction of the remedy. Following removal, there is no potential for a release because the waste will have been removed.*

2.3.53 Comment: How long will the elevated risks associated with releases during construction continue before risks return to baseline levels?

Response: *Risks are not expected to be elevated above baseline during construction because the excavation will be completed in the "dry" and not subject to the typical residuals and resuspension associated with dredging.*

2.3.54 Comment: What are the risks to the community associated with fugitive emissions of the contamination during removal, drying and transportation of waste material from the Site during construction?

Response: *A number of techniques are used to control fugitive emissions from contaminated sediment sites, and these techniques will be fully explored, assessed, and included in the design plans as necessary. The work plan to be developed for implementing the remedy will include provisions for containing and controlling losses from excavated sediment. The traffic volume is inconsequential for I-10 and its ramps, representing about 0.1 percent of the average daily traffic on I-10 and less than three percent of the ramp capacity. Because the incremental traffic on I-10 is very small, the incremental diesel exhaust is also expected to be small.*

2.3.55 Comment: Reasonable estimates of the resuspension and releases that inevitably would result from each remedial alternative are necessary to permit reasoned comparisons of the net risk reduction associated with each alternative. The risks associated with resuspension and releases may be substantial because, as the Guidance notes, sediment resuspension losses "generally range from less than one percent to between 0.5 and 9 percent." (p. 6-23) These estimates and their incorporation into the remedy evaluation process are mandated by the Sediment Guidance (Sections 6.2, 6.5.5, 6.5.6, 6.5.7, Highlight 6-11, and Highlight 7-3). Here, the Region appropriately requested the evaluation of potential releases at this Site during the proposed removal of the cap and underlying waste in order to benefit from the world renowned expertise of the Army Corps on this subject and should heavily rely on the Corps' conclusions that some releases are inevitable despite use of Best Management Practices (BMPs) and that significant releases are likely to occur during heavy rain events or other storms that have been documented to occur locally at a regular frequency. In fact, the Army Corps Report notes that contaminant mobilization from resuspension is expected to release 400,000 times as much contaminants as currently occurs with the intact cap (U.S. Army Corps Report at p. 6) and possibly five times higher than that if a flood event occurs (Id. at p. 7). Experience at other sites shows that resuspension and release of contaminants during dredging events can have long-term effects on the aquatic ecosystem. For example, the dredging in Commencement Bay in Seattle in 2004 caused a spike in fish tissue concentrations that persisted for years (Patmont, et al., Battelle 2013). After two major dredging projects were completed, concentrations of PCBs in fish tissue are still higher than they were over 20 years ago before dredging began (38 ppb before and 70 ppb after). Simply hoping to "do a better job" dredging than in all past projects is not a realistic expectation and does not constitute sound decision-making.

Response: *The comment regarding resuspension and release is based on dredging, or removal in the wet, where water is able to be transported through the Site, with limited residuals management, and with a low potential for natural recovery as existed for the dredging in Commencement Bay. The US Army Corps of Engineers evaluation report (2016) predicted similar responses when dredging is performed with traditional methods. The selected remedy does not include "wet" dredging as a principle component.*

As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste *material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

2.3.56 Comment: The expected release from localized disturbances with an enhanced cap is projected to be more than 1,000 times smaller than compared to the proposed removal action.

Response: *Releases from removal are only greater if it is assumed that there are no large-scale disturbances to a cap. If there are large scale disturbances (i.e. significant scour of the cap), US Army Corps of Engineers modeling has shown that release could be much more that from removal for a single event. Utilization of excavation in the "dry" in the selected remedial action will greatly reduce releases associated with the Alternative 6N removal.*

2.3.57 Comment: The COE projects that the removal action will set back the natural recovery of the Site by more than 10 to 20 years.

Response: *This estimate is based on alternatives that include underwater dredging, with the associated resuspension and release. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

2.3.58 Comment: Under the selected removal option potential exposure to the contaminants of concern will be 4,000 times greater than with a secure closure in place.

Response: *First, this comment assumes that there will be no large-scale future disturbances to a cap. If there are large scale disturbances (i.e. significant scour of the cap), US Army Corps of Engineers modeling has shown that releases could be much more than from removal for a single event with future cap erosion. Further, the estimate referenced in this comment is based on an evaluation that assumes underwater dredging, with the associated resuspension and release. The selected remedy does not include "wet" dredging as a principle component.*

As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.

2.3.59 Comment: Increases in the release of contaminants directly related to the proposed removal will also be directly related to fish tissue concentrations hundreds of time greater for a duration of years. The proposed plan fails to clearly demonstrate how any of the remedial action objectives will be met. Rather, the failure to consider the enhanced closure in place will have exactly the opposite effect, essentially significantly increasing the release from the impoundments of the very dioxins over which the surrounding communities and citizens have expressed so much interest, concern and even fear.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

2.3.60 Comment: Regardless of the suppositions about the performance of a significantly enhanced cap, the simple fact is that the current cap, although well below the desired future standards, is working. Data requested by EPA to be collected clearly show that concentrations of toxic constituents of concern in surface sediments are currently below protective concentration levels and continue to decline. Except for samples from wells intentionally completed in the waste deposits, groundwater samples both north and south of IH 10 are in compliance with Texas surface water quality standards and show no mobility to surface waters. Samples of porewater do not detect constituents of concern and fish tissue concentrations (Gulf killifish) show virtually no difference upstream or downstream of the site. Given that the current cap is performing the job it is intended to perform, there is every good reason to believe that a significantly enhanced cap will continue to do the same and with far greater certainty.

Response: *EPA concurs that the current cap has improved conditions; however as noted in previous comment responses, the current cap has exhibited weaknesses, and even with the placement of a significantly enhanced cap, is unlikely to withstand extreme weather events in the future. Documented events have shown that the current cap has suffered repeated damages and deficiencies from floods that were less than a 100-year flood event, even though the northern impoundment was designed for a 100-year flood. Repairs to the cap have been performed in July 2012, January 2013, January 2014, December 2015, February 2016, March 2016, and June 2016 since its completion in July 2011. The goal of the selected removal alternative is to eliminate the potential of an enhanced cap being breached and releasing contaminated material into the environment. The selected alternative for removal instead of capping the wastes presents the best long-term solution to eliminate the threat of releases from the Site.*

Results of the 2016 surface water quality study also showed that average TEQ in the vicinity of the site remained above the TSWQS (Table 3). The highest average concentration of 0.681 pg/L TEQ remained directly above the eastern cell, and the lowest average downstream concentration was 0.319 pg/L TEQ (Integral, 2016). Although the greatest change (>90% decrease) in TEQ between past and current conditions occurred at the station located directly above the eastern cell of the waste impoundments north of I-10 (Integral, 2016), the average concentration of TCDD (0.386 pg/L) above the waste impoundments remained 3.5 times on average higher than the upstream concentration (0.118 pg/L). The average concentration of TCDF (1.169 pg/L) directly above the eastern cell of the waste pits remained 3.9 times average higher than upstream levels. TCDD and TCDF are forms of dioxin and furan specifically associated with the site waste.

2.3.61 Comment: Consistent with the general chemical properties of dioxins and furans, the capped pulp waste at this Site should not be considered mobile.

Response: *Based on sampling conducted in 2016, the dioxin is mobile in the environment of the Site. Results of the 2016 surface water quality study showed that average TEQ in the vicinity of the site remained above the TSWQS (Table 3). The highest average concentration of 0.681 pg/L TEQ remained directly above the eastern cell, and the lowest average downstream concentration was 0.319 pg/L TEQ (Integral, 2016). Although the greatest change (>90% decrease) in TEQ between past and current conditions occurred at the station located directly above the eastern cell of the waste impoundments north of I-10 (Integral, 2016), the average concentration of TCDD (0.386 pg/L) above the waste impoundments remained 3.5 times on average higher than the upstream concentration (0.118 pg/L). The average concentration of TCDF (1.169 pg/L) directly above the eastern cell of the waste pits remained 3.9 times average higher than upstream levels. TCDD and TCDF are forms of dioxin and furan specifically associated with the site waste. A severe storm event could release and mobilize large quantities of dioxin and furan contaminated wastes and sediment to downstream sections of the river and the surrounding area. EPA is concerned that an armored cap might be breached during such extreme weather events.*

2.3.62 Comment: EPA Region 6's preferred remedy does not focus or streamline the remedial action and does not specify treatment of any source materials.

Response: *The remedy has been focused and streamlined to the extent practical. Excavated waste material would be dewatered (decanted) and stabilized by addition of Portland cement or other additive, as necessary, to eliminate free liquids for transportation and disposal. Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during the remediation will be tested to comply with the applicable requirements. Treatment of a portion of the paper mill waste by solidification with cement was successfully performed during the Time Critical Removal Action (TCRA) on a portion of the Western Cell materials.*

2.3.63 Comment: EPA Region 6 failed to present evidence that the designated waste is highly mobile or toxic.

Response: *The dioxin waste was shown to be mobile based on the modeling conducted by the US Army Corps of Engineers using the current temporary cap with enhancements (Alternative 3N). Further, the Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike). However, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic.*

In addition, results of the 2016 surface water quality study showed that average TEQ in the vicinity of the site remained above the TSWQS (Table 3). The highest average concentration of 0.681 pg/L TEQ remained directly above the eastern cell, and the lowest average downstream concentration was 0.319 pg/L TEQ (Integral, 2016). Although the greatest change (>90% decrease) in TEQ between past and current conditions occurred at the station located directly above the eastern cell of the waste impoundments north of I-10 (Integral, 2016), the average concentration of TCDD (0.386 pg/L) above the waste impoundments remained 3.5 times on average higher than the upstream concentration (0.118 pg/L). The average concentration of TCDF (1.169 pg/L) directly above the eastern cell of the waste pits remained 3.9 times average higher than upstream levels. TCDD and TCDF are forms of dioxin and furan specifically associated with the site waste.

The removal of the waste material provides the best long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

Regarding the toxicity of dioxin, the human health effects from exposures to dioxin and dioxin like compounds have been documented extensively in epidemiologic (human) and toxicological (animal) studies. TCDD is one of the most toxic members of this class of compounds and has a robust toxicological database. EPA thoroughly and publicly reviewed the toxicity of TCDD and published a reference dose (RfD) for TCDD in 2012 (EPA's Reanalysis of Key Issues Related to

Dioxin Toxicity and Response to NAS Comments, Volume 1, EPA/600/R-10/038F, February 2012). EPA is not currently assessing the carcinogenicity of TCDD. The World Health Organization's International Agency for Research on Cancer (IARC) and the U.S. National Toxicology Program have both independently concluded that TCDD is a known human carcinogen.

EPA gathers evidence from a variety of sources regarding the potential for a substance to cause adverse health effects (carcinogenic and noncarcinogenic) in humans. These sources include controlled epidemiologic investigations, clinical studies, and experimental animal studies. Supporting information may be obtained from sources such as in-vitro test results and comparisons to structure-activity relationships. Taken together, EPA then develops a quantitative analysis and reports qualitatively the confidence in the study from which toxicity values were derived. In most cases one type of study does not provide conclusive evidence on its own, so researchers usually look at both human and lab-based studies and other supporting information when trying to determine if something causes cancer.

EPA recognizes that several epidemiological investigations involved Vietnam veterans. One of those studies was completed by the Centers for Disease Control, Atlanta, on U.S. Army Vietnam veterans who were likely to be exposed to the herbicide Agent Orange. Serum levels of TCDD, a toxic contaminant in Agent Orange, were obtained for 646 ground combat troops who served in heavily sprayed areas of Vietnam, and for 97 veterans who did not serve in Vietnam. TCDD medians for Vietnam veterans (median = 3.8 ppt) and non-Vietnam veterans (median = 3.9 ppt) were virtually the same. This study is consistent with later studies and suggests that most U.S. Army ground troops who served in Vietnam were not heavily exposed to TCDD. (JAMA 1988;260:1249-1254).

EPA also looked at studies done on other groups of people: 1) herbicide manufacturing workers, herbicide applicators and farmers who often had much higher blood dioxin levels than Vietnam veterans; 2) people exposed to dioxin after industrial accidents in Seveso (Italy) and Germany; and 3) people after chronic exposures at work and in the environment. The EPA considered this information in developing its toxicity value for TCDD.

EPA followed the National Contingency Plan or NCP (a rule implementing the Superfund program) and other guidance in developing a site-specific baseline risk assessment for the San Jacinto River Waste Pits Superfund Site. EPA's selection of toxicity values for dioxin was based on EPA's December 5, 2003, directive Human Health Toxicity Values in Superfund Risk Assessments. This directive provides a hierarchy, based on best science available, of human health toxicity values generally recommended for use in risk assessments at Comprehensive Environmental Response Compensation and Liability Act (CERCLA, or Superfund) sites. The hierarchy consists of three tiers:

- *Tier 1. EPA's Integrated Risk Information System (IRIS) toxicity values*
- *Tier 2. In the absence of IRIS values, selection of EPA's Provisional Peer-Reviewed Toxicity Values (PPRTVs). The Office of Research and Development/National Center for*

Environmental Assessment/Superfund Health Risk Technical Support Center (STSC) develops PPRTVs on a chemical specific basis when requested by EPA's Superfund program.

- *Tier 3. In the absence of PPRTVs, selection of Other Toxicity Values, which includes additional EPA and non-EPA sources of toxicity information. Priority should be given to those sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer reviewed.*

EPA selected a Tier 1 toxicity value as the reference dose for noncancer effects. The reference dose for TCDD is 7E-10 mg/kg-day (EPA's Reanalysis of Key Issues Related to Dioxin, 2012). The noncancer toxicity value for TCDD was based on two epidemiologic studies that associated TCDD exposures with adverse health effects. The first study reports decreased sperm concentration and sperm motility in men who were exposed to TCDD during childhood during the Seveso accident (Mocarelli et al., 2008), and the second reports increased thyroid-stimulating hormone levels in newborns born to mothers who were exposed to TCDD during the Seveso accident (Baccarelli et al., 2008). Adverse health effects were observed in sensitive susceptible very young members of the population during their development in utero and identified the first 10 years of life as a critical window of susceptibility for TCDD induced sperm effects in young children. IRIS also gives the confidence level associated with the toxicity value. The degree of confidence ascribed to a toxicity value is a function of both the quality of the individual study from which it was derived and the completeness of the supporting data base. IRIS gave a confidence level of "High" to the non-cancer toxicity value for dioxin. Toxicity values published in IRIS are classified as Tier 1 toxicity values and are preferred over other classified tiered toxicity values.

Currently there is no cancer toxicity value or slope factor for dioxin published in IRIS. However, EPA requires whenever possible to evaluate chemicals for both cancer and non-cancer effects for chemicals that exert these types of effects. Dioxin is known to have both cancer and non-cancer effects. Therefore, EPA evaluated the risk from both types of adverse health effects in its site specific baseline risk assessment. Complying with EPA's Dec. 5, 2003 directive, EPA used a Tier 3 cancer toxicity value in its cancer risk evaluation in the site specific risk assessment. EPA used the California EPA Cancer Slope Factor (CSF) for TCDD of 1.3E+5 (mg-kg-day)-1 (at Cal EPA's 2002 Air Toxics Hot Spots Program, Risk Assessment Guidelines, Part II, Technical Support Document for Describing Available Cancer Potency Factors. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment (OEHHA), Sacramento, CA). As a result of its evaluation, EPA relied on the Tier 1 toxicity value for noncancer effects in its decision regarding the risk and cleanup development for the Site, but not the cancer effects of dioxin. EPA included a discussion of the cancer effects in its risk assessment to show that by cleaning the site to the non-cancer effects level, EPA is also protecting for cancer effects.

2.3.64 Comment: A detailed refined analysis shows that the Preliminary Remedial Goals could be orders of magnitude higher than those proposed by Region 6 and still be protective of human health.

Response: *The risk-based remediation level was established at 30 mg/kg based on EPA policy and guidance. Commenters requested that EPA utilize a clean-up goal of 30 ng/kg for the northern waste pits instead of the 200 ng/kg presented in the Proposed Plan. The EPA adopted the 30 ng/kg clean-up goal for the northern waste pits because it is protective of the child fisherman exposure scenario used for the rest of the San Jacinto River. Other sites have had goals both lower and higher than the goals established for San Jacinto, but the final value selected is conservative and consistent with EPA guidance and is also realistic.*

2.3.65 Comment: Region 6 also committed many scientific errors throughout the process of developing the Proposed Plan. Among them were failure to recognize that the dioxins and furans at the site have vastly different physicochemical and pharmacokinetic properties and an inaccurate analysis of the time that it could take dioxins and furans to degrade if they were allowed to naturally attenuate. These errors need to be corrected if there is to be a credible remedy for this site.

Response: *The risk assessment, upon which the remediation goal of 30 ng/kg was established, was based on exposures used in the original Baseline HHRA with some updates based on EPA guidance. Consistent with dioxin risk assessment procedures, the use of Toxicity Equivalency Factors (TEFs) for selected dioxin and furan congeners were used to generate 2378-TCDD Toxicity Equivalent Quotients (TEQs). The different physical and chemical characteristics associated with dioxin and furan congeners were not ignored. With respect to the degradation estimates it is true that there is a wide range of degradation half-lives, but the congeners associated with the site (primarily 2,3,7,8-TCDD and 2,3,7,8-TCDF) are both resistant to degradation. Further, regardless of if the residence time is more or less centuries, maintenance of a hardened cap over this time is unlikely to be successful given the propensity of the area to extreme weather events.*

2.3.66 Comment: EPA Region 6 should withdraw the Principal Threat Waste concept and designation, select scientifically appropriate Preliminary Remedial Goals for the site, and seriously consider all of the proposed remedial alternatives using the National Contingency Plan criteria. All of this should be done in an open and transparent fashion, candidly discussing scientific and engineering uncertainties. Several EPA regions (3,4,8) have used alternative values for HIs in various Superfund decision documents. For example, EPA Region 3 has recently approved an Remedial Action Objective corresponding to HI=2, This language was first used in the Safe Drinking Water Act (SDWA) as a basis for setting Maximum Contaminant Levels and Maximum Contaminant Level Goals. It was not numerically defined in the SDWA or in CERCLA on the basis of toxicological uncertainty in an Reference Dose (US Army Corps of Engineers 2016). As will be seen below, there is substantial toxicological uncertainty in applying the 2,3,7,8-TCDD Reference Dose to the TEQs at the Site. On the basis of the logic used by Region 3, toxicological uncertainty alone could increase the SJRWP principal threat waste bright line from 300 ng/kg to 600 ng/kg. Region 4 (EPA 2014) specifically directs developing remediation goals with HQ of 3 based on statements regarding uncertainty made in RAGS A (EPA 1989). This would result in a principal threat waste bright line of 900 ng/kg. Another regulatory interpretation is that used by the Maryland Department of the Environment (MDE 2008) which is based on orders of magnitude values for hazard indices in analogy to the orders of magnitude for cancer risks noted in the National Contingency Plan. In fact, the MDE explicitly considers a hot spot as a site that exceeds a HI of 100. The concept of a hot spot is not substantially different than the concept of a principal threat. Based on this reasoning, the SJRWP bright line could easily take on a value of 3,000 ng/kg. This paragraph demonstrates that the uncertainty associated with a selection of a margin of safety for a non-carcinogen can result in a substantial variability and lack of reproducibility in the outcome. All of the values cited here incorporate an adequate margin of safety and are based on regulatory guidance and usage. All are fully documented and their application is transparent. As with all Superfund regulatory risk management decisions, the selection of an adequate margin of safety and subsequent value of a target hazard index depends on transparent and justified decision-making by the risk manager rather than arbitrary selection of a value.

Response:
CERCLA Section 121(b)(1) states in part:

- *Remedial actions in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances, pollutants, or contaminants is a principal element, are to be preferred over remedial actions not involving such treatment.*

- *The President shall conduct an assessment of permanent solutions and alternative treatment technologies or resource recovery technologies, that in whole or in part, will result in a permanent and significant decrease in the toxicity, mobility, or volume of the hazardous substance, pollutant, or contaminant.*

- *The President shall select a remedial action that is protective of human health and the environment, that is cost effective, and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. If the President selects a remedial action not appropriate for preference under this subsection, the President shall publish an explanation as to why a remedial action involving such reductions was not selected.*

Reflecting these provision in CERCLA Section121(b), EPA established program management principals and certain expectations in the NCP regarding types of remedies that EPA has found to be most appropriate for different types of waste.[52] Although remedy selection decisions are ultimately site-specific determinations based on an analysis of the remedial alternatives using the nine criteria, these expectations are intended to streamline and focus the RI/FS on appropriate waste management options. They reflect EPA's belief that certain source materials are addressed best through treatment because of technical limitations to the long-term reliability

[52] Preamble to the Final NCP Rule, 55 Fed. Reg. 8666, 8702 (Mar. 8, 1990) and Preamble to the Proposed NCP Rule, 53 Fed. Reg. 51394, 51422 (Dec. 21, 1988).

of containment technologies, or the serious consequences of exposure should a release occur.[53] *For example, EPA's experience that highly mobile waste generally requires treatment may help guide EPA to focus the detailed analysis in the FS on treatment alternatives, as compared to containment alternatives.*[54]

Under the NCP at 40 CFR § 300.430(a)(iii)(A), EPA expects to use treatment to address the principal threats posed by a site, wherever practicable. Principal threats for which treatment is most likely to be appropriate include liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile materials.[55] *The EPA Guide to Principal Threat and Low-level Threat Waste further explains that principal threat wastes are those source materials considered highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur.*[56] *Principal Threat Waste (PTW) includes liquids and other highly mobile materials (e.g. solvents) or materials having high concentrations of toxic compounds.*[57] *No threshold of toxicity/risk has been established to equate to "principal threat." However, where toxicity and mobility of source material combine to pose a potential risk of 10-3 or greater, generally treatment alternatives should be evaluated.*[58] *Also, treatment that destroys or reduces hazardous properties of contaminants (e.g., toxicity or mobility) frequently will be required to achieve solutions that afford a high degree of permanence.*[59] *EPA also recognizes that "although no threshold level of risk has been established to identify principal threat waste, a general rule of thumb is to consider as a principal threat those source materials with toxicity and mobility characteristics that combine to pose a potential risk several orders of magnitude greater than the risk level that is acceptable for the current or reasonably anticipated future land use, given realistic exposure scenarios."*[60]

Examples of PTW include but are not limited to:

- *Liquids – wastes contained in drums, lagoons, or tanks, free product (NAPL or DNAPL)*

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[53] "A Guide to Principal Threat and Low Level Threat Wastes", U.S. EPA, November 1991 (OSWER 9380.3-06FS)
[hereinafter *PTW Guidance*] at p.1. "Source material" is defined as material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration on contaminants to ground water, to surface water, to air, or act as a source for direct exposure.

[54] 55 Fed. Reg. at 8702.

[55] 40 C.F.R. § 300.430(a)(iii)(A).

[56] *PTW Guidance* at p.2, *see also 55 Fed. Reg. at 8703 and 53 Fed. Reg. at 51422.* Principal threats are characterized as waste that cannot be reliably controlled in place such as liquids, highly mobile materials (e.g., solvents), and high concentrations of toxic compounds (e.g., several orders of magnitude above levels that allow for unrestricted use and unlimited exposure).

[57] Id.

[58] Id.

[59] 53 Fed. Reg. at 51422.

[60] "Rules of Thumb for Superfund Remedy Selection", U.S. EPA, August 1997, (OSWER Pub. 9355.0-69) at p.11.

- *Mobile source materials – surface soil or subsurface soil containing high concentrations of contaminants of concern that are (or potentially are) mobile due to wind entrainment, volatilization (e.g., VOCs), surface runoff, or subsurface transport.*

- *Highly toxic source material – buried drummed non-liquid wastes, buried tanks containing non-liquid wastes, or soils containing significant concentrations of highly toxic materials. For PCB contamination or PCB waste at Superfund sites, principal threats will generally include material contaminated at concentrations exceeding 100ppm for sites in residential areas and concentrations exceeding 500 ppm for sites in industrial areas reflecting concentrations that are 1 to 2 orders of magnitude higher than the preliminary remediation goals.*[61]

Under the NCP at 40 C.F.R. § 300.430(e) Feasibility Study, the primary objective of the feasibility study (FS) is to ensure that appropriate remedial alternatives are developed and evaluated such that relevant information concerning the remedial action options can be presented to the decision-maker and an appropriate remedy be selected. EPA's RI/FS guidance on developing and screening remedial alternatives further provides that alternatives should be developed ranging from one that would eliminate or minimize the extent feasible the need for long-term management (including monitoring) at a site to one that would use treatment as a primary component of an alternative to address principal threats at the site.[62] *EPA's PCB Guidance states that the Superfund program expectations should be considered in developing appropriate response options for the identified area over which some action must take place.*[63] *In particular, the expectation that principal threats at the site should be treated, wherever practicable, and that consideration should be given to containment of low-threat material, forms the basis for forming alternatives.*[64]

A detailed analysis in the FS at this Site has evaluated remedial alternatives using the nine criteria specified in the NCP, including the criterion Reduction of toxicity, mobility, or volume through treatment, which addresses how treatment is used to address principal threats at the site.[65] *This evaluation criterion addresses the statutory preference for selecting remedial actions that employ treatment that permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances as their principal element. This preference is satisfied when treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, reduction of total mass of toxic contaminants, irreversible reduction in*

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61 "Guidance on Remedial Actions for Superfund Sites with PCB Contamination", U.S. EPA, August 1990, (EPA/540/G-90/007) [hereinafter *PCB Guidance*] at p. iv. *See also PCB Guidance* p. 6, p. 39, and p. 40.

62 "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA - Interim Final", U.S. EPA October 1988 (OSWER Dir. 9355.3-01) [hereinafter *RI/FS Guidance*] at p. 4-7.

63 *PCB Guidance* at p. iv.

64 *Id*.

65 *See* 40 C.F.R. § 300.430(e)(9) *Detailed Analysis of Alternatives*.

contaminant mobility, or reduction in the total volume of contaminated media.[66] *In evaluating this criterion an assessment should be made as to whether treatment is used to reduce principal threats, including the extent to which toxicity, mobility, or volume are reduced either alone or in combination.*[67] *Additionally, alternatives were using the Long-term effectiveness and permanence criterion which focuses on the degree to which an alternative reduces, toxicity, mobility, or volume through treatment, minimizes residual risks and affords long-term protection.*[68]

Pursuant to 40 C.F.R. § 300.430(e)(3), for source control actions, the lead agency shall develop, as appropriate: (i) A range of alternatives in which treatment that reduces the toxicity, mobility, or volume of the hazardous substances, pollutants, or contaminants is a principal element. As appropriate, this range shall include an alternative that removes or destroys hazardous substances, pollutants, or contaminants to the maximum extent feasible, eliminating or minimizing, to the degree possible, the need for long-term management. The lead agency also shall develop, as appropriate, other alternatives which, at a minimum, treat the principal threats posed by the site but vary in the degree of treatment employed and the quantities and characteristics of the treatment residuals and untreated waste that must be managed." (Emphasis added)

Consistent with CERCLA, the NCP, and EPA guidance, PTW was identified at this Site as discussed below in this section.

Furthermore, consistent with the statutory mandate to utilize permanent solutions and alternative treatment or resource recovery technologies to the maximum extent practicable and the preference for remedies that to the maximum extent practicable employ treatment that permanently and significantly reduces the toxicity, mobility, or volume of hazardous substances, pollutants or contaminants, the Agency has evaluated potential treatment options for the dioxin prior to disposal. These options are designed to address the toxicity and mobility of the PTW at this site so that it will not be further released into the environment after disposal. Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during the remediation will be tested to comply with the applicable requirements. Treatment of a portion of the paper mill waste by solidification with cement was successfully performed during the Time Critical Removal Action (TCRA) on a portion of the Western Cell materials. EPA will implement the best technology to meet the statutory requirements discussed above after further evaluation in the remedial design.

The purpose of discussing PTW is not to set cleanup levels. The purpose is to reflect EPA's belief that certain source materials are addressed best through treatment because of technical

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[66] *RI/FS Guidance* at p. 6-8.

[67] *Id*. at p. 6-8 and p. 6-9

[68] 40 C.F.R. § 300.430(e)(7)(i) and § 300.430(e)(9)(iii).

limitations to the long-term reliability of containment technologies, or the serious consequences of exposure should a release occur.

Dioxin is highly toxic and persistent (will not break down for hundreds of years) in nature. With the regular occurrence of severe storms and flooding in the area, there is uncertainty that the waste material can be reliably contained over the long term and therefore should be considered potentially highly mobile due to its location in a dynamic river environment. Because the dioxin waste in the northern impoundments and southern impoundment at the Site is both highly toxic and potentially highly mobile, it is considered a Principal Threat Waste.

EPA notes differences used by Regions 3 and 4 in selecting remedial goals. However, Region 6 has selected an HQ of 1 to be protective of human health and the environment for this site. Further, the uncertainty associated with the 2,3,7,8-TCDD Reference Dose is not sufficient justification for increasing the acceptable HQ at the site. The 2,3,7,8-TCDD Reference Dose was set based upon an uncertainty of 30 due to the use of a LOAEL (UF=10) and inter-individual variability (UF=3). The Reference Dose is set forth in IRIS and based upon epidemiological data with a degree of confidence ascribed as "High". Therefore, the remediation goals determined for the site are reasonable in their margin of safety and selected hazard index.

2.3.67 Comment: One of the key criteria for a principal threat waste is a high degree of mobility. In the Proposed Plan, Region 6 has failed to demonstrate that the material in the northern impoundments is highly mobile. In actuality, dioxin congeners are highly immobile and will sorb strongly to materials in the impoundments. A properly designed and maintained cap over the northern impoundments will prevent the mobility of the waste materials and any sorbed PCDD/F congeners.

Response: *EPA concurs that the temporary cap has reduced mobility of the dioxin/furan wastes, however there have been numerous failures and repairs of the cap. In the event of a severe hurricane even a hardened cap may fail based on modeling of the enhanced cap (Alternative 3N). The fingerprint assessment has demonstrated that wastes from the impoundments have expanded beyond the limits of the impoundments, and a major release could easily occur upon failure of a cap. The dioxin/furan congeners of concern (those with TEFs) are not typically considered mobile as dissolved constituents in surface water or porewater. However, they are known to bind to fine grained sediments that could be mobilized over a large area in the event of cap failure, which is possible given the dynamic nature of the San Jacinto River.*

Based on sampling conducted in 2016, the dioxin is mobile in the environment of the Site. Results of the 2016 surface water quality study showed that average TEQ in the vicinity of the site remained above the TSWQS (Table 3). The highest average concentration of 0.681 pg/L TEQ remained directly above the eastern cell, and the lowest average downstream concentration was 0.319 pg/L TEQ (Integral, 2016). Although the greatest change (>90% decrease) in TEQ between past and current conditions occurred at the station located directly above the eastern cell of the waste impoundments north of I-10 (Integral, 2016), the average concentration of

TCDD (0.386 pg/L) above the waste impoundments remained 3.5 times on average higher than the upstream concentration (0.118 pg/L). The average concentration of TCDF (1.169 pg/L) directly above the eastern cell of the waste pits remained 3.9 times average higher than upstream levels. TCDD and TCDF are forms of dioxin and furan specifically associated with the site waste.

The US Army Corps of Engineers has demonstrated that Alternative 6N provides a more certain, quantifiable outcome than Alternative 3N, with lower overall potential for release of mass. This is especially true given the additional best management practices planned for removal. EPA maintains that the use of an armored cap will be inadequate to contain the pulp waste over the long-term.

2.3.68 Comment: One of the general criteria for a principal threat waste is a characterization of highly toxic. The guidance and some precedent goes on to state that a lifetime excess cancer risk exceeding 10^{-3} can be used to give general support to that characterization. The highest cancer risk found in Region 6's risk assessment (Khoury, 2016a) was 6.6 x 10^{-4}, thus the guidance threshold value of 10^{-3} was not exceeded and the cancer risk failed to meet the criterion. EPA Region 6 then opted for alternative methods to attempt to demonstrate high toxicity including applying an arbitrary safety factor to a PRG that, itself, did not reflect a reasonable maximum exposure.

Response: *The guidance and some precedent goes on to state that a lifetime excess cancer risk exceeding 10^{-3} can be used to give general support to the Principal Threat Waste characterization. The lifetime excess cancer risk exceeding 10^{-3} is one order of magnitude or a factor of 10 higher than the EPA acceptable upper end of the cancer risk range of 10^{-4}. The sediment remediation goal is based on non-cancer effects. Therefore, one order of magnitude or a factor of 10 greater than EPA's acceptable level for non-cancer effect is applied here. EPA in its evaluation of risk from exposure to dioxin at the San Jacinto River Waste Pits site considered the scientifically verified and peer reviewed highly toxic value of dioxin for noncancer effects. The toxicity value or reference dose developed for tetrachlorodibenzo-p-dioxin was published in the EPA Integrated Risk Information System (IRIS) and is based on real human epidemiological data. IRIS gave a confidence level of "High" to the non-cancer toxicity value for dioxin. EPA is still developing the cancer effects toxicity value from dioxin exposure and currently there is no cancer toxicity value or slope factor for dioxin published in IRIS. EPA requires whenever possible to evaluate chemicals for both cancer and non-cancer effects for chemicals that exert these types of effects including dioxin/furan. Therefore, EPA evaluated the risk from cancer using a tier 3 cancer toxicity value. EPA relied on the tier 1 toxicity value for non-cancer effects in its decision regarding the site and included the cancer effects to show that by cleaning the site down to the non-cancer effects level, EPA is also protecting for cancer effects.*

2.3.69 Comment: Region 6 has invented a generic hypothetical compound that they designate as a "TEQ" and to which they ascribe the physicochemical and pharmacokinetic properties of 2,3,7,8-TCDD. As shown in Figure 1, the predominant PCDD/F congeners at the site are OCDD and 2,3,7,8-TCDF, however, the chemical-specific parameters used in Region 6's calculations were all only based on 2,3,7,8-TCDD properties assigned to the hypothetical "TEQ". This introduces a significant amount of error in the use of these PRGs for any chemical other than 2,3,7,8-TCDD and obviates the use of the PRGs either to derive cleanup goals or to characterize PTW unless they are limited to application to 2,3,7,8-TCDD.

Response: *The use of the TEQ to represent dioxin/furans is standard methodology set forth by EPA (EPA 2010, 2013). Because the PRGs were risk-based, the use of the TEQ is an appropriate method when assessing dioxins/furans. A review of the summary statistics for dioxins/furans from the Remedial Investigation Report reveal that 2,3,7,8-TCDD is a primary contributor to the TEQ concentrations in sediment and fish tissue (Anchor 2013). Therefore, the use of the TEQ does not introduce a "significant amount" of error because 2,3,7,8-TCDD is a primary contaminant of concern.*

2.3.70 Comment: A sensitivity analysis performed by CPF Associates identified several exposure factors used by EPA Region 6 (Khoury 2016a) to develop the preliminary remediation goal as being responsible for much of the uncertainty in these calculations. In addition to toxicity, the biota-sediment accumulation factor (BSAF) was found to be highly important. Other important exposure factors include the fraction ingested from the site (FC), soil adherence factor (AF), skin surface area (SA), sediment ingestion rate (IRSc) and exposure event time (which was erroneously not considered by EPA Region 6). Each of these factors has associated scientific uncertainty and they combine in ways to propagate and magnify uncertainty in the preliminary remediation goal calculation. Ultimately, this combination of uncertain exposure factors represents a scenario that reflects a virtually impossible, rather than a reasonable maximum, exposure scenario.

Response: *The exposure factors used by EPA Region 6 were taken directly from the BHHRA (Integral 2013), except for body weight and lifetime cancer averaging time. All exposure factors used were consistent with other national risks assessments and are reflected in the 2016 Regional Screening Level Calculator. The issue of BSAF has been discussed in previous comment responses.*

2.3.71 Comment: It is highly unusual for a site to have a preliminary remediation goal based on an indirect exposure pathway such as sediment→fish→human due to the uncertainties in the linkages. The preliminary remediation goal for this pathway, which dominates the overall preliminary remediation goal for sediment, involves selection and application of BSAFs that can link the amount of a PCDD/F congener in sediment to the concentration in edible fish or shellfish. The BSAF used by EPA Region 6 to calculate the preliminary remediation goal that is used to characterize principal threat waste suffers from several deficiencies including: 1) failure to demonstrate a complete pathway, 2) failure to use congener-specific data, 3) use of a generic rather than site-specific BSAF, 4) use of the same BSAF for fish and shellfish, and 5) failure to transparently inform the public of the uncertainties in the BSAF and how it impacts the calculation of the preliminary remediation goal. The many problems associated with Region 6's application of the BSAF concept are puzzling in light of the fact that EPA's National Health and Environmental Effects Research Laboratory is internationally acknowledged to be a center of excellence regarding BSAFs. For example, EPA scientists at this center led by Burkhard et al. (2004) clearly show the relationship between BSAFs and Log Kow values which was not used by Region 6. In another publication, Burkhard et al. (2010) estimated the errors in translating BSAFs across species and across and within sites and found 90th percentile errors from 5.1X to 12X using actual empirical (not default) data. Finally, this lab at EPA has developed a large (over 10,000 entries) database of BSAF values which is available on-line as an interactive MS Access document. The database contains information for the various congeners, finfish and shellfish species, and types of water bodies. As an example of its contents, a quick search by CPF revealed 27 entries for BSAFs for 2,3,7,8-TCDF in estuarine waters. These data could have been further sorted to identify fish species in the San Jacinto River (or analogous closely-related species) that are potentially consumed by local fishers. Despite the existence of this center of excellence, Region 6 opted to not avail itself of these resources and use a single default value of dubious provenance for BSAF.

Response: *EPA did not use the site specific BSAFs because they varied over orders of magnitude, and were determined to be unreliable. Appendix B of the Remedial Investigation, specifically states that the Site-specific BSAF would "generate unreliable results" due to the high variability of the site specific BSAF data. EPA was transparent and provided justification for the use of a BSAF value provided in the EPA Combustion guidance (US EPA, 2005). EPA's Combustion Guidance BSAF value of 0.09 pg/g tissue per pg/g sediment for calculating the sediment PRG value was judged to be reasonable, and the derivation of the BSAF is provided in detail in US EPA (2005).*

2.3.72 Comment: Integral/Anchor (2010, 2013) performed a detailed literature review analysis of bioaccumulation of PCDD/Fs in the SJR. This analysis concluded that "the majority of dioxin and furan congeners do not consistently accumulate in fish or invertebrate tissue". Integral reached these conclusions by sampling both biological tissue and sediment and subjecting the results to statistical analysis using Kendall's non-parametric rank correlation procedure. Note that, appropriately, no values were developed or analyzed for TEQs, but only for individual congeners. Of all the congener relationships in this dataset, only 5 (29%) were statistically significant at a 95% level of confidence (marked in bold). This means that any apparent relationship between sediment concentrations and fish tissue concentrations for the other congeners could be explained as random chance or statistical noise. Even those pairs with statistically significant relationships had very weak relationships. Kendall's tau-b is a non-parametric correlation coefficient that is conceptually similar to Pearson's product moment correlation coefficient for parametric analysis. A value of zero indicates that there is no relationship between the variables, a value of +1 indicates the maximum positive relationship between the variables and a value of -1 indicates the maximum negative relationship between the variables. Of the variables with a statistically significant relationship, one (OCDF) had a negative relationship suggesting that the occurrence of higher OCDF values in sediment were associated with lower OCDF values in fish. The remaining four congeners had weak Kendall's tau values (ranging from 0.144 to 0.449) strongly suggesting that some other, currently unidentified, variable or variables had stronger associations with congener levels in fish than did sediment levels. Thus, a site-specific analysis showed only weak relationships between a few dioxin congeners in sediment and those in fish. This certainly implies a lack of a complete pathway even from sediment to fish.

Response: *The preliminary remedial goal (PRG) of 30 ng/kg was established based on incidental ingestion of and dermal contact with sediment as well as the ingestion of fish. Site-specific data were used, including site-specific fish concentrations. Additionally, the fingerprint analysis of the site showed that 2,3,7,8-TCDD and -TCDF were the primary dioxin/furan congeners associated with the pulp waste, not OCDD or OCDF (which has a very low TEF anyway). It is not surprising that some congeners show smaller bioaccumulation factors, either due to selective degradation within the organism or size exclusion for the larger congeners. However, because the PRG (and subsequent Principal Threat or remedial goal establishment) are based on multiple exposures (sediment and fish), and the use of site-specific data to establish the PRG, these factors have been accounted for.*

2.3.73 Comment: The decision to base the principal threat waste determination on fish ingestion is particularly perplexing given that Region 6 apparently believes that the problem with fish is not PCDD/Fs but PCBs. Turner (2016) noted that fish PCDD/F concentration levels were already “so close to background” and that “the advisories are likely to remain in place primarily due to PCBs. Although dioxins can be found throughout the watershed, PCBs are more prevalent.”

Response: *The Principal Threat Waste determination is based upon the preliminary remediation goal for sediment that takes into account ingestion of sediment, dermal contact with sediment, and fish ingestion. Further, while PCBs may be more prevalent, the site presents a potential risk concern for human health and the environment due to dioxins/furans. It is unreasonable to make the assumption that cleanup is not warranted for the site just because PCBs are more prevalent in the watershed. The memo from Turner (2016) does note that PCBs are more prevalent in the watershed; however, the memo also notes that TCDD is also present and the site is the primary contributor to TCDD in the watershed. Further, the memo states that removal of the dioxins/furans from the site will result in a risk reduction from consuming fish surrounding the site.*

2.3.74 Comment: Region 6’s inappropriate reliance on physicochemical and pharmacokinetic properties of a hypothetical “TEQ” compound rather than congener-specific data permeates their PRG calculations. With the possible exception of the reference dose, nowhere is this more problematic than the use of TEQs with BSAFs. Congener-specific effects on bio-uptake of PCDD/Fs into fish have been known since the mid-1980s. Region 6 (Khoury 2016b) explicitly acknowledges this. Quoting extensively from ATSDR (1998), “Measurements of the bioconcentration of CDDs tend to increase with the degree of chlorination up to TCDDs and then decrease as chlorination continues to increase up to the OCDD congeners. The more highly chlorinated congeners, such as OCDD, appear to have the lowest bioconcentration potential either because they are less bioavailable because of their rapid adsorption to sediment particles or because of their large molecular size”. Despite this, Region 6 went on to assume that a BSAF for 2,3,7,8-TCDD was appropriate to be applied to all congeners.

Response: *The fingerprinting exercise demonstrated that the primary dioxin/furans at this site are 2,3,7,8-TCDD and 2,3,7,8-TCDF. Higher and lower chlorinated dioxin/furans contributed to total dioxin and furans, but did not dominate. Consequently, the use of the*

2,3,7,8-TCDD BSAF is entirely appropriate because it (and the furan correlative 2,3,7,8-TCDF) are not only the most toxic, but also the most prevalent in pulp waste. In general, both the toxicity and bioconcentration potential of dioxins increase with their hydrophobicity, with TCDD having a high toxicity and high bioconcentration factor. The use of TEFs adjusts for differences in toxicity between dioxin congeners in comparison to TCDD. Given the co-relation of hydrophobicity, toxicity, and bioconcentration potential, the TCDD bioconcentration factor can be applied to the total TCDD TEQ as a general estimate of overall accumulation.

2.3.75 Comment: Region 6 appears to base its judgements regarding the time over which a cap may need to be stable on the degradation rates of PCDD/Fs. In the Feasibility Study (EPA 2016c), Region 6 states, "Dioxins/furans are highly persistent chemicals and will not break down for hundreds of years. While there is considerable uncertainty regarding biodegradation of dioxins/furans, Region 6 estimates that, for dioxins that are not exposed to sunlight the dioxin half-life ranges from 25 to 100 years." Region 6 (Khoury 2016c) then proceeds to take the upper end of this range to estimate that it would take between 450 years and 750 years for the "dioxin" in the sediment to reduce from a putative 40,000 ppt to various proposed cleanup levels. The origin of the half-life range is obscure at best and misleading at worst. Region 6 cites to EPA's Clu-In website, but that site merely restates what Region 6 wrote in the Feasibility Study. In a memorandum, Region 6 (Khoury 2016c) notes that his source of information was ATSDR's 1998 Toxicological Profile for dioxin, a secondary and almost 20-year old source, which cited to a statement made by Paustenbach et al. (1992) who derived it from documents dealing with risk assessment rather than environmental fate. Nonetheless, as originally developed it clearly was a default value that only applies to 2,3,7,8-TCDD in subsurface soil rather than to a variety of congeners in sediment. If we assume that all 40,000 ppt "dioxin" is 2,3,7,8-TCDD (consistent with Region 6 usage) and use the data from Kim et al (2009) in this formulation, we find that it will take only 74 years for the cleanup level of 220 ppt noted by Region 6 (Khoury 2016c) to be attained rather than the 750 years predicted by Region 6. One of the reasons for this large difference is Region 6's tacit assumption that 2,3,7,8-TCDD is being totally mineralized rather than being degraded to the non-toxic TCDD products.

Response: *As noted in several comment responses, based on the fingerprinting exercise the primary dioxin and furans found in the waste are the 2,3,7,8-TCDD and TCDF congeners. Consequently, using the TCDD as a surrogate for determining the half-life is appropriate. While it is acknowledged that estimates of half-lives of TCDD (or any other organic compound) are difficult, and range often by orders of magnitude, it has to be acknowledged that dioxins and furans are long-lived and persistent in the environment. EPA maintains that the use of an armored cap will be inadequate to contain the pulp waste over the long-term. The likelihood of major hurricanes, severe storms and storm surges in the Houston area cannot be denied, and such events pose risks to the integrity of any cap, and the future risk of releases of contaminated wastes and sediments. EPA therefore selected Alternative 6N (removal of the pulp waste) as the preferred alternative.*

2.3.76 Comment: The US Army Corps of Engineers concluded that over a 500-year period, Alternative 3N is predicted to release between 0 mg (sic) and 2.18 mg of 2,3,7,8-TCDD depending on the input assumptions used. On the other hand, Alternative 6N could release between 3 x 10-16 mg and 10,200 mg of 2,3,7,8-TCDD, again depending on the inputs used.

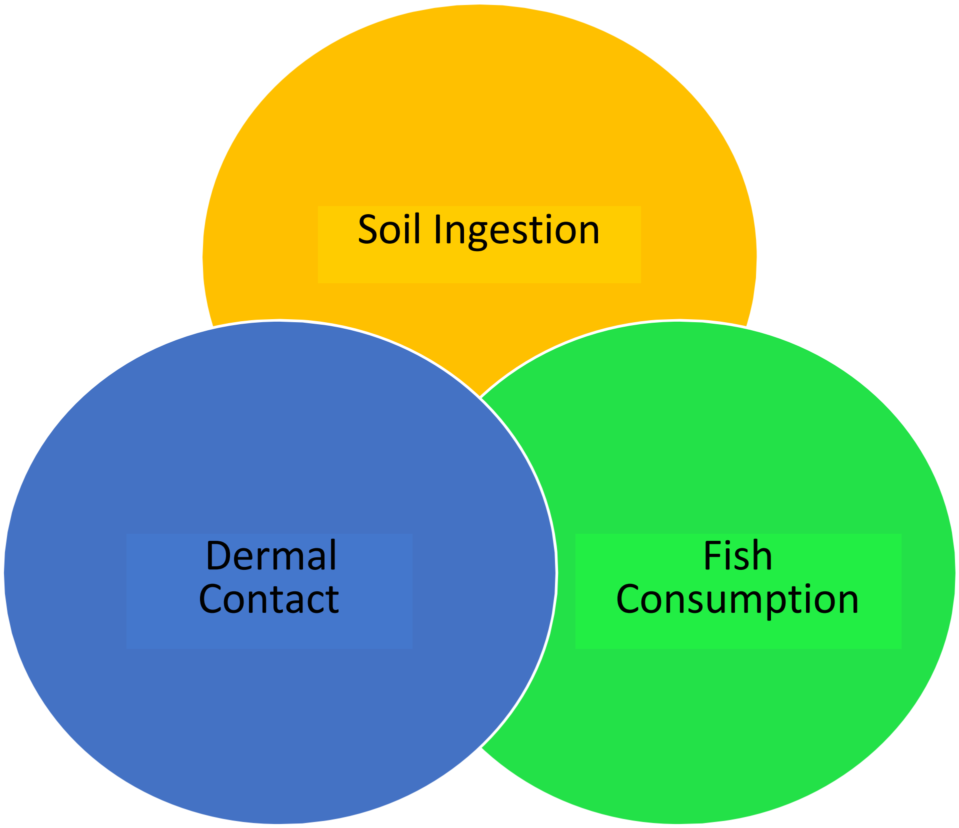
Response: *Releases for Alternative 6N are at the low end of the range (i.e. $3x10^{-16}$ mg) when best management practices are used, and are subject to a higher degree of certainty than those for Alternative 3N. The release estimates for Alternative 3N above are only valid if there is no major disturbance of the cap, which could result in significant release.*

As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.

2.3.77 Comment: The lower release values for some Alternative 6N scenarios are contingent on the successful operation of best practices that have yet to be defined. The US Army Corps of Engineers' suggested best practices for placement involve "carefully placing the sand material in two equal layers which considerably reduces mixing with the contaminated materials and resuspension. This results in the top 6 inches of material, including the mixed layer, remaining clean and increasing the barrier between the contaminated residuals and the water column". The US Army Corps of Engineers shows the depth of the mixed layer as 10 cm (3.9 inches), two sand layers of 5 cm and 15 cm (2 and 5.9 inches) and a residual layer of 3 cm (1 inches), each with prescribed porosities and TOC content. The idea of heavy equipment operating over a large area in an uncertain environment with the precision needed to attain this specification precision in practice is a laudable goal, but probably not attainable in the field. Insofar as other best practices, the US Army Corps of Engineers has stated "it will be necessary to prepare a contingency plan as part of the Remedial Design in order to develop best practices to prevent, contain, or manage such release." The US Army Corps of Engineers does caution us, however, that "it may be necessary to conduct the work by removing only small portions of the cap at a time, and provide cover for any residuals before starting the next area" which may be considered to constitute a best practice, albeit one that adds complexity and uncertainty to the efficacy of the remedy. In general, however, no mention is given regarding the content of these desired best practices including quality assurance/quality control, performance goals, or consistency with standards.

***Response**: EPA recognizes the limitations in construction practices as suggested in the comment. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize* *the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. Quality assurance/quality control, performance goals, or consistency with standards are topics to be addressed in the Remedial Design and work plan. These topics are standard components of all remediation projects. Acceptance criteria will be established target depth, residuals management, emissions, effluent quality, production, water management, containment, site closure, and other items.*

2.3.78 Comment: EPA policy and guidance (EPA 1989, RAGS A4) states that "actions at Superfund sites should be based on an estimate of the reasonable maximum exposure (RME) expected to occur under both current and future land use". EPA continues that, if a population is exposed by more than one pathway, the combination of exposures across pathways also must represent an RME. For decades, it has been clear from this and other guidance and regulatory decisions that the RME should be plausible and well within the range of possibilities, i.e., it does not represent an extreme worst case. The PRGs calculated by Region 6 (Khoury 2016a) are based on a child from birth to six years of age simultaneously inadvertently ingesting sediment, dermally contacting sediment over a majority of his/her body surface area, and ingesting a large amount of fish solely from isolated areas of the site. In all of these calculations, the hypothetical child is assumed to be contacting sediment contaminated with chemicals of concern at a concentration representing the 95% upper confidence limit (UCL) on the mean. The overall PRGs calculated by Region 6 can be conceptually represented by a classical Venn diagram in which the exposure scenario is represented by the area of overlap of the three circles:



In the Venn diagram, each circle can be taken to represent the proportion of the population exposed or, alternatively, the probability of exposure. Each one of these alone (individual circles) is a very low probability event (EPA 2011a, Gephart et al. 1994) and, in combination, the probability of them simultaneously occurring (area of overlap) approaches the infinitesimal.

Response: *EPA follows its own Risk Assessment process to be consistent in developing risk assessments across the nation. One such consistency factor is the definition of a young child. A young child exposure is here defined as six years of exposure. This time period is important for a young child exposed to dioxin (2,3,7,8-TCDD as TEQs) because non-cancer or systemic effects were observed in neonates and in young children during their first ten years of life. EPA uses the concept of a "reasonable maximum exposed" (RME) individual to develop risk assessments. The RME exposure includes both average values and upper end values. That is why for soil ingestion and dermal contact an exposure frequency of 39 days per year was used. The 39-day exposure frequency was adopted from the PRP's site specific baseline human health risk assessment. For fish ingestion 350 days per year was used because the annualized average daily fish ingestion rate is used. We don't use time spent in hours at the site since soil ingestion rate is based on a daily basis (i.e. mg/day). Body weight, skin surface area and ingestion rates are average values and exposure frequency and exposure duration tend to be upper end values. EPA used both average values and upper end values in the same equation to define the RME individual. The RME based calculation was then used in the development of the site specific PRP's baseline human health risk assessment and by EPA's PRG development for the San Jacinto River site as recommended in EPA risk assessment guidance (RAGS part A). As noted in several comments, exposure parameters, as well as exposure concentrations are the same as those used in the*

Baseline Risk Assessment, with the exception of the child body weight and lifetime (which were based on EPA guidance). EPA strives to be conservative in the derivation of risks, which results in PRGs that are protective of the most sensitive receptors.

2.3.79 Comment: The development of these PRGs is far from transparent and has not been documented to the degree contemplated by RAGS B guidance. In addition, there is no justification for the process used to derive the preliminary remediation goals nor evidence that they were modified throughout the Superfund process to reflect the intent of the National Contingency Plan or RAGS B. Most important, there is no justification for the use of a preliminary remediation goal to define the principal threat waste with or without the application of an arbitrary safety factor.

Response: *The PRGs were modified and documented in both the PRP's baseline human health risk assessment and in the EPA's addendum risk and PRG values for site specific exposure scenarios. EPA had to decide whether to develop a cleanup level for a subsistence fisher scenario or go with a recreational fisher scenario. Although there were reports that some people may be subsistence fisher but EPA could not confirm these reports. So, EPA first modified the type of receptors involved, and later modified frequency of exposure and ingestion rates. As recommended by RAGS part B, EPA relied upon the PRP's BHHRA to reflect a site specific exposure scenarios and used site specific exposure frequency of 39 days/year for dermal and soil ingestion. EPA also used site specific annualized average fish ingestion rate of 14 g/day and 30 g/day respectively for a child and adult fish ingestion rates. EPA also modified the fraction of fish ingested from the contaminated site and used 25 percent instead of 100 percent. EPA clearly documented all of these modifications in the risk assessment documents for the site. Regarding the derivation of the Principal Threat Waste please see the response to Comment 2.3.27.*

2.3.80 Comment: The Remedial Investigation Report and related documentation (Integral/Anchor 2013a, Anchor 2016) developed a series of protective concentration levels (PCLs). Although this report used different nomenclature (PCL vs PRG), the intent was obviously to satisfy the NCP requirement for PRGs. The Remedial Investigation authors presented PCLs for a hypothetical recreational visitor and hypothetical future construction worker based on plausible present and future land use considerations. The assumptions underlying the calculations of these PCLs were fully explained in the Region 6 approved Remedial Investigation Report and in subsequent letters from Anchor QEA to Region 6 (Anchor 2013, Anchor 2016) and the uncertainties were characterized in the baseline human health risk assessment (BHHRA) (Integral/Anchor 2013b). These PCLs were summarily rejected by Region 6 in the Feasibility Study without explanation, however, our review shows these PCLs fulfilled the NCP requirements for PRGs and could have been readily used to inform the remedy selection process.

Response: *EPA did not reject or ignore the PCLs developed by the PRPs in the Remedial Investigation. On the contrary, EPA used the information and input parameters developed in the Remedial Investigation and made modifications as necessary to be consistent with EPA guidance, or based on site specific information. For example, EPA used recreational fisher scenario instead of subsistence fisher scenario which was used in the PRP's PCL* *development. EPA also changed in the 0.5 factor of relative bioavailability for dioxin used by the PRPs to a factor of 1.0, as EPA recommends.*

2.3.81 Comment: Region 6 apparently believes that PRGs or final Remedial Action Objectives for chemicals with systemic non-carcinogenic effects need to be set at a hazard index (HI) of HI=1. Although this frequently may be the case, it is not required by statute, regulation, policy or guidance. The NCP [§ 300.430(e)(2)(i)(A)(*1*)] states, "For systemic toxicants, acceptable exposure levels shall represent concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety". The NCP gives no further direction regarding the definition of an "adequate margin of safety" and does not define a numerical goal for achieving this margin. In RAGS B, we see that EPA has directed that the "total risk for non-carcinogenic effects is set at an HI of 1 for each chemical in a particular medium" when developing a PRG, however, gives no direction how this should be translated into an Remedial Action Objective.

Response: *The "Role of Baseline Risk Assessment in Superfund Remedy Selection Decision"; OSWER Directive 9355.0-30 April 22, 1991 states the following: "For non-carcinogenic effects of toxicants, unacceptable risk occurs when exposures exceed levels which represent concentrations to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, ..." This translates to a HI of 1 which is defined as the ratio of average daily intake in milligrams of chemical per day per kilogram body weight divided by the reference dose (RfD) in milligrams of chemical per day per kilogram body weight developed based on toxicity studies or epidemiological studies identified in the published literature.*

EPA follows this guidance in protecting human health. Especially for very toxic chemicals such as dioxins and furans which human epidemiological studies have shown that observed adverse health effect such as endocrine disruption effects on the most sensitive subgroup of the population (young children and developing fetus) did occur and determined the lowest concentration at which these adverse health effects were observed. These epidemiological studies indicated that there is no room to accept higher hazard index levels. For the San Jacinto River site, reducing the margin of safety by increasing the acceptable HI by a factor of 2 or 3 would increase the probability of observing toxic effects in the most susceptible group of the population and is considered professionally and morally unacceptable.

2.3.82 Comment: The concept of uncertainty in environmental decision making is key to developing a remedy for this site. By failing to acknowledge uncertainty, Region 6 implies that all the elements of its Proposed Plan, from preliminary remediation goals to principal threat waste designation to analysis of short-term effectiveness, are certain which can convey a false sense of security to the public. In addition, the failure to incorporate uncertainty into risk management means that Region 6 has lost a valuable tool for evaluating and managing the site (Maier 2008). It should be noted that a formal uncertainty analysis was undertaken in the BHHRA, however, Region 6 did not avail itself of this analysis in developing the proposed plan nor did it undertake any uncertainty analysis in its own risk assessment or PRG calculations (Khoury 2016a, b).

Response: *The risk assessment and preliminary remediation goal calculations done by EPA is an addendum to the BHHRA (Integral, 2013) prepared for the site. EPA used the same site specific information such as exposures input parameters as was used by the BHHRA except for general input parameters that are used for child body weight and averaging time. Therefore, all the uncertainties mentioned in the BHHRA, which were properly reported in the uncertainty section of the BHHRA, also applies to the risk assessment and PRG done by EPA.*

2.3.83 Comment: It should be apparent to the reader that a fatal flaw in Region 6's preliminary remediation goals calculations was the assumption that all PCDD/F congeners behave identically to 2,3,7,8-TCDD and each other in the environment and in living tissue of human and aquatic life. If the TEQ concept was to be used in these calculations, it should have been applied to the concentrations of the individual congeners in the target tissue and not to concentrations of congeners in the environment. Alternatively, the preliminary remediation goals and principal threat waste definition may be applied only to 2,3,7,8-TCDD concentrations in the environment, all other things being equal. This would result in the determination that there was little if any PTW at the Site.

Response: *The San Jacinto River waste pits dioxin finger print indicates that the waste is dominated by the presence of the most studied and most highly toxic chemical of all congeners 2,3,7,8-TCDD and by 2,3,7,8-TCDF. Therefore, the risk will also be dominated by these two congeners. See EPA's recommendations to evaluate risk from dioxin and dioxin like compounds (EPA, May 2013) Use of Dioxin TEFs in Calculating Dioxin TEQs at CERCLA and RCRA sites fact sheet):* https://semspub.epa.gov/work/HQ/174558.pdf *"The evaluation of dioxin (TCDD) and dioxin like compounds (DLCs) at CERCLA and RCRA sites includes consideration of the toxicity (i.e., cancer risks and non-cancer effects) of these contaminants. In the absence of toxicity values for DLCs, TEFs are used as a measure of the toxicity of the DLCs relative to TCDD. Concentrations of DLCs measured in media are modified by TEFs to determine the dose of each DLC in a medium that is equivalent to a dose of TCDD. The modified DLC doses are expressed in terms of TCDD toxicity equivalence (TEQ). The DLC TEQ concentrations are used, rather than the DLC concentrations measured in media, for site evaluations including site characterization, risk assessment, cleanup level development and confirmatory sampling."*

The TEF approach is based on the concept of dose addition, under which it is assumed that the toxicokinetics and toxicodynamics for all DLCs are similar, and that the DLCs act by a common toxic mode of action (i.e., for all DLCs, effects are mediated through aryl hydrocarbon receptor binding). Further, this approach assumes that toxicological interactions do not occur among the DLCs within the environmental mixtures being assessed (e.g., synergism and antagonism do not occur).

EPA understands that there are uncertainties associated with the application of TEF approach. However, EPA currently believes that the TEF approach is a reasonable approach to take in addressing risk from exposure to mixtures of dioxin and DLC wastes. This approach has national and international scientific consensus in evaluating sites contaminated with dioxin and DLCs.

2.3.84 Comment: A sensitivity analysis performed by CPF Associates identified several exposure factors used by EPA Region 6 (Khoury 2016a) to develop the PRGs as being responsible for much of the uncertainty in these calculations. In addition to toxicity, the biota-sediment accumulation factor (BSAF) was found to be highly important. Other important exposure factors include the fraction ingested from the site (FC), soil adherence factor (AF), skin surface area (SA), sediment ingestion rate (IRSc) and exposure event time (which was erroneously not considered by EPA Region 6). Each of these factors has associated scientific uncertainty and they combine in ways to propagate and magnify uncertainty in the PRG calculation. Ultimately, this combination of uncertain exposure factors represents a scenario that reflects a virtually impossible, rather than a reasonable maximum, exposure scenario.

Response: *In accordance with EPA guidance (RAGS Part A) actions at Superfund sites should be based on an estimate of the reasonable maximum exposure (RME) expected to occur under both current and future land-use conditions. The reasonable maximum exposure is defined here as the highest exposure that is reasonably expected to occur at a site.*

The guidance also provides information on how to determine the RME at a site and identifies some exposure variable values appropriate for use in this determination. The specific values identified are regarded as general recommendations, and could change based on site-specific information and the needs for the project management of the site.

The discussion of uncertainty is a very important component of the risk assessment for the site. Based on the sources and degree of uncertainty associated with estimates of exposure, the decision-maker evaluates whether the exposure estimates are the maximum exposures that can be reasonably expected to occur. The potential magnitude for over-estimation, under-estimation or over or under estimation of exposure is reported.

The Baseline Human Health Risk Assessment prepared by the PRPs used default exposure values recommended by the guidance and made changes where defendable site-specific values were available. It also addressed sources of uncertainties and their impact on the risk assessment. They were reported in details in Section 6.2.3, page 6-14 of the PRPs' Baseline Human Health Risk Assessment. This all was done as required and in accordance with recommendations of EPA risk assessment guidance. EPA Region 6 utilized most of these exposure factors, and slightly modified some exposure factors such as exposure duration that have been discussed elsewhere.

2.3.85 Comment: Integral/Anchor (2010, 2013) performed a detailed literature review analysis of bioaccumulation of PCDD/Fs in the SJR. This analysis concluded that "the majority of dioxin and furan congeners do not consistently accumulate in fish or invertebrate tissue". Integral reached these conclusions by sampling both biological tissue and sediment and subjecting the results to statistical analysis using Kendall's non-parametric rank correlation procedure….
It is not sufficient to merely assert that there is a human receptor at the end of an exposure pathway; this must be demonstrated using scientific evidence (Chrostowski 1994). In order to provide this evidence, the next step of the pathway analysis would have been to analyze

PCDD/Fs in potential receptors. Serum or plasma PCDD/F measurements are commonly performed in environmental health studies (ATSDR 1998). If the chemical profile (fingerprint) of PCDD/F congeners in a human population matches that in the fish, the fish ingestion pathway would be deemed to be complete. This evidence is particularly important given that PCDD/Fs are ubiquitous in the human population and have an almost infinite number of sources. No such data were obtained for hypothetical fish consumers at the SJRWP Site. The results of the statistical analysis plus the absence of human body burden analysis strongly argue against a complete exposure pathway for human exposure to sediment from consumption of fish.

Response**:** *A human health risk assessment is the process to estimate the nature and probability of adverse health effects in humans who may be exposed to chemicals in contaminated environmental media, now or in the future. The human health risk assessment cannot predict which individuals will end up with disease or predict the body burden of dioxin in their blood. For an exposure to be a complete pathway, there should be a source of contamination, a specific migration pathway carrying contaminants to a receptor and a receptor. A site-specific conceptual site model (CSM) is developed to help in identifying complete exposure pathways. The PRPs' risk assessment identified ingestion of fish by an individual as a complete pathway. Section 5.1.1 of the baseline human health risk assessment prepared by the PRPs says the following: "Based on the CSM for the area north of I-10 and aquatic environment, the following potential exposures were quantified for these hypothetical receptor groups:*

- *Recreational Fisher—direct contact (incidental ingestion and dermal contact) with sediment and soils, ingestion of finfish, and ingestion of shellfish*
- *Subsistence Fisher—direct contact (incidental ingestion and dermal contact) with sediment and soils, ingestion of finfish, and ingestion of shellfish*
- *Recreational Visitor—direct contact (incidental ingestion and dermal contact) with sediment and soils."*

EPA does not wait until an adverse health impact occurs to take action. EPA can use existing information (e.g. dioxin in serum blood or lead in blood) to supplement its decision regarding the site. EPA uses its human health risk assessment processes and methods to evaluate potential for exposure and the probability for adverse harm, and then uses this information in deciding how best to protect human health and the environment.

2.3.86 Comment: EPA Region 6 selected and applied a generic BSAF of 0.09 to calculate the PRGs for the SJRWP Site (Khoury 2016a,b). The value of 0.09 was cited to EPA's 2005 Combustion Guidance. These BSAFs ultimately came from EPA's (2000) dioxin reassessment and are based on an assumed fish lipid content of 7% and a sediment organic carbon content of 3% and fish species which may or may not be relevant to the SJRWP Site[14]. It should be noted that even EPA (2000) recommends different values for different homolog classes – hexa-CDD/Fs, hepta-CDD/Fs, and OCDD/F which were not used by Region 6 in development of the PRGs despite the relevance of these homologs. The rationale for Region 6's reliance on this value despite the existence of some site-specific values reported by Integral and the large database available from EPA (2003) is not apparent.

Response: *Two site specific studies were performed to develop BSAF values, neither of which were consistent with EPA protocol for developing BSAF. The authors of these two studies in their conclusions recommended against using their BSAF values for setting remedial goals or for risk assessment. The PRP Integral report found that the derived BSAFs were unreliable and inadequate for back calculation of acceptable sediment concentrations. The Baylor study came up with a BSAF value for fish of 0.044 pg/g tissue per pg/g sediment and indicated that the methodology utilized may lead to low BSAFs and were not appropriate for the setting for remedial goals.*

Because of the lack of reliable site specific information to use a BSAF value which would be acceptable in the risk assessment or in developing remedial goals, EPA relied on the BSAF provided in the combustion guidance. The Combustion guidance BSAF value of 0.09 pg/g tissue per pg/g sediment is a reasonable value based on studies in the published literature. It was developed using proper EPA protocols and is consistent with guidance and with other dioxin contaminated sites. It was based on data collected from Lake Ontario and from data in Passaic River for water column feeders such as trout as referenced in EPA's 2005 Combustion Guidance.

2.3.87 Comment: In calculating PRGs, Region 6 (Khoury 2016a) failed to take into account the time over which exposure could occur… This is an illustration of an unreasonable maximum exposure. At the very least, Region 6 should have taken the time course of absorption into account in calculating the PRGs.

Response: *In developing PRGs and risk assessments for Superfund sites, the scientific community frequently uses equations for soil/sediment ingestion and dermal and inhalation for a recreational child exposure scenario. These equations can be found on the RAIS web page or EPA guidance. Exposure time for ingestion and dermal contact with soil/sediment are not part of the equations because the time of exposure is incorporated in the ingestion rate or dermal contact. Intake rates represent long-term average daily values based on ingestion rates and body weight (e.g. mg/kg-day). Exposure time is considered and evaluated in the equation for inhalation exposure to be consistent with the Inhalation Dosimetry Methodology, which represents EPA's current methodology.*

2.3.88 Comment: It should be noted that the value of 0.03 for ABSd is obsolete. Newer data developed from EPA-sponsored research shows this value to be between 0.0024 for high organic soil and 0.019 for low organic soil (Roy et al. 2008). Data presented in the Remedial Investigation show that the total organic carbon in SJRWP Site sediments is between the low and high values from Roy et al. (2008), thus an accurate dermal absorption coefficient would also be between these values and should be used for any calculation of PRGs.

Response: *In the absence of site-specific chemical specific information, EPA recommends that default values for the ABSd parameter be used when calculating RME soil exposure. These defaults are presented in order to facilitate performance of risk assessments by compiling these factors in one place, and to promote consistency in risk assessment. The* *range of absorption was reported to be 0.1 percent to 3 percent in the dermal guidance (RAGS Part E). EPA recommends accepting the three percent value as a conservative assumption of ABS for chlorinated dioxins, in accordance with RAGS. The use of conservative assumptions is appropriate when determining Reasonable Maximum Exposure (RME), and reflects EPA's policy that protection of human health should be ensured. The value of three percent has been used consistently in EPA site specific dioxin risk assessments.*

2.3.89 Comment: The amount of soil that a child inadvertently ingests has also been shown to be a function of time. Basically, the more time the child spends playing in the soil, the greater the amount of soil that adheres to his or her hands and is ultimately conveyed to the child's mouth. Wilson et al. (2015) investigated this phenomenon and found that sediment ingestion rates varied from 18 mg/hr to 72 mg/hr. Based on his data, a plausible reasonable maximum value for IRSc for the hypothetical child recreator at the SJWP Site sediments would be 50 mg/hr, substantially less than the 125 mg/day value assumed in the PRG calculations that did not take time into account.

Response: *EPA developed its recommended soil ingestion rate on an adjusted daily average basis and not on an hourly average basis to be consistent with the chronic daily average oral intake equations. These equations do not have time in hours as an input variable. In addition, EPA used the same input ingestion rate of 125 mg/day that the PRPs used to be consistent with the HHRA developed by the PRP.*

2.3.90 Comment: The PRG that Region 6 used to calculate the PTW bright line was based on systemic non-cancer effects as expressed by a toxicological reference dose (RfD). Our sensitivity analysis of the calculations shows that the RfD is one of the most important parameters in the entire set of calculations. Contrary to EPA guidance and EPA's assertions of transparency, the uncertainties in the toxicity assessment were not presented in the Proposed Plan or underlying documentation (Khoury 2016a,b, Turner 2016a,b). Some of the items normally discussed in a toxicity assessment uncertainty analysis include qualitative toxicity, derivation of the toxicity values, study duration, extrapolations, biological mechanisms, selection of appropriate datasets, effect of different exposure routes, and potential for interactions (EPA 1989, 1992a, NRC 1994). This leaves the reader with the impression that there is absolute certainty in the RfD, which is certainly not the case. EPA's RfD for 2,3,7,8-TCDD has certainly been controversial. Although beyond the scope of these comments, detailed critiques are available elsewhere (e.g., Magee 2010). Our comments here will be limited to those aspects of the RfD that bear on the PRG calculations and the PTW characterization.

Response: *RfD development is not within the scope of the Proposed Plan. Toxicity values such as RfD are developed separately from site specific risk assessments and are published in central locations such as the Integrated Risk Information System (IRIS) so that consistent toxicity values are used across the regions. Values published in the IRIS go through rigorous internal and external peer review. Uncertainty factors are incorporated in the development of the IRIS values. Accepted IRIS listed values were used in both the PRPs and EPAs risk assessments as well as the PRG derivation.*

2.3.91 Comment: Although the use of PRGs to characterize a principal threat is contrary to EPA guidance and, in this case, scientifically flawed, it is instructive to see what PRGs would look like if standard default assumptions or alternative reasonable maximum exposure concepts were used in their calculation. Since there is a poor correlation between PCDD/Fs in sediment and that in fish and since Region 6 has failed to demonstrate that a sediment→fish→human exposure pathway is complete, a standard PRG would not include this pathway but would be limited to dermal contact and inadvertent ingestion of sediment plus inhalation of particulate matter emitted by wind erosion. The ORNL/RAIS recreator receptor scenario is the basis of this PRG. This scenario assumes that a recreator contacts sediments for 75 days per year for a 1 hour event over a standard 26 year exposure period (6 years as a child and 20 years as an adult). All of the exposure factors in the ORNL/RAIS PRG model are purposefully biased to be conservative (health protective) as per EPA's reasonable maximum exposure concept (although the probability of this exposure occurring is almost infinitesimally small). The results of this calculation yield a child PRG of 240 ng/Kg, an adult PRG of 215,000 ng/Kg with a combined life-cycle PRG of 778 ng/Kg. In addition, we calculated PRGs for various default hypothetical worker receptors… These PRGs of course, only pertain to 2,3,7,8-TCDD and have bearing only on the calculation of Remedial Action Objectives and not designation of a PTW. These calculations are all based on a HI of 1. Due to uncertainties in the toxicology behind the RfD, the lack of severity of an effect, and the fact that substantial dermal absorption is not likely to occur during a 1-hour exposure period, an HI of 2 or 3 would be more appropriate and the PRGs would be adjusted upward accordingly. The resulting Remedial Action Objectives would be much higher than the maximum surface sediment 2,3,7,8-TCDD concentration of 23.9 ng/Kg found in 2016 by Integral and would likely apply only to a small portion of the northern impoundments area.

Response: *EPA utilized default exposure equations and input parameters, and where reasonable, site specific input parameters replaced default values. Appropriate site specific RME exposure input values were used in developing the PRG for the site. EPA also used input values used in the baseline human health risk assessment for the site to develop the site health based PRG value. EPA adjusted input values when necessary to do so. When uncertainty existed, EPA tried to err on the side of safety. Elimination of the fish consumption pathway is inconsistent with the Conceptual Site Model used by both the EPA and PRPs, consequently derivation of a PRG without this pathway is not reasonable.*

2.4 Policy Comments

EPA received over 100 comments from individuals in the surrounding communities, various regions of the United States, foreign countries, school age children, industry, industry associations, and non-governmental organizations voicing their concerns regarding EPA's implementation of the National Contingency Plan (NCP) and CERCLA as they relate to the San Jacinto River Waste Pits site.

2.4.1 Comment: For the determination of net present value to compare remedial alternatives, the EPA used a discount rate of 7% with no assumed inflation in accordance with EPA guidance. This methodology may not provide realistic costs, considering that it would be difficult to achieve a 7% return on investment in today's financial markets. The commenter believes that a 4% discount rate along with 2% inflation would provide a more realistic cost estimate. The net effect of using EPA's methodology of 7% discount rate may understate the actual costs, especially for longer term remediation alternatives.

For remedial alternatives involving capping at the northern impoundments, present worth costs were developed assuming operation and maintenance (O&M) for a 30-year period. Considering that dioxins/furans are expected to persist in the environment for centuries, the present worth costs for a 30-year period would under-estimate the real costs and is inconsistent with EPA's own guidance document, "*A Guide to Developing and Documenting Cost Estimates During the Feasibility Study (EPA 540-R-00-002)*", which recommends that the present worth cost analysis should not necessarily be limited to the commonly used assumption of 30 years, and an explanation should be provided whenever the period of analysis is less than the estimated project duration (in this case, centuries). Life-time O&M costs must be developed to ensure the integrity of the armored cap is maintained while COCs persist at the site.

Response: *The commenter is concerned that it may take a century or more of O&M based on Site conditions for the remedial alternatives involving capping of the northern impoundments. The commenter supports the assumption that a life-time of O&M costs must be developed to ensure the integrity of the armored cap is maintained while COCs persist at the Site. In addition, the commenter suggests it would be appropriate to use a lower discount rate for calculating the remedial alternatives.*

We acknowledge that given the position of the Site in the San Jacinto River, the frequent storms, and the history of repeated damage to the cap, O&M is likely to be required even beyond the normal 30-year period that is the estimate for most capped sites. To assess the impact of the commenter's concerns, EPA calculated the net present value (NPV) of Alternatives 3aN and 6N (Selected Remedy) adjusting the period of analysis, the cash outflows for each year of the project, and the discount rate, based on the commenter's assumptions. These two alternatives are discussed because they represent a range of alternatives from containment (Alternative 3aN) to removal (Alternative 6N).

EPA estimated costs for 30, 100, and 500 years of O&M. (For specific cost calculations, see "Alternative 3aN Cost Assessment, San Jacinto River Waste Pits Superfund Site" contained in the Administrative Record.

Alternative 3aN

EPA calculated the cost of Alternative 3aN using an adjusted 100 years of O&M – rather than 30 years – based on the commenter's reference to "centuries" of project duration, given the site-specific circumstances. In this calculation EPA used an increased annual maintenance cost of $800,000 per year over 100 years, as opposed to annual maintenance costs of $100,000 for only the first two years as was done in the Feasibility Study, given that the current cap has required repeated repairs in the 6 years following completion due to cap erosion, riverbed erosion, for future repairs that may be necessary following severe storm events. Other costs considered in the evaluation include natural recovery monitoring, ground water monitoring, cap inspections, institutional controls, five-year reviews, project management, oversight by the regulatory agencies, and a 30% contingency. Typically, these costs are reduced in future years as experience is obtained with the performance of a remedial action. However, for the Site, the continuing need for maintenance and evaluation since the cap was completed do not provide support for reduced costs in the future. This evaluation is based on the following guidance: "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" (EPA 540-R-00-002 OSWER 9355.0-75 July 2000).

To further assess the cost of Alternative 3aN to be more in line with the commenter's concern about a lower discount rate, EPA used a discount rate of 0.7% for projects of 30 years or longer and for constant-dollar flows (inflation premium removed) in accordance with the current Office of Management and Budget (OMB) "2017 Discount Rates for OMB Circular No. A-94, Appendix C", dated December 12, 2016.

Using the 100-year project life, annual O&M costs of $800,000 per year and a discount rate of 0.7%, the NPV of Alternative 3aN is $80 million.

EPA also estimated costs based on the scenario of 500 years of O&M. See "Alternative 3aN Cost Assessment, San Jacinto River Waste Pits Superfund Site" contained in the Administrative Record.

For Alternative 6N:

For Alternative 6N, the cost estimate has been modified somewhat in response to the public comments, namely to employ the use of a BMP such as a cofferdam and perform the excavation in the "dry" so that no material release is expected during the removal. These conditions are for the cost estimate only as the actual Best Management Practices to be employed will be determined during the Remedial Design.

The commenters two concerns had little impact on the Alternative 6N. The NPV for Alternative 6N was calculated using a discount rate of 0.7%. While there are no maintenance costs *associated with Alternative 6N, there are future costs ($40,000 per year) related to five-year reviews, institutional controls, and MNA, all associated with the Sand Separation Area. These costs were continued for 30-years. Based on the additional capital cost for a cofferdam, and no operation and maintenance costs except for MNA sampling, five-year reviews, and institutional controls monitoring/maintenance, and a discount rate of 0.7%, the NPV of Alternative 6N is $106 million.*

The ROD uses the conservative assumption of only 30 years O&M, while recognizing that the period could be longer. However, if the commenter is correct, and using new cost parameters based on the commenter's concerns, the cost of the capping remedy would be significantly higher. Estimating 100 years of O & M Alternative 6N would be only approximately $26 million (or 33%) higher total cost than Alternative 3aN. Thus, the commenter's view and perspective, while not adopted in the ROD, provides further support for the Agency's remedy selection decision.

2.4.2 Comment: EPA also failed to explain the cost-effectiveness of its preferred dredging remedies. Among other things, CERCLA requires EPA to "select a remedial action ... that is cost effective." 42 U.S.G. § 9621(b)(1). EPA chose the most-expensive of the proposed remedies because, in EPA's view, they are superior to the alternatives. But the question is not whether alternatives 6N and 4S are better than the alternatives; the question is whether EPA can explain how those remedies are more cost-effective—that is, whether and to what extent they are so far superior to the alternatives that they warrant exponential increases in the cost of the remedial order. EPA should further consider the cost-effectiveness of the proposed remedy, and explain its choice in light of CERCLA's cost-effectiveness mandate.

Response: *During the remedy selection process, nine evaluation criteria are considered in distinct groups which play specific roles in working toward the selection of a remedy that satisfies the following five principal statutory requirements:*

1) Protect human health and the environment;
2) Comply with applicable or relevant and appropriate requirements (ARARs) unless a waiver is justified;
3) Be cost-effective;
4) Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and
5) Satisfy a preference for treatment as a principal element, or provide an explanation in the Record of Decision (ROD) why the preference was not met.

The nine evaluation criteria include two "threshold" criteria, five "balancing" criteria (including cost), and two "modifying" criteria (state and community acceptance). The alternatives are also separately evaluated against a subset of the criteria to make the determination of which option(s) satisfy statutory cost-effectiveness. A remedial alternative is cost-effective if its "costs are proportional to its overall effectiveness" (40 CFR 300.430(f)(1)(ii)(D)). Overall effectiveness of a remedial alternative is determined by evaluating the following three of the five balancing criteria:

- *long-term effectiveness and permanence;*
- *reduction in toxicity, mobility and volume (TMV) through treatment;*
- *and short-term effectiveness. Overall effectiveness is then compared to cost to determine whether the remedy is cost-effective.*

As discussed below, EPA did not merely "chose the most-expensive of the proposed remedies".

For Alternative 3aN, the net present worth for Alternative 3aN is $24.8 million based on a 7% discount rate and 30-years of operation and maintenance costs in accordance with EPA policy.

For Alternative 6N, the cost estimate has been modified somewhat in response to the public comments, namely to employ the use of a cofferdam and to perform the excavation in the "dry" so that no material release is expected during the removal. These conditions are for the cost estimate only because the actual Best Management Practices (BMPs) to be employed will be determined during the Remedial Design. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. The cost estimate was further modified to include costs for the additional excavation required (about 10,000 cubic-yards) associated with lowering the cleanup level from 200 ng/kg as presented in the Proposed Plan to 30 ng/kg. Based on the additional capital cost for a cofferdam and additional excavation volume, the net present worth for Alternative 6N is $105 million.

Although the costs for Alternative 6N are higher than those for the other alternatives, a comparison of the overall effectiveness (evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness)) to the cost of each alternative lead to the determination that Alternative 6N is more cost-effective.

Removal of waste under Alternative 6N will eliminate the potential for the costs associated with cleaning up a large contaminated sediment site that may result from a failure of a cap, and will eliminate the potential for future environmental and human health impacts should a release occur. The history of the need for repeated cap repairs, the exposure of waste materials, the riverbed erosion that occurred adjacent to the cap, all of which occurred during storms with much less intensity than the hurricanes to which the area is prone, do not support capping as a cost-effective remedy. It should be further noted that the recent occurrence of Hurricane Harvey did not impact the Site with storm surge or wind driven waves typical of hurricanes. Storm surge and hurricane wind driven waves create more extensive damage than flooding alone. This is shown by a comparison of the 2016 modelling done by the Corps of Engineers for flood conditions similar to the 1994 flood, as opposed to the USACE modelling for both storm and hurricane conditions (equivalent to both the 1994 flood and Hurricane Ike occurring together).

The enhanced capping of the waste may be less expensive and less disruptive in the short-term, but it also results in less protection of human health and the environment for the long-term. Cap *failure due to severe or extreme storm events or a lack of sustained effective maintenance would result in the release of the dioxin contaminated waste from the site.*

Given the position of the Site in the San Jacinto River, the frequent storms, and the history of repeated damage to the cap, O&M of the cap is likely to be required even beyond the normal 30-year period that is the estimate for most capped sites. The true cost of a capping remedy at this Site may be significantly larger than expected.

The Selected Remedy, removal of the waste pits, is protective of human health and the environment, complies with applicable or relevant and appropriate requirements, and provides the best balance of tradeoffs among the balancing criteria. It reduces risks within a reasonable time frame, provides for long-term reliability of the remedy, and minimizes reliance on institutional controls. It will achieve substantial risk reduction by removing the contaminated materials, unlike capping, which would always be susceptible to a future release following a severe storm event, or due to a failure of maintenance over a period of centuries. The selected remedy is also cost-effective because its costs are proportional to its overall effectiveness, with overall effectiveness being determined by an evaluation of its long term effectiveness and permanence, reduction in toxicity, mobility or volume through treatment, and short-term effectiveness.

2.4.3 Comment: Harris County requests the EPA require the Potentially Responsible Parties to consider off-site impacts should a release occur during cleanup, and especially include the nearby Harris County Parks as all Harris County citizens may make use of the parks and recreational fishing in its nearby waters. This review should include determining and providing appropriate warning to the public, placing limitations on public access and use, and monitoring for contamination and possible remediation if necessary.

Response: *The concerns raised by Harris County in this comment will be addressed during the planning for the remediation and during the actual cleanup as appropriate. Public participation has been an integral part of the cleanup process to date, and will continue to be so throughout the process. EPA continues to plan and coordinate community meetings, open houses, elected officials' briefings, media interviews, public notices, and fact sheets to inform the public and keep residents updated on all site developments that affect cleanup actions. All remediation plans include contingencies to address potential releases during cleanup and when transporting contaminated materials to off-site disposal facilities.*

2.4.4 Comment: As usual, the Fed. (any Dept., but especially the EPA) moves at glacial speed to enhance the wellbeing of the citizens of this country. The toxic dumpsites in the US were identified more than 5 years ago, and it will be several years before anything is undertaken to ameliorate the mess at the site along the San Jacinto River in Texas.

Response: *The Comprehensive Environmental Response, Compensation and Liability Act process is a very complex and detailed program with studies taking years to complete to reach the final remedy in the Record of Decision. The San Jacinto River Waste Pits Superfund Site is very complex due to the issues involved with its location in a river that is prone to* *flooding and hurricanes. According to General Accounting Office document 13-252, page 48, dated April 2013, the median amount of time from Remedial Investigation and Feasibility Study phase through Remedial Action takes 120 months (10 years) to complete.*

2.4.5 Comment: A Technical Assistance Grant (TAG) was awarded in 2011 but has since expired. Given the complexity of the Waste Pits Site Superfund Site and the large volume of public interest, we ask that the EPA require the PRPs to fund a TAG for the Design and Construction Phases of the Superfund process.

Response: *Technical Assistance Grants are a government-funded grant mechanism provided to communities. EPA will consider this request. EPA cannot require a potentially responsible party to fund a TAG.*

2.4.6 Comment: We ask that the EPA host monthly Community Advisory Committee (CAC) meetings during construction. This would allow for CAC members to receive information, relay concerns, and ask questions in one meeting which would minimize the amount of time EPA and others have to spend time answering the same questions or sharing the same concerns. We understand that it would not be reasonable to request EPA personnel to travel to Houston each month. However, CAC meetings have proven productive in the past even when EPA personnel is present via phone conference.

Response: *The EPA will take this recommendation under consideration and continue to maintain communication channels with the community.*

2.4.7 Comment: The Coalition strongly encourages the EPA to put procedures in place to notify residents and landowners when remedial activities are taking place. During the 2011 TCRA, it was clearly visible that construction was taking place but most local residents were unaware that the Waste Pits were a toxic waste site under construction. If our residents are informed about these types of activities, they can make better informed decisions for their family and their use of the river at that time.

Response: *The EPA will put procedures in place to notify the community when remedial activities are taking place and will provide regular updates.*

2.4.8 Comment: Nearby municipalities mix at least 20% groundwater with surface water, and according to the City of Houston Public Works, there are 1,424 private groundwater wells within a 5-mile radius of the Pits. The nearest municipal water well is 1.8 miles from the Waste Pits. The nearest private groundwater well is 0.39 miles from the Pits. To date, varying levels of dioxin and furan congeners (including 2,3,7,8-TCDD) have been found in local groundwater wells. It is known that both the northern pits and southern pits are in communication with the water table and shallow groundwater. We ask the EPA to strongly consider the following recommendation made by the National Remedy Review Board "The Board recommends that, during development of decision documents, the Region include plans for monitoring groundwater quality (including all COCs) in areas bounding waste materials (laterally and vertically) to ensure groundwater contamination does not become a concern, adjacent to the site, during remedial activities. The Board also recommends that the Region include plans for evaluating, in their groundwater monitoring plan, both dissolved phase COC concentrations and concentrations that may result from facilitated transport." (September 23, 2016 Memorandum: National Remedy Review Board Recommendations for the San Jacinto River Waste Pits Superfund Site, p. 11). (San Jacinto River Coalition)

Response: *Comment noted. Ground water monitoring at the Site will be evaluated during development of the Remedial Design and during clean up activities. Previous ground water sampling has not identified any dioxin migration from the Site.*

2.4.9 Comment: The Proposed Plan meets the requirements of CERCLA and the National Contingency Plan. Protection of human health and permanence of the remedy are driving considerations. "The National goal of the remedy selection process is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste." 40 CFR 300.430 (a) (l)(i); See also 42 U.S.C. 9621. "EPA's policy on management of principal threat wastes as stated in the National Contingency Plan" (40 CFR 300.430(aXl)(ii)). That policy can be summarized as: EPA expects to use treatment to address the principal threats posed by a site, wherever practicable ...EPA expects to use engineering controls, such as containment for waste that poses a relatively low long-term threat or where treatment is impracticable" (Garland, 2015). Removal is the alternative that best satisfies the goal stated above. Furthermore, it is the option that best satisfies the 9 evaluation criteria in the National Contingency Plan (40CFR300.430(e)(9)). Alternatives involving enhancement of the current temporary cap fail. to meet the criteria of overall protection of human health and the environment, long-term effectiveness and performance, community acceptance, or reduction of toxicity, mobility, or volume.

Response: *EPA has noted the comment. Removal of the waste pits material is the selected remedy for the reasons described in the Record of Decision.*

2.4.10 Comment: Why is the Government paying for the cleanup?

Response: *EPA is not paying for the cleanup. Under the Comprehensive Environmental Response, Compensation, and Liability Act, EPA can either pay for the site cleanup or take legal action to force the parties responsible for the site contamination to clean up the site or pay back the Federal government for the cost of the cleanup. In this case, Potentially Responsible Parties have been identified and are responsible for cleanup costs and reimbursement to the Federal government for costs.*

2.4.11 Comment: Why has it taken so long to clean up the pits?

Response: *In April 2005, the Texas Parks and Wildlife Department sent a letter notifying the Texas Commission on Environmental Quality of the existence of former waste pits in a sandbar in the San Jacinto River north of I-10. The Comprehensive Environmental Response, Compensation and Liability Act process is very complex and detailed with studies taking years to complete to reach the final remedy in the Record of Decision. The San Jacinto River Waste Pits*

Superfund Site is very complex due to its location within the San Jacinto River. According to General Accounting Office document 13-252 page 48 dated April 2013, the median amount of time from Remedial Investigation and Feasibility Study phase through Remedial Action takes 120 months to complete. This site was placed on the National Priorities List on March 19, 2008.

2.4.12 Comment: A commenter requested the comment period be extended to February 26, 2017.

Response: *EPA Region 6 denied this request stating; "The Environmental Protection Agency (EPA) previously extended the public comment period until January 12, 2017, so that the public comment period at this site will be open for a total of 105 days." EPA further stated; "However, if, after the close of the public comment period, any party provides EPA significant information not contained elsewhere in the administrative record, which it could not have submitted during the comment period and which supports the need to significantly alter the remedial action for this site, the EPA certainly will consider this information as part of the remedy selection process, as provided in Section 300.825(c) of the National Contingency Plan."*

2.4.13 Comment: Is there a plan in place to monitor the waters/area after the clean-up is completed?

Response: *A monitoring plan will be developed during the Remedial Design as appropriate.*

2.4.14 Comment: Region 6's application of the second threshold criteria (overall protectiveness) is flawed and supports Alternative 3aN rather than Alternative 6N.

Response: *EPA disagrees that Alternative 3aN is more protective than 6N. Alternative 6N results in the removal of material over the cleanup levels, while for Alternative 3aN, the waste will remain in place and be susceptible to floods and hurricanes for hundreds of years with no assurance that the waste can be reliably contained. During the removal process, the application of best management practices will preclude any material releases from the Site, while there is no control under Alternative 3aN should the cap be eroded and releases occur during a flood or hurricane.*

The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike). However, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

2.4.15 Comment: Region 6's assessment of the long-term effectiveness and performance of the alternatives (a primary balancing criterion) is misleading.

Response: *EPA disagrees that its assessment of long-term permanence is misleading. Alternative 6N results in the removal of material over the cleanup levels, while for Alternative 3aN, the waste will be left in place and susceptible to floods and hurricanes for hundreds of years. The location of the Site in the San Jacinto River and the high degree of uncertainty with model predictions for hundreds of years into the future result in little assurance that the waste can be reliably contained. During the removal process, application of best management practices will minimize any material releases from the Site, while there is no control under Alternative 3aN should the cap be eroded and releases occur during a flood or hurricane.*

The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane-Ike. However, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

2.4.16 Comment: By Region 6 selecting Alternative 6N, EPA ignores Alternative 3aN will best satisfy the National Contingency Plan.

Response: *The EPA has selected Alternative 6N using the nine CERCLA remedy selection criteria. For Alternative 3aN, the waste will remain in place and be susceptible to floods and hurricanes for hundreds of years with no assurance that the waste can be reliably contained. During the removal process, application of best management practices will preclude any material releases from the Site, while there is no control under Alternative 3aN should the cap be eroded and releases occur during a flood or hurricane. Alternative 6N provides a more certain outcome than Alternative 3aN with lower overall potential for release.*

2.4.17 Comment: If Region 6 does not select Alternative 3aN, it should defer from selecting a remedy until a cost estimate and a transparent evaluation is performed that meets the requirements of the NCP.

Response: *EPA is following the procedures outlined in the NCP, and the selection rational is documented in the Record of Decision. The EPA does not agree that the remedy selection, and Site cleanup, should be delayed for further study. One of the most important factors, that of the actual frequency and intensity of future storms and hurricanes, is not knowable to any greater extent than is already available. Furthermore, delaying the cleanup for additional study will only increase the time until the protectiveness of the final remedy can be achieved.*

Finally, the Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

2.4.18 Comment: Did USEPA fully evaluate the US Army Corps of Engineers report before they selected and documented the proposed plan? Or was the proposed plan written prior to receiving the US Army Corps of Engineers report?

Response: *EPA reviewed the associated draft and final documents issued by the US Army Corps of Engineers prior to issuance of the Proposed Plan.*

2.4.19 Comment: Does USEPA believe in-place containment remedies in other waterways throughout the US are not protective of human health and environment and inconsistent with the National Contingency Plan?

Response: *Each waterway has its own design limitations based on weather conditions, surrounding environment and population, and the nature of the waterway in which the waste material is located. A remedy that works at one location may not work at another location.*

2.4.20 Comment: Why did USEPA not formally consult with the Contaminated Sediment Technical Advisory Group (CSTAG), comprised of sediment remediation experts throughout the Agency, as expected for projects that are likely to cost more than 100 million dollars? Did CSTAG's recent opinion that a confined disposal remedy was appropriate for the Portland Harbor site cause USEPA to avoid seeking help from CSTAG?

Response: *The Site is not a large sediment site that triggers a formal review by CSTAG, instead it is a source area that is being remediated so that it does not become a large sediment site. The EPA discussed the Site with members of CSTAG in developing the remedial approach. Additionally, EPA provided detail responses to the CSTAG eleven risk management principles for contaminated sediment sites.*

2.4.21 Comment: Did USEPA feel any pressure or considered it advantageous to push this proposed plan within a few weeks of receiving US Army Corps of Engineers report to ensure USEPA's presumptive remedy would be adopted before the next Administration?

Response: *No, EPA was not pressured to release the Proposed Plan due to the change in Administrations. EPA released the Proposed Plan as early as possible due to the many concerns expressed by the community regarding the Site, including that it was taking too long to complete the Proposed Plan. Although the Corps report was formally released shortly before the release* *of the Proposed Plan, EPA was aware of its contents and had reviewed a draft and discussed the findings with the Corps of Engineers before it was formally released*

2.4.22 Comment: If EPA, for example, directs the PRPs to use berms, then sheet pile walls, then caissons when previous efforts do not work, what releases to the river during these attempts will occur? How will cost be impacted in order to have the mandatory understanding of the proportionality of cost to environmental benefit? EPA should not just hand wave, ignoring the regulatory requirements for a detailed evaluation of remedial alternatives under the National Contingency Plan, and say that these significant issues will be addressed at the Remedial Design stage.

Response: *The disturbance of waste materials during removal is unavoidable based on excavation as the selected remedial action. Minimization of sediment release will be addressed through Best Management Practices during excavation activities. Removal of the source waste will eliminate the potential for a release to the environment, which is a long-term benefit that outweighs the cost of removal. As stated in the Proposed Plan, dioxin in the environment is very persistent in the environment, and remains toxic for a long time. Therefore, any cleanup approach involving containment would have to reliably achieve containment for a long time. The regulatory requirements are not being ignored now, nor will they be ignored in the future. The Record of Decision for the Site describes and fully evaluates each alternative considered, and provides a justification for the selected remedy. See Sections entitled "Description of Alternatives" and "Summary of Comparative Analysis of Alternatives."*

2.4.23 Comment: The Final Interim Feasibility Study and Proposed Plan reflect a clear bias in Region 6 against containment as an effective remedy approach. Alternative 3aN was not selected as the preferred alternative based on EPA concerns over an ultra-extreme flow condition, based on a 500-year reliability benchmark. The use of a 500-year event is extreme and is inconsistent with EPA technical guidance for capping.

Response: *Due to the persistence of the contaminants of concern at the site, a conservative approach for modeling was used to best protect human health and the environment. The EPA does not agree that an ultra-extreme flow condition was used to evaluate the various alternatives. The evaluation was based on Hurricane Ike combined with the 1994 flood. These storms were selected because data was available, both had resulted in extensive damage, and using actual storm data would improve the validity of the simulation results. However, this combined storm resulted in a river flow at the Site of 390,000 cubic feet per second as reported by the US Army Corps of Engineers, but this flow was only marginally larger than the flood in 1994 alone, which was 360,000 cubic feet per second. In fact, two other floods in the 20th Century had higher flood levels than the 1994 flood based on the river gauge at Sheldon, Texas (in 1929 and in 1940). So, the simulated storm was hardly an ultra-extreme storm, although it did represent a flood that was in the range of a 100-year flood. Much of the simulated damage to the current cap with enhancements (Alternative 3N) resulted from hurricane driven waves. A category 4 or 5 hurricane would have greater wind and more intense wind driven waves, but actual storm data for these more intense hurricanes was not available and an attempt to* *mathematically create such a storm would inject another level of uncertainty in the simulated results.*

The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

Regarding the conditions for evaluating the protectiveness of capping, guidance typically considers the occurrence of a 100-year flood. However, the objective for the San Jacinto site, as well as any Superfund site, is to evaluate the remedy's effectiveness under the conditions that may reasonably be expected to occur at the site, and not some arbitrary standard. The EPA notes that the recent flooding from Hurricane Harvey resulted in a 500-year flood in the San Jacinto River as indicated by the Harris County Flood Warning System. This flooding did not include the erosion effects of hurricane driven waves, which would be expected to increase the amount of cap damage that occurred.

2.4.24 Comment: The EPA Superfund Sediment Guidance (USEPA 2005 p. 7-3) encourages project managers to consider a range of scenarios reflecting both best case and worst case. For this Site, EPA Region 6 has focused on the ultra-worst case only, in its attempt to reduce uncertainty.

Response: *While a less intense storm could have been simulated, it would not add any useful information regarding protectiveness and the question of whether a cap could stand up to an intense storm that is likely to occur during the long time that the dioxin would remain toxic. The evaluation was based on Hurricane Ike combined with the 1994 flood. These storms were selected because data was available, both had resulted in extensive damage, and using actual storm data would improve the validity of the simulation results. However, this combined storm resulted in a river flow at the Site of 390,000 cubic feet per second as reported by the US Army Corps of Engineers, but this flow was only marginally larger than the flood in 1994 alone, which was 360,000 cubic feet per second. In fact, two other floods in the 20th Century had higher flood levels than the 1994 flood based on the river gauge at Sheldon, Texas (in 1929 and in 1940). So, the simulated storm was hardly an ultra-extreme storm, although it did represent a flood that was in the range of a 100-year flood. Much of the simulated damage to the current cap with enhancements (Alternative 3N) resulted from hurricane driven waves. A category 4 or 5 hurricane would have greater wind and more intense wind driven waves, and presumably resulted in more damage to the cap and more erosion of the waste materiel. However, actual storm data for these more intense hurricanes is not available and an attempt to mathematically create such a storm at the Site would inject another level of uncertainty in the simulated results.*

2.4.25 Comment: To the extent there are issues related to the weight of such a thick armor layer (Alternative 3aN), these issues could be addressed during remedial design considering features such as an additional rock toe berm and flattened slopes, as recommended in the Respondents' draft Feasibility Study.

Response: *Additional and larger rock, flattened slopes, and rock added at the toe were all included with the enhancements to the current cap considered as part of Alternative 3N model study. However, the model results still found that 80% of the cap would be significantly eroded with the simulated storm. Furthermore, the Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

2.4.26 Comment: A casual reading of the Final Interim Feasibility Study and Proposed Plan can be confusing, in that it is not clearly stated what alternative or cap design was modeled and found to have an 80% erosion under the hypothetical ultra-extreme event.

Response: *There were a number of differing conditions, both for the cap configuration and the storm simulated, so it is understandable that there could be some confusion regarding the modeling effort. The 80 percent erosion rate was calculated while modeling a "hypothetical synoptic occurrence of Hurricane Ike and the October 1994 flood" applied to the temporary cap with the Alternative 3N upgrades. The modeling results are clarified in the Record of Decision.*

2.4.27 Comment: The Proposed Plan is premised on a Principal Threat Waste determination that is unnecessary, flawed, and ignores Site-specific data demonstrating that the wastes are reliably contained. The EPA's Principal Threat Waste Guidance clearly emphasizes the primacy of the National Contingency Plan remedy selection framework and its evaluation of remedial alternatives using the nine criteria in 40 CFR § 350.430(f)(1). A Principal Threat Waste determination is intended to streamline the identification of source material to be treated to reduce toxicity, mobility, or volume (TMV), if practicable. In this case, Region 6 has misused the Principal Threat Waste Guidance to select a remedy (and, indeed, to override the applicable selection criteria), not to identify wastes that should be treated. In fact, Region 6's preferred remedy does not provide for treatment to reduce TMV; rather, the preferred remedy simply removes the waste from one location and transports it to another.

Response: *CERCLA Section 121(b)(1) states in part:*

- *Remedial actions in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances, pollutants, or* *contaminants is a principal element, are to be preferred over remedial actions not involving such treatment.*

- *The President shall conduct an assessment of permanent solutions and alternative treatment technologies or resource recovery technologies, that in whole or in part, will result in a permanent and significant decrease in the toxicity, mobility, or volume of the hazardous substance, pollutant, or contaminant.*

- *The President shall select a remedial action that is protective of human health and the environment, that is cost effective, and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. If the President selects a remedial action not appropriate for preference under this subsection, the President shall publish an explanation as to why a remedial action involving such reductions was not selected.*

Reflecting these provision in CERCLA Section121(b), EPA established program management principals and certain expectations in the NCP regarding types of remedies that EPA has found to be most appropriate for different types of waste.[69] *Although remedy selection decisions are ultimately site-specific determinations based on an analysis of the remedial alternatives using the nine criteria, these expectations are intended to streamline and focus the RI/FS on appropriate waste management options. They reflect EPA's belief that certain source materials are addressed best through treatment because of technical limitations to the long-term reliability of containment technologies, or the serious consequences of exposure should a release occur.*[70] *For example, EPA's experience that highly mobile waste generally requires treatment may help guide EPA to focus the detailed analysis in the FS on treatment alternatives, as compared to containment alternatives.*[71]

Under the NCP at 40 CFR § 300.430(a)(iii)(A), EPA expects to use treatment to address the principal threats posed by a site, wherever practicable. Principal threats for which treatment is most likely to be appropriate include liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile materials.[72] *The EPA Guide to Principal Threat and Low-level Threat Waste further explains that principal threat wastes are those source materials considered highly toxic or highly mobile that generally cannot be reliably contained or would*

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[69] Preamble to the Final NCP Rule, 55 Fed. Reg. 8666, 8702 (Mar. 8, 1990) and Preamble to the Proposed NCP Rule, 53 Fed. Reg. 51394, 51422 (Dec. 21, 1988).

[70] "A Guide to Principal Threat and Low Level Threat Wastes", U.S. EPA, November 1991 (OSWER 9380.3-06FS)
[hereinafter *PTW Guidance*] at p.1. "Source material" is defined as material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration on contaminants to ground water, to surface water, to air, or act as a source for direct exposure.

[71] 55 Fed. Reg. at 8702.

[72] 40 C.F.R. § 300.430(a)(iii)(A).

present a significant risk to human health or the environment should exposure occur.[73] *Principal Threat Waste (PTW) includes liquids and other highly mobile materials (e.g. solvents) or materials having high concentrations of toxic compounds.*[74] *No threshold of toxicity/risk has been established to equate to "principal threat." However, where toxicity and mobility of source material combine to pose a potential risk of 10-3 or greater, generally treatment alternatives should be evaluated.*[75] *Also, treatment that destroys or reduces hazardous properties of contaminants (e.g., toxicity or mobility) frequently will be required to achieve solutions that afford a high degree of permanence.*[76] *EPA also recognizes that "although no threshold level of risk has been established to identify principal threat waste, a general rule of thumb is to consider as a principal threat those source materials with toxicity and mobility characteristics that combine to pose a potential risk several orders of magnitude greater than the risk level that is acceptable for the current or reasonably anticipated future land use, given realistic exposure scenarios."*[77]

Examples of PTW include but are not limited to:

- *Liquids – wastes contained in drums, lagoons, or tanks, free product (NAPL or DNAPL)*

- *Mobile source materials – surface soil or subsurface soil containing high concentrations of contaminants of concern that are (or potentially are) mobile due to wind entrainment, volatilization (e.g., VOCs), surface runoff, or subsurface transport.*

- *Highly toxic source material – buried drummed non-liquid wastes, buried tanks containing non-liquid wastes, or soils containing significant concentrations of highly toxic materials. For PCB contamination or PCB waste at Superfund sites, principal threats will generally include material contaminated at concentrations exceeding 100ppm for sites in residential areas and concentrations exceeding 500 ppm for sites in industrial areas reflecting concentrations that are 1 to 2 orders of magnitude higher than the preliminary remediation goals.*[78]

Under the NCP at 40 C.F.R. § 300.430(e) Feasibility Study, the primary objective of the feasibility study (FS) is to ensure that appropriate remedial alternatives are developed and

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73 *PTW Guidance* at p.2, *see also 55 Fed. Reg. at 8703 and 53 Fed. Reg. at 51422.* Principal threats are characterized as waste that cannot be reliably controlled in place such as liquids, highly mobile materials (e.g., solvents), and high concentrations of toxic compounds (e.g., several orders of magnitude above levels that allow for unrestricted use and unlimited exposure).

74 Id.

75 Id.

76 53 Fed. Reg. at 51422.

77 "Rules of Thumb for Superfund Remedy Selection", U.S. EPA, August 1997, (OSWER Pub. 9355.0-69) at p.11.

78 "Guidance on Remedial Actions for Superfund Sites with PCB Contamination", U.S. EPA, August 1990, (EPA/540/G-90/007) [hereinafter *PCB Guidance*] at p. iv. *See also PCB Guidance* p. 6, p. 39, and p. 40.

evaluated such that relevant information concerning the remedial action options can be presented to the decision-maker and an appropriate remedy be selected. EPA's RI/FS guidance on developing and screening remedial alternatives further provides that alternatives should be developed ranging from one that would eliminate or minimize the extent feasible the need for long-term management (including monitoring) at a site to one that would use treatment as a primary component of an alternative to address principal threats at the site.[79] EPA's PCB Guidance states that the Superfund program expectations should be considered in developing appropriate response options for the identified area over which some action must take place.[80] In particular, the expectation that principal threats at the site should be treated, wherever practicable, and that consideration should be given to containment of low-threat material, forms the basis for forming alternatives.[81]

A detailed analysis in the FS at this Site has evaluated remedial alternatives using the nine criteria specified in the NCP, including the criterion Reduction of toxicity, mobility, or volume through treatment, which addresses how treatment is used to address principal threats at the site.[82] This evaluation criterion addresses the statutory preference for selecting remedial actions that employ treatment that permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances as their principal element. This preference is satisfied when treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, reduction of total mass of toxic contaminants, irreversible reduction in contaminant mobility, or reduction in the total volume of contaminated media.[83] In evaluating this criterion an assessment should be made as to whether treatment is used to reduce principal threats, including the extent to which toxicity, mobility, or volume are reduced either alone or in combination.[84] Additionally, alternatives were using the Long-term effectiveness and permanence criterion which focuses on the degree to which an alternative reduces, toxicity, mobility, or volume through treatment, minimizes residual risks and affords long-term protection.[85]

Pursuant to 40 C.F.R. § 300.430(e)(3), for source control actions, the lead agency shall develop, as appropriate: (i) A range of alternatives in which treatment that reduces the toxicity, mobility, or volume of the hazardous substances, pollutants, or contaminants is a principal element. As appropriate, this range shall include an alternative that removes or destroys hazardous substances, pollutants, or contaminants to the maximum extent feasible, eliminating or minimizing, to the degree possible, the need for long-term management. The lead agency also shall develop, as appropriate, other alternatives which, at a minimum, treat the principal threats posed by the site but vary in the degree of treatment employed and the quantities and

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79 "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA - Interim Final", U.S. EPA October 1988 (OSWER Dir. 9355.3-01) [hereinafter *RI/FS Guidance*] at p. 4-7.

80 *PCB Guidance* at p. iv.

81 *Id*.

82 *See* 40 C.F.R. § 300.430(e)(9) *Detailed Analysis of Alternatives*.

83 *RI/FS Guidance* at p. 6-8.

84 *Id*. at p. 6-8 and p. 6-9

85 40 C.F.R. § 300.430(e)(7)(i) and § 300.430(e)(9)(iii).

characteristics of the treatment residuals and untreated waste that must be managed." (Emphasis added)

Consistent with CERCLA, the NCP, and EPA guidance, PTW was identified at this Site as discussed below in this section.

Furthermore, consistent with the statutory mandate to utilize permanent solutions and alternative treatment or resource recovery technologies to the maximum extent practicable and the preference for remedies that to the maximum extent practicable employ treatment that permanently and significantly reduces the toxicity, mobility, or volume of hazardous substances, pollutants or contaminants, the Agency has evaluated potential treatment options for the dioxin prior to disposal. These options are designed to address the toxicity and mobility of the PTW at this site so that it will not be further released into the environment after disposal. Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during the remediation will be tested to comply with the applicable requirements. Treatment of a portion of the paper mill waste by solidification with cement was successfully performed during the Time Critical Removal Action (TCRA) on a portion of the Western Cell materials. EPA will implement the best technology to meet the statutory requirements discussed above after further evaluation in the remedial design.

The purpose of discussing PTW is not to set cleanup levels. The purpose is to reflect EPA's belief that certain source materials are addressed best through treatment because of technical limitations to the long-term reliability of containment technologies, or the serious consequences of exposure should a release occur.

Dioxin is highly toxic and persistent (will not break down for hundreds of years) in nature. With the regular occurrence of severe storms and flooding in the area, there is uncertainty that the waste material can be reliably contained over the long term and therefore should be considered potentially highly mobile due to its location in a dynamic river environment. Because the dioxin waste in the northern impoundments and southern impoundment at the Site is both highly toxic and potentially highly mobile, it is considered a Principal Threat Waste.

The Proposed Plan states that the "waste material is highly toxic and may be highly mobile in a severe storm and therefore is considered a Principal Threat Waste. EPA disagrees that the waste is reliably contained for the long term. Repeated instances of repair and maintenance occurred from July 2012 to June 2016. All of the above cases of eroded or missing armor stone occurred with flooding less than that of a 100-year storm. The EPA applied the CERCLA remedy criteria for selection of the removal alternative in determining that the containment of the waste could not be reliably done over the long term. Excavated waste material would be dewatered (decanted) and stabilized by addition of Portland cement or other additive, as necessary, to eliminate free liquids for transportation and disposal. Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving *facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during the remediation will be tested to comply with the applicable requirements. Treatment of a portion of the paper mill waste by solidification with cement was successfully performed during the Time Critical Removal Action (TCRA) on a portion of the Western Cell materials.*

2.4.28 Comment: Alternative 6N does not include a supportable cost estimate that complies with the requirements of CERCLA and the NCP for its new "removal in the dry" alternative. Failure to address this means that selection of Alternative 6N based on the Final Interim Feasibility Study and the current Administrative Record would be arbitrary and capricious.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. The Record of Decision includes revised cost estimates to incorporate the use of cofferdams, removal in the "dry", additional de-watering, changing the remediation goal for the waste pits from 200 ng/kg to 30 ng/kg, as well as other components that were incorporated in response to consideration of the public comments. The estimated costs are still within the + 50 % to minus 30% range expected for feasibility study estimates, and are not inappropriate. These changes are discussed in the Record of Decision and included in the administrative record.*

2.4.29 Comment: EPA Region 6's evaluation of remedial alternatives under CERCLA and the NCP is fatally flawed. The Proposed Plan rejects the demonstrably more effective remedy (Alternative 3aN) in favor of a remedy that will cause significant releases of dioxin to the San Jacinto River. In doing so, EPA Region 6 performs a flawed and arbitrary evaluation of the alternatives under CERCLA and the NCP's nine criteria test. EPA Region 6 states that both Alternative 3aN and Alternative 6N meet the threshold criteria of protection of human health and the environment and compliance with all applicable or relevant and appropriate requirements (ARARs). However, these determinations are questionable with regard to Alternative 6N because Region 6 does not clearly define how Alternative 6N will be implemented or how it will comply with applicable ARARs, given that its implementation will result in significant releases to the San Jacinto River. Region 6 has inappropriately and without a credible basis dismissed these concerns as to whether Alternative 6N meets the threshold criteria. These are not concerns that, as Region 6 suggests, can be addressed in the design phase.

Response: *The EPA evaluated the remedial alternatives in accordance with the nine CERCLA remedy selection criteria as documented in the Record of Decision. Alternative 6N will be implemented using best management practices, and will comply with the Site ARARs as described in the Record of Decision. The removal with best management practices will minimize and control releases to the San Jacinto River, and will prevent the potential for much greater releases to the San Jacinto River as a result of a severe storm damage to a cap. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

2.4.30 Comment: For the balancing criteria addressing treatment to reduce toxicity, mobility, or volume (TMV), Region 6 clearly misapplies the criterion because Alternative 6N involves no treatment to reduce TMV, yet Region 6 ranks Alternative 6N as higher than Alternative 3aN on this criterion. Region 6 rates Alternative 6N higher than Alternative 3aN on long-term effectiveness and permanence by downplaying the releases that the US Army Corps of Engineers predicts will occur as a result of Alternative 6N and by disregarding the US Army Corps of Engineers conclusions regarding capping and the long-term record of performance of such remedies.

Response: *Under Alternative 6N excavated waste material would be dewatered (decanted) and stabilized by addition of Portland cement or other additive, as necessary, to eliminate free liquids for transportation and disposal. Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during the remediation will be tested to comply with the applicable requirements. Treatment of a portion of the paper mill waste by solidification with cement was successfully performed during the Time Critical Removal Action (TCRA) on a portion of the Western Cell materials. The mobility and volume of waste within the San Jacinto River will be greatly reduced by the removal of the waste material. Alternative 6N is the selected remedial action following a consideration of the nine CERCLA remedy selection criteria as discussed in the Record of Decision, including its improved long term effectiveness compared to containment in the San Jacinto River, which is subject to potential releases as a result of the impact of hurricanes, among other things. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. As discussed in the Proposed Plan of Action, EPA and the US Army Corps of*

Engineers indicated that a potential small release of the waste material may occur during removal activities under alternative 6N.

As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.

The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

2.4.31 Comment: The Proposed Plan is not based on a cost estimate that satisfies the National Contingency Plan's requirements. It also does not include a discussion of cost-effectiveness although it is a criterion that must be evaluated under CERCLA. Even in the absence of an appropriate cost estimate, Alternative 6N will be significantly more expensive to implement than Alternative 3aN. Alternative 6N also results in significantly more releases of dioxin to the environment and a much greater environmental footprint than Alternative 3aN. Alternative 3aN is clearly the more cost-effective remedy, and the Proposed Plan is flawed for not even including an evaluation of this CERCLA-required criterion.

Response: *During the remedy selection process, nine evaluation criteria are considered in distinct groups which play specific roles in working toward the selection of a remedy that satisfies the following five principal statutory requirements:*

1) Protect human health and the environment;
2) Comply with applicable or relevant and appropriate requirements (ARARs) unless a waiver is justified;
3) Be cost-effective;
4) Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and
5) Satisfy a preference for treatment as a principal element, or provide an explanation in the Record of Decision (ROD) why the preference was not met.

The nine evaluation criteria include two "threshold" criteria, five "balancing" criteria (including cost), and two "modifying" criteria (state and community acceptance). The alternatives are also separately evaluated against a subset of the criteria to make the determination of which option(s) satisfy statutory cost-effectiveness. A remedial alternative is cost-effective if its "costs are *proportional to its overall effectiveness" (40 CFR 300.430(f)(1)(ii)(D)). Overall effectiveness of a remedial alternative is determined by evaluating the following three of the five balancing criteria:*

- *long-term effectiveness and permanence;*
- *reduction in toxicity, mobility and volume (TMV) through treatment;*
- *and short-term effectiveness. Overall effectiveness is then compared to cost to determine whether the remedy is cost-effective.*

As discussed below, EPA did not merely "chose the most-expensive of the proposed remedies".

For Alternative 3aN, the net present worth for Alternative 3aN is $24.8 million based on a 7% discount rate and 30-years of operation and maintenance costs in accordance with EPA policy.

For Alternative 6N, the cost estimate has been modified somewhat in response to the public comments, namely to employ the use of a cofferdam and to perform the excavation in the "dry" so that no material release is expected during the removal. These conditions are for the cost estimate only because the actual Best Management Practices (BMPs) to be employed will be determined during the Remedial Design. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. The cost estimate was further modified to include costs for the additional excavation required (about 10,000 cubic-yards) associated with lowering the cleanup level from 200 ng/kg as presented in the Proposed Plan to 30 ng/kg. Based on the additional capital cost for a cofferdam and additional excavation volume, the net present worth for Alternative 6N is $105 million.

Although the costs for Alternative 6N are higher than those for the other alternatives, a comparison of the overall effectiveness (evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness)) to the cost of each alternative lead to the determination that Alternative 6N is more cost-effective.

Removal of waste under Alternative 6N will eliminate the potential for the costs associated with cleaning up a large contaminated sediment site that may result from a failure of a cap, and will eliminate the potential for future environmental and human health impacts should a release occur. The history of the need for repeated cap repairs, the exposure of waste materials, the riverbed erosion that occurred adjacent to the cap, all of which occurred during storms with much less intensity than the hurricanes to which the area is prone, do not support capping as a cost-effective remedy. It should be further noted that the recent occurrence of Hurricane Harvey did not impact the Site with storm surge or wind driven waves typical of hurricanes. Storm surge and hurricane wind driven waves create more extensive damage than flooding alone. This is shown by a comparison of the 2016 modelling done by the Corps of Engineers for flood conditions similar to the 1994 flood, as opposed to the USACE modelling for both storm and hurricane conditions (equivalent to both the 1994 flood and Hurricane Ike occurring together).

The enhanced capping of the waste may be less expensive and less disruptive in the short-term, but it also results in less protection of human health and the environment for the long-term. Cap failure due to severe or extreme storm events or a lack of sustained effective maintenance would result in the release of the dioxin contaminated waste from the site.

Given the position of the Site in the San Jacinto River, the frequent storms, and the history of repeated damage to the cap, O&M of the cap is likely to be required even beyond the normal 30-year period that is the estimate for most capped sites. The true cost of a capping remedy at this Site may be significantly larger than expected.

The Selected Remedy, removal of the waste pits, is protective of human health and the environment, complies with applicable or relevant and appropriate requirements, and provides the best balance of tradeoffs among the balancing criteria. It reduces risks within a reasonable time frame, provides for long-term reliability of the remedy, and minimizes reliance on institutional controls. It will achieve substantial risk reduction by removing the contaminated materials, unlike capping, which would always be susceptible to a future release following a severe storm event, or due to a failure of maintenance over a period of centuries. The selected remedy is also cost-effective because its costs are proportional to its overall effectiveness, with overall effectiveness being determined by an evaluation of its long term effectiveness and permanence, reduction in toxicity, mobility or volume through treatment, and short-term effectiveness.

2.4.32 Comment: The Proposed Plan contravenes CERCLA's requirement that any removal action, to the greatest extent practicable, contributes to the efficient performance of any long-term remedial action. As part of a Time Critical Removal Action (TCRA), Respondents, under an agreed order on consent with EPA Region 6, constructed and later enhanced the armored cap. The Action Memorandum for the TCRA, as required by §104(a)(2) of CERCLA, requires that the TCRA be consistent with the long-term remedy at the Site. Alternative 3aN is consistent with the TCRA. In contrast, Alternative 6N deconstructs and removes the existing cap, which renders Alternative 6N far more complicated and in fact will result in releases; Alternative 6N thus is not "consistent with" the TCRA. Alternative 6N does not comply with CERCLA §104(a)(2).

Response: *The EPA's April 2, 2010 Action Memorandum (Request for a Time-Critical Removal Action at the San Jacinto River Waste Pits Site) documented the hazardous conditions at the San Jacinto River Waste Pits prior to the removal action, finding that should a removal action be delayed, the potential threats to human health and the environment would increase; a substantial amount of dibenzo-p-dioxins and polychlorinated dibenzofurans would continue to be released and spread into the San Jacinto River; and unrestricted access to the site would continue to threaten nearby populations. Following the April 2010 Action Memorandum, McGinnes Industrial Maintenance Corporation and International Paper entered into an administrative settlement with the EPA (Administrative Settlement Agreement and Order on Consent for Removal Action, CERCLA Docket No. 06-12-10, dated May 11, 2010). Pursuant to the April 2010 Action Memo and the administrative order, the PRPs prepared and submitted a technical memorandum to evaluate all removal option alternatives for the design and construction of a physical protective barrier surrounding the waste ponds to temporarily address* *the releases or threat of release from the Site. Based on the analysis of alternatives in the PRPs' technical memorandum, the Decision Document for the Time-Critical Removal Action, dated July 28, 2010, selected the cap currently in place at the Site to temporarily abate the releases and threats of releases of dioxin until a permanent remedy could be evaluated and selected.*

Section 104(a)(2) of CERCLA states: "Any removal action undertaken by the President under this subsection (or by any other person referred to in section 9622 of this title) should, to the extent the President deems practicable, contribute to the efficient performance of any long term remedial action with respect to the release or threatened release concerned." As stated repeatedly in the April 2010 Action Memorandum, the May 2010 administrative settlement order, and the July 2010 Decision Document, the purpose of the removal action was to stabilize the Site and temporarily abate the release of dioxins and dibenzofurans into the waterway for the period of time necessary to fully characterize the site conditions and to select a remedy. The National Contingency Plan specifically states that capping of contaminated soils or sludges, where needed to reduce migration of hazardous substances into soil, ground or surface water, or air, is an appropriate removal action. 40 CFR Section 300.415(e)(4). It was anticipated that the Site would require a significant amount of time to complete the necessary Site investigations and assessments, so the temporary cap could not be delayed pending a final remedy selection. The position that the temporary cap cannot now be removed because it is not consistent with the selected final remedy would require EPA to either forego the use of temporary caps, even where necessary to protect human health and the environments, if it thought another remedy might eventually be chosen, or to effectively select a final remedy whenever it chooses a cap as a removal action, without the benefit of full analysis and consideration of the nine criteria. The CERCLA Section 104(a)(2) requirement for a removal action to "contribute to the efficient performance of any long term remedial action" is to the extent deemed "practicable." The EPA has met this standard for the removal action for this Site. Now, the investigations are complete, additional data and analysis are available that were not available at the time of the temporary cap construction, and a final remedy has been selected based on the nine CERCLA remedy selection criteria. These criteria resulted in the selection of removal of the dioxin waste as the final remedy because, among other considerations, the capping remedy could not be shown to reliably contain the waste under the conditions of the San Jacinto River with the potential occurrence of severe storms and hurricanes.

2.4.33 Comment: EPA Region 6 does not appear to have meaningfully involved the State of Texas in the selection of the proposed remedy. Under Section 121(f)(1) of CERCLA, EPA is required to provide substantial and meaningful involvement by the State in the selection of remedial actions. The State played a central role in the listing of the Site; it was involved in earlier stages of the Remedial Investigation process and the initial development of remedial alternatives for the Site. Once Region 6 apparently settled on removal as its preferred remedy, however, the State's involvement appears to have been limited. The NCP requires that a proposed remedial action plan state either that (1) the EPA and the State have reached agreement on the preferred remedy, or (2) the EPA and the State have not reached an agreement and set out the State's concerns. This required statement is glaringly missing in the Proposed Plan, which instead simply states that the Texas Commission on Environmental Quality (TCEQ) "has been informed about the Preferred Remedy for the Site."

Response: *TCEQ has been involved throughout the entire Superfund process, including in the remedy selection phase. The EPA Region 6 office is the lead agency for this Site. TCEQ is the support agency. As the support agency, TCEQ had an opportunity to review and comment on the remedial investigation and feasibility study, the Proposed Plan, the Record of Decision, and the remedial design. As part of the Public Comment Period, the state's position and key concerns related to the preferred alternative and other alternatives were assessed before EPA selected the remedy.*

2.4.34 Comment: The Proposed Plan is inconsistent with EPA's "Greener Cleanup Activities" policy. Under EPA's August 2, 2016, memorandum regarding "Consideration of Greener Cleanup Activities in the Superfund Cleanup Process," and associated agency policies (Greener Cleanup Policy), EPA encourages the Regions to conduct an environmental "footprint" analysis of remedial alternatives to help evaluate and quantify the environmental impact of the remedial alternatives using five core elements. A "footprint" analysis of the remedial alternatives for the Northern Impoundment does not appear to have been included in the Administrative Record. Had such an analysis been completed, however, it is clear that it would have shown that Alternative 6N will create a much larger environmental footprint than Alternative 3aN, and compares unfavorably to Alternative 3aN on all five core elements of the Greener Cleanup Policy. In the Final Interim Feasibility Study, Region 6 admits that Alternative 6N is a "less sustainable" alternative "considering potential ozone precursor, [particulate matter] and greenhouse gas emissions from the construction activity."

Response: *As stated in the referenced memorandum, consideration of greener cleanup activities should be carried out in a manner consistent with CERCLA, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and EPA guidance. This memorandum supplements the Agency's fact sheets and policy statements addressing greener cleanup activities, tools and considerations; however, it neither amends nor modifies the NCP in any way (*e.g., *consideration of greener cleanup activities should not be treated as a new criterion under 40 CFR Section 300.430(e)(9)(iii)). EPA utilized existing criteria in selection of the Preferred Alternative as required by the NCP.*

The environmental footprint of Alternative 6N, with the use of BMPs such as a cofferdam and excavation in the "dry", is much less than the environmental footprint of Alternative 3aN with its potential for a future long-term release of dioxins. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

2.4.35 Comment: Full removal could result in violations of state law that are not shielded by CERCLA. As the US Army Corps of Engineers Report makes clear, the existing armored cap cannot be removed and the underlying waste excavated without releases of dioxins to the environment. Consequently, if Respondents (and their contractors) were to implement the proposed remedy, they would be subject to potential civil enforcement actions under the Texas Water Code and state water quality standards. It is highly questionable whether Region 6 has the authority under CERCLA to order Respondents to implement Alternative 6N under these circumstances. Moreover, such an action by EPA Region 6 would violate Respondents' due process rights. The current Administrative Record fully supports selection of Alternative 3aN as the preferred alternative. The Proposed Plan should be rejected and EPA Region 6 should instead select Alternative 3aN. In fact, given the shortcomings in the remedy selection process identified above, selecting Alternative 6N would be arbitrary, capricious, and not supported by the Administrative Record. Respondents strongly believe that an unbiased remedy selection assessment, based on a complete Administrative Record, supports the selection of Alternative 3aN as the preferred remedy for the Site.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

EPA disagrees with the statement that the Administrative Record supports the selection of Alternative 3aN. In fact, the Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

2.4.36 Comment: Armored caps are being utilized nationally and have a strong record of performance. Table 4-1a of the Final Interim Feasibility Study includes an example list of sites around the country where caps are being utilized and where conditions are similar to the Site. The report evaluating the remedial alternatives prepared by the US Army Corps of Engineers for Region 6 (US Army Corps of Engineers Report) concluded that no armored cap has "failed" to date. Region 6 acknowledges this fact in the Proposed Plan. Despite these facts, Region 6 questions the long-term effectiveness of a cap, applying a 100% certainty standard of effectiveness to Alternative 3aN over a 500-year period. The standard of certainty applied to the capping remedy by Region 6 is inconsistent with the NCP and national remedy evaluation precedent, as well as being internally inconsistent.

Response: *The Proposed Plan states that there appears to be no documented cases of any armored cap or armored confined disposal facility breaches, while the Final Interim Feasibility Study states that after an extensive literature review, there appear to be no documented cases of any armored cap or armored confined disposal facility breaches. However, both documents go on to additionally state that there have been many occurrences of breaches and slope failures of armored dikes, jetties, and breakwaters, with some of those structures confining dredged material. Table 10-1 within Appendix A of the Final Interim Feasibility Study lists 10 examples of locations where armor breaches and failures have occurred. In conjunction with the persistent nature of the site contaminants, it is due to these types of failures over relatively short time periods that EPA has selected the removal alternatives. The list of failures is also why EPA questions the long-term effectiveness of the current cap, which itself has undergone a series of repeated damage events and repairs since it's installation in 2011.*

The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

Regarding certainty, EPA does not have a requirement for a "100% certainty" to evaluate capping effectiveness; instead capping, or any remedial action, must provide long-term protectiveness. However, the current cap's history, the future exposure to repeated hurricanes, and the U.S. Corps of Engineers model results for an upgraded cap do not demonstrate that capping could provide acceptable long-term protectiveness.

2.4.37 Comment: The Proposed Plan fails to provide an appropriate evaluation of the remedial alternatives particularly the comparison of Alternatives 3aN and 6N, which is contrary to CERCLA and the National Contingency Plan ("NCP") (40 CFR Part 300).

Response: *A detailed evaluation of the remedial alternatives is presented in the Final Interim Feasibility Study Report and in the Record of Decision.*

2.4.38 Comment: The Proposed Plan does not comport with the Principals for Managing Contaminated Sediment Risks at Hazardous Waste Sites (U.S. EPA 2002a) nor U.S. EPA's Contaminated Sediment Guidance (2005).

Response: *EPA disagrees with the assertion that the Proposed Plan is not in conformity with the Principals for Managing Contaminated Sediment Risks at Hazardous Waste Sites or the EPA's Contaminated Sediment Guidance. The management of the Site, the Proposed Plan, and the Record of Decision addressed the principals covered in the 2002 memo, including the principal of achieving long term protectiveness. EPA provided detailed responses to the CSTAG eleven risk management principles for contaminated sediment sites in an August 22, 2016 memorandum to EPA's Office of Land and Emergency Management. Based on historical performance of the temporary cap and surrounding area, there is a concern regarding the sediment erosion adjacent to the capped area and potential release and transport of the dioxin which would further impact ecological and human receptors. The long-term performance of the cap is questionable. There have been multiple repairs required to maintain the isolation barrier for the contaminated sediment. Furthermore, the Proposed Plan is consistent with Section 2.7 of the Contaminated Sediment Guidance which addresses phased approaches, adaptive management, and early actions. EPA believes that its remedy selected for this Site is fully supported.*

2.4.39 Comment: The U.S. EPA Region 6 has not applied the NCP's cost effectiveness criterion correctly in its Proposed Plan. In particular, U.S. EPA Region 6 has proposed a remedy, Alternative 6N, that will cost substantially more than an alternative remedy (Alternative 3aN) but will not provide any meaningfully greater risk reduction. In fact, the implementation of the Proposed Plan would have the unenviable distinction of resulting in significant incremental cost to achieve significantly less incremental protectiveness, in violation of the NCP's cost-effectiveness requirement. Accordingly, U.S. EPA Region 6 has failed to demonstrate that the Proposed Plan's remedy is cost-effective when compared to Alternative 3aN.

Response: *During the remedy selection process, nine evaluation criteria are considered in distinct groups which play specific roles in working toward the selection of a remedy that satisfies the following five principal statutory requirements:*

1) Protect human health and the environment;
2) Comply with applicable or relevant and appropriate requirements (ARARs) unless a waiver is justified;
3) Be cost-effective;
4) Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and
5) Satisfy a preference for treatment as a principal element, or provide an explanation in the Record of Decision (ROD) why the preference was not met.

The nine evaluation criteria include two "threshold" criteria, five "balancing" criteria (including cost), and two "modifying" criteria (state and community acceptance). The alternatives are also separately evaluated against a subset of the criteria to make the determination of which option(s) satisfy statutory cost-effectiveness. A remedial alternative is cost-effective if its "costs are proportional to its overall effectiveness" (40 CFR 300.430(f)(1)(ii)(D)). Overall effectiveness of *a remedial alternative is determined by evaluating the following three of the five balancing criteria:*

- *long-term effectiveness and permanence;*
- *reduction in toxicity, mobility and volume (TMV) through treatment;*
- *and short-term effectiveness. Overall effectiveness is then compared to cost to determine whether the remedy is cost-effective.*

As discussed below, EPA did not merely "chose the most-expensive of the proposed remedies".

For Alternative 3aN, the net present worth for Alternative 3aN is $24.8 million based on a 7% discount rate and 30-years of operation and maintenance costs in accordance with EPA policy.

For Alternative 6N, the cost estimate has been modified somewhat in response to the public comments, namely to employ the use of a cofferdam and to perform the excavation in the "dry" so that no material release is expected during the removal. These conditions are for the cost estimate only because the actual Best Management Practices (BMPs) to be employed will be determined during the Remedial Design. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. The cost estimate was further modified to include costs for the additional excavation required (about 10,000 cubic-yards) associated with lowering the cleanup level from 200 ng/kg as presented in the Proposed Plan to 30 ng/kg. Based on the additional capital cost for a cofferdam and additional excavation volume, the net present worth for Alternative 6N is $105 million.

Although the costs for Alternative 6N are higher than those for the other alternatives, a comparison of the overall effectiveness (evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness)) to the cost of each alternative lead to the determination that Alternative 6N is more cost-effective.

Removal of waste under Alternative 6N will eliminate the potential for the costs associated with cleaning up a large contaminated sediment site that may result from a failure of a cap, and will eliminate the potential for future environmental and human health impacts should a release occur. The history of the need for repeated cap repairs, the exposure of waste materials, the riverbed erosion that occurred adjacent to the cap, all of which occurred during storms with much less intensity than the hurricanes to which the area is prone, do not support capping as a cost-effective remedy. It should be further noted that the recent occurrence of Hurricane Harvey did not impact the Site with storm surge or wind driven waves typical of hurricanes. Storm surge and hurricane wind driven waves create more extensive damage than flooding alone. This is shown by a comparison of the 2016 modelling done by the Corps of Engineers for flood conditions similar to the 1994 flood, as opposed to the USACE modelling for both storm and hurricane conditions (equivalent to both the 1994 flood and Hurricane Ike occurring together).

The enhanced capping of the waste may be less expensive and less disruptive in the short-term, but it also results in less protection of human health and the environment for the long-term. Cap *failure due to severe or extreme storm events or a lack of sustained effective maintenance would result in the release of the dioxin contaminated waste from the site.*

Given the position of the Site in the San Jacinto River, the frequent storms, and the history of repeated damage to the cap, O&M of the cap is likely to be required even beyond the normal 30-year period that is the estimate for most capped sites. The true cost of a capping remedy at this Site may be significantly larger than expected.

The Selected Remedy, removal of the waste pits, is protective of human health and the environment, complies with applicable or relevant and appropriate requirements, and provides the best balance of tradeoffs among the balancing criteria. It reduces risks within a reasonable time frame, provides for long-term reliability of the remedy, and minimizes reliance on institutional controls. It will achieve substantial risk reduction by removing the contaminated materials, unlike capping, which would always be susceptible to a future release following a severe storm event, or due to a failure of maintenance over a period of centuries. The selected remedy is also cost-effective because its costs are proportional to its overall effectiveness, with overall effectiveness being determined by an evaluation of its long term effectiveness and permanence, reduction in toxicity, mobility or volume through treatment, and short-term effectiveness.

2.4.40 Comment: In its Guidance on National Consistency in Superfund Remedy Selection (U.S. EPA 1996), U.S. EPA emphasized the critical importance of maintaining appropriate national consistency in the remedy selection process. In this context, appropriate consistency means applying decision-making processes recommended in national policies and guidance using the criteria, they lay out, and exercising the built-in flexibility as appropriate to address site specific circumstances. Several aspects of the Proposed Plan fail to comply with EPA Superfund Remediation Policy, as embodied in CERCLA, the NCP and the Contaminated Sediment Guidance. These include its unprecedented requirement to remove the existing TCRA cap, the virtual 100% certainty applied to evaluation of potential capping effectiveness, the misapplication of the Principal Threat Waste Guidance, the failure to evaluate and apply extensive data required to be collected by EPA that confirms the existing cap's effectiveness, and the failure to comply with the NCP's proportionality test for cost-effectiveness evaluation.

Response: *The process used to prepare the Proposed Plan and the Record of Decision are consistent with appropriate regulation and guidance. The early action in the San Jacinto River involved placement of a cap over a hot spot in the river, which is in conformity with the number one Principal (i.e., "Control Sources Early") contained in EPA's guidance for managing contaminated sediment sites. Over the course of multiple years, the integrity of the cap, the stability of the river bed, and the potential release of the contamination raised substantial questions regarding the long-term performance of the remedy. There have been repeated repairs required for the cap and in certain instances, the underlying contaminated sediment was completely exposed to the aquatic environment. The environmental conditions are having a significant impact on the cap integrity. The selected remedy for removal is in conformity with another principal (i.e., "Achieving Long-Term Protection") contained in EPA's guidance for managing contaminated sediment sites.*

Regarding certainty, EPA does not have a requirement for a "virtual 100% certainty" to evaluate capping effectiveness; instead capping, or any remedial action, must provide long-term protectiveness. However, the current cap's history, the future exposure to repeated hurricanes, and the U.S. Corps of Engineers model results for an upgraded cap do not demonstrate that capping could provide acceptable long-term protectiveness.

2.4.41 Comment: U.S. EPA Region 6 failed to conduct an adequate cost-effectiveness evaluation. The Proposed Plan is not cost-effective as required by CERCLA, the NCP and the Sediment Guidance. CERCLA requires that any remedial action that is selected must be "cost effective." 42 USC 9621(a). The NCP states, "[e]ach remedial action selected shall be cost effective, provided that it first satisfies the threshold criteria set forth in § 300.430(f)(1)(ii)(A) and (B). Cost-effectiveness is defined as when "costs are proportional to [the remedial alternative's] overall effectiveness." 40 CFR §300.430(f)(1)(ii)(D). As U.S. EPA stated in its Superfund Guidance, "cost-effectiveness is concerned with the reasonableness of the relationship between the effectiveness afforded by each alternative and its costs compared to other available options." U.S. EPA 1999. Moreover, "if the difference in effectiveness is small but the difference in cost is very large, a proportional relationship between the alternatives does not exist." U.S. EPA 1990, Preamble to NCP. These proportionality requirements were reiterated by U.S. EPA in the Sediment Guidance. Regions must select remedies that are cost effective (p. 7-17) and should "compare and contrast the cost and benefits of various remedies." (p. 7-1). EPA has estimated the cost of the Proposed Plan to be $87 million. However, Alternative 3aN is expected to cost $24.8 million. The technical reports at the Site confirm that Alternative 3aN is likely to be as protective, and in all likelihood, more protective of human health and the environment than the Proposed Plan, which would result in substantial risks due to the inevitable resuspension and release during the unprecedented removal of the existing armored cap, as discussed above. Consequently, the incremental (and total) cost of the Proposed Plan is not only disproportionate to the risk reduction, it appears to be inversely proportional (causing more risk rather than risk reduction) for more cost, and, therefore, the Proposed Plan fails to meet the cost-effectiveness requirement of CERCLA and NCP Section 40 CFR §300.430(f)(1)(ii)(D).

Response: *During the remedy selection process, nine evaluation criteria are considered in distinct groups which play specific roles in working toward the selection of a remedy that satisfies the following five principal statutory requirements:*

1) Protect human health and the environment;
2) Comply with applicable or relevant and appropriate requirements (ARARs) unless a waiver is justified;
3) Be cost-effective;
4) Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and
5) Satisfy a preference for treatment as a principal element, or provide an explanation in the Record of Decision (ROD) why the preference was not met.

The nine evaluation criteria include two "threshold" criteria, five "balancing" criteria (including cost), and two "modifying" criteria (state and community acceptance). The alternatives are also separately evaluated against a subset of the criteria to make the determination of which option(s) satisfy statutory cost-effectiveness. A remedial alternative is cost-effective if its "costs are proportional to its overall effectiveness" (40 CFR 300.430(f)(1)(ii)(D)). Overall effectiveness of a remedial alternative is determined by evaluating the following three of the five balancing criteria:

- *long-term effectiveness and permanence;*
- *reduction in toxicity, mobility and volume (TMV) through treatment;*
- *and short-term effectiveness. Overall effectiveness is then compared to cost to determine whether the remedy is cost-effective.*

As discussed below, EPA did not merely "chose the most-expensive of the proposed remedies".

For Alternative 3aN, the net present worth for Alternative 3aN is $24.8 million based on a 7% discount rate and 30-years of operation and maintenance costs in accordance with EPA policy.

For Alternative 6N, the cost estimate has been modified somewhat in response to the public comments, namely to employ the use of a cofferdam and to perform the excavation in the "dry" so that no material release is expected during the removal. These conditions are for the cost estimate only because the actual Best Management Practices (BMPs) to be employed will be determined during the Remedial Design. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. The cost estimate was further modified to include costs for the additional excavation required (about 10,000 cubic-yards) associated with lowering the cleanup level from 200 ng/kg as presented in the Proposed Plan to 30 ng/kg. Based on the additional capital cost for a cofferdam and additional excavation volume, the net present worth for Alternative 6N is $105 million.

Although the costs for Alternative 6N are higher than those for the other alternatives, a comparison of the overall effectiveness (evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness)) to the cost of each alternative lead to the determination that Alternative 6N is more cost-effective.

Removal of waste under Alternative 6N will eliminate the potential for the costs associated with cleaning up a large contaminated sediment site that may result from a failure of a cap, and will eliminate the potential for future environmental and human health impacts should a release occur. The history of the need for repeated cap repairs, the exposure of waste materials, the riverbed erosion that occurred adjacent to the cap, all of which occurred during storms with much less intensity than the hurricanes to which the area is prone, do not support capping as a cost-effective remedy. It should be further noted that the recent occurrence of Hurricane Harvey did not impact the Site with storm surge or wind driven waves typical of hurricanes. Storm surge and hurricane wind driven waves create more extensive damage than flooding alone. This is shown by a comparison of the 2016 modelling done by the Corps of Engineers for flood *conditions similar to the 1994 flood, as opposed to the USACE modelling for both storm and hurricane conditions (equivalent to both the 1994 flood and Hurricane Ike occurring together).*

The enhanced capping of the waste may be less expensive and less disruptive in the short-term, but it also results in less protection of human health and the environment for the long-term. Cap failure due to severe or extreme storm events or a lack of sustained effective maintenance would result in the release of the dioxin contaminated waste from the site.

Given the position of the Site in the San Jacinto River, the frequent storms, and the history of repeated damage to the cap, O&M of the cap is likely to be required even beyond the normal 30-year period that is the estimate for most capped sites. The true cost of a capping remedy at this Site may be significantly larger than expected.

The Selected Remedy, removal of the waste pits, is protective of human health and the environment, complies with applicable or relevant and appropriate requirements, and provides the best balance of tradeoffs among the balancing criteria. It reduces risks within a reasonable time frame, provides for long-term reliability of the remedy, and minimizes reliance on institutional controls. It will achieve substantial risk reduction by removing the contaminated materials, unlike capping, which would always be susceptible to a future release following a severe storm event, or due to a failure of maintenance over a period of centuries. The selected remedy is also cost-effective because its costs are proportional to its overall effectiveness, with overall effectiveness being determined by an evaluation of its long term effectiveness and permanence, reduction in toxicity, mobility or volume through treatment, and short-term effectiveness.

2.4.42 Comment: In developing the Proposed Plan and communicating its results, EPA Region 6 did not comply with EPA national guidelines for transparency and failed to acknowledge scientific and engineering uncertainty in its presentation of the Proposed Plan.

Response: *EPA disagrees and has been open throughout the process of development of the Proposed Plan. The issue of uncertainty has been thoroughly discussed in the record for the Site and in the Record of Decision.*

2.4.43 Comment: A containment remedy such as Alternative 3aN would meet goals for protection of human health and the environment and compliance with Applicable or Relevant and Appropriate Requirements, while being considerably more implementable, more effective in the short-term, and more cost-effective than the proposed remedy.

Response: *The factors listed by the commenter were considered in selecting the preferred remedy and are presented in the Record of Decision. However, EPA believes that the selected remedy is protective of human health and the environment, complies with applicable or relevant and appropriate requirements, and provides the best balance of tradeoffs among the balancing criteria. It reduces risks within a reasonable time frame, provides for long-term reliability of the remedy, and minimizes reliance on institutional controls. It will achieve* *substantial risk reduction by removing the contaminated materials. and will manage the remaining risks health through institutional controls.*

Regarding the protection of human health and the environment with Alternative 3aN, the Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community and eliminate the potential for a release to the environment. The selected remedy is cost effective because it will prevent the costs associated with the Site becoming a large contaminated sediment site.

Regarding the implementability of Alternative 6N, the use of a BMP such as a cofferdam is considered to be an effective best management practice to control releases and residuals for complete removal of the waste material at the San Jacinto River Waste Pits. Cofferdams offer flexibility in construction methods and material to accommodate the local site conditions and project goals. Additionally, the cofferdam can be placed outside of the armored cap to prevent disturbance of the contaminated sediment prior to containment. Cofferdams have been constructed in similar locales for excavation and construction activities such as at the Formosa Plastics, Texas site for contaminated sediment removal, at Matagorda Bay for archeological recovery and at numerous coastal sites for construction. The Phase 1 Removal Action in Passaic River included sheetpile enclosures as a cofferdam for dioxin-contaminated sediment. Removal in the "dry" was performed to control organic chemical liquid releases in the upper 1 ½ miles of the Housatonic River site using cofferdams and by-passing the river flows. Sheet pile wall cofferdams have been used in a large sediment removal in the "dry" project in the Grand Calumet River in Indiana to control organic chemical liquid releases. Berms have been employed to form cofferdams to control resuspension at Hooker Chemical site in New York. In conclusion, the use of cofferdams is a proven technology previously implemented at multiple sites. While the final BMPs will be determined during the remedial design, EPA and USACE have demonstrated that there is at least one technology (cofferdams) that is implementable and would be effective in preventing releases from the Site during removal.

2.4.44 Comment: EPA policy is that significant Superfund sediment projects require review by the EPA headquarters National Remedy Review Board (NRRB). In its review, the NRRB (2016) posed four questions to Region 6 regarding PTW and requested that the region explain fully how the site's PTW approach was consistent with CERCLA and the NCP. Three of these four questions deal with the subject of treatment:

- CERCLA § 121(b)(1) preference for treatment to the maximum extent practicable
- CERCLA § 121(d)(1) requirements regarding selection of remedies that ensure protectiveness of human health and the environment and achieve or waive applicable or relevant and appropriate requirements
- 40 CFR § 300.430(a)(1)(iii)(A) expectation that treatment be used to address the principal threats posed by a site wherever practicable

• 40 CFR § 300.430(a)(1)(ii)(E) preference for treatment to the maximum extent practicable while protecting human health and the environment, attaining ARARs, and providing the best balance of trade-offs among the NCPs five balancing criteria.

In its response to these questions, Region 6 chose not to address the questions but to make qualitative subjective statements defending their characterization of the waste as PTW. In the context of Superfund, "treatment" is defined by CERCLA § 121 as an activity that "permanently and significantly reduces the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants." Region 6's preferred remedial alternative does not involve treatment of the putative PTW in the context of CERCLA, but merely moving it from one place to another. It will not result in a decrease in toxicity.

Response: *Treatment of sediments containing high concentrations of dioxins is challenging. Dioxins are notoriously persistent, and there are few technologies (i.e. ex situ incineration using specialized equipment) demonstrated to permanently decrease the volume, toxicity, and mobility at the same time. These technologies are very costly and involve substantial logistical concerns. As such, Alternative 6N goes furthest of any alternative evaluated to decrease mobility through removal, stabilization, and placement in a licensed, controlled facility; to limit the impacts of toxicity by reducing potential environmental exposures in the San Jacinto River bed; and to control volume by eliminating the potential for releases to other sediments in the future. As such, Alternative 6N is the most effective at achieving the goals of treatment of any of the alternatives practically available even if it does not involve treatment.*

Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during the remediation will be tested to comply with the applicable requirements. Treatment of a portion of the paper mill waste by solidification with cement was successfully performed during the Time Critical Removal Action (TCRA) on a portion of the Western Cell materials.

2.4.45 Comment: EPA uses the term "catastrophic" in the Proposed Plan (page 2) to describe possible future releases. It is recommended that this term be defined.

Response: *Noted. Catastrophic refers to an event that involves or causes a sudden great damage or suffering, or a large scale alteration of the condition of something, as in a sudden erosion of the cap and the release of toxic contaminated waste from the waste pits.*

2.4.46 Comment: EPA determined that the removal alternative (4S) is more protective in the long-term and permanent because the waste material could be potentially compromised by future extreme weather events. Removal of all waste would be potentially more protective in the long-term regardless of the contamination, the location, or the situation. However, that may go beyond what is actually required by regulation. Stating "because the dioxin waste in the northern impoundments and southern impoundment at the site is both highly toxic and potentially highly mobile (due to river flooding), it is considered a principal threat waste", EPA concludes that the Southern impoundment is subject to similar river flooding as the northern impoundment. It would be helpful for EPA to clarify if the different environments of these two areas both support waste removal.

Response: *The locations of the Site's waste materials in the San Jacinto River—partially submerged along the riverbank at the northern impoundments or on a small peninsula at the southern impoundment —, are subject to dramatic environmental changes which raise reasonable concerns about the permanence of an armored cap. The Site has a high threat of repeated storm surges and flooding from hurricanes and tropical storms, which, if the material was left in place, could result in a release of hazardous substances. The history of repeated armor cap maintenance as a result of floods that are much less severe than the design 100-year flood does not support the long term effectiveness of a containment remedy. In addition, dioxin in concentrations of more than 43,000 ng/kg is present in the northern waste pits and in concentration of more than 50,000 ng/kg in the southern impoundment. Dioxin is highly toxic and persistent in nature, and will not break down for hundreds of years under the conditions at the Site. With the regular occurrence of severe storms and flooding in the area, there is uncertainty that the waste material can be reliably contained over the long-term. Past experience and documentation have also shown that flooding travels in both the San Jacinto River channel and the Old River Channel (travels on both sides of the Southern Impoundment). Therefore, EPA considers the wastes at the Site are to be potentially highly mobile because they are located in a dynamic river environment. Due to this mobility and persistence, EPA believes that both areas support waste removal.*

2.5 Cap Characteristics

EPA received hundreds of comments from individuals, industry, industry associations, non-governmental organizations, professional organizations, and regulatory agencies voicing their concern that USEPA has not fully evaluated the ability to remove the exiting cap and that an improved cap is the most reliable method for long-term containment of the waste.

2.5.1 Comment: The US Army Corps of Engineers found that capping would be permanent and effective at containing pollutants at the northern disposal site. EPA rejected the USAGE conclusions because it is possible that (a) the cap could be damaged by a barge strike, (b) the cap could be damaged by "extreme weather events," and (c) climate change and sea-level rise is likely to make future weather events even more severe and frequent. As to EPA's first reason, the US Army Corps of Engineers found that "[a] major barge strike, which would be predicted to occur once in 400 years, would impact less than 1% of the cap area and potentially release less than 0.1% of the contaminated sediment, which is less than 25% of the releases predicted for [EPA's preferred removal remedy]." (Feasibility Study App. A at 3.) And the US Army Corps of Engineers noted that the risks of a barge strike could be all but eliminated by reinforcing and protecting the cap. See id. at 60-69. EPA did not provide a reasoned basis for rejecting the US Army Corps of Engineers findings, given that (1) major barge strikes happen once every 400 years, (2) even a major barge strike would affect less than 1% of the cap, (3) the toxins released by even a major barge strike would pale in comparison to the toxins released by EPA's chosen dredging remedy, and (4) capping (even when reinforced to all but eliminate the risks of barge strikes) is dramatically cheaper than EPA's preferred removal remedy.

Response: *EPA utilized the U.S. Corps of Engineers' results, among other factors, to develop the selected remedy for the Site. To clarify the Corps of Engineers' conclusions, the Corp's report, on page 2, under "Permanence of Capping" states; "The evaluations performed to address the permanence of the existing repaired TCRA cap with the proposed modifications outlined in the capping Alternative 3N showed that the cap is expected to be generally resistant to erosion except for very extreme hydrologic events, which could erode a sizable portion of the cap." The Corps model simulations of a severe storm also found that "Approximately 80 percent (12.5 acres) of the 15.7 acre TCRA cap incurred severe erosion during the simulated extreme (hypothetical) storm. The maximum scour depth in any grid cell within the cap boundary during this hypothetical extreme event was 2.4 ft (0.73 m). Replacement of the armor materials with a median size of at least D50 = 12 inches would be needed to greatly reduce the amount of scour that occurs during such an extreme event."*

The Corps of Engineers also performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the cap during this extreme storm event. Based on the observed barge activity in the area of the waste times and a barge facility located just north of the waste pits, EPA believes that barge strikes would occur more often than once every 400 years.

2.5.2 Comment: EPA's reasons for rejecting the capping remedy are untenable. EPA found that, "based on the Corps of Engineers review (Appendix A of the Feasibility Study), a severe future storm could result in significant erosion of 80% of the armor cap and up to 2.4 feet of scour into the waste pits." (Proposed Plan page 32.) But that finding is based on the US Army Corps of Engineers review of only one of the capping alternatives (namely, alternative 3N). The US Army Corps of Engineers specifically recommended additional changes to the capping remedy (such as alternative 3aN) that would not suffer 80% erosion or 2.4 feet of scour in even the most severe and anomalous weather events. EPA's only response is to speculate that it is theoretically conceivable that there are still more severe weather events that no one could foresee, that the US Army Corps of Engineers did not model, and that could theoretically damage even the enhanced and armored cap. EPA does not even attempt to explain, quantify, or justify that speculation. If it were true that EPA could reject any remedy where there is any risk in it— however infinitesimally small, however ill-defined, and however speculative—then EPA could reject any remedy it wanted.

Response: *The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The upgraded cap was simulated using the same severe storm conditions as were used to model the Alternative 3N cap. The results of the modeling showed that erosion of the Alternative 3aN cap would likely occur over most of the cap during this storm event. The amount (or depth) of net erosion was not determined because sediment transport modeling was not performed.*

EPA disagrees that the reasons for rejecting an upgraded cap are untenable. The primary upgrades for the cap under Alternative 3aN were to add barriers to prevent barge strikes along with an additional 24 inches of armor stone over the armor cap recommended for Alternative 3N. In addition to the recent model studies, several reasons are stated in the Feasibility Study for concern regarding the adequacy of containment alternatives. The additional armoring for 3aN does not reliably address the issue regarding stream bed stability. Furthermore, the Feasibility Study indicates that the additional weight of the armor stone may push waste out of the sides of the cap. This would cause uncontrolled releases of contaminants.

Even though Alternative 3aN consists of an upgraded cap, it is still subject to the uncertainties of severe floods, a dynamic river, and adequate maintenance over the centuries that the waste will remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

2.5.3 Comment: The preferred remedial alternatives for the northern impoundments (alternative 6N) and the southern impoundment (alternative 4S) involve dewatering of the sediment and soil column. The Proposed Plan did not provide information on wastewater management. The TCEQ requests preliminary wastewater management information such as the contaminants of concern (COCs) to be monitored, threshold COC concentrations in the wastewater prior to disposal, and the method and location of the wastewater disposal. Even though details are expected during the remedial design phase, the TCEQ would like preliminary wastewater management information prior to issuance of the record of decision (ROD).

Typically, total suspended solids (TSS) concentrations in the decant water from dredging activities must not exceed 300 mg/L. In addition, if the decant water is diverted back to the river, the COC concentrations in the water must be protective of TSWQS. The diverted water must be treated, if necessary.

Response: *The selected remedy must comply with Applicable or Relevant and Appropriate Requirements (ARARs). Best Management Practices (BMPs) will be incorporated into the Remedial Design as necessary to support water quality and attainable use standards for this section of the San Jacinto River. On-site water discharges will comply with the substantive technical requirements of the Clean Water Act, but do not require a permit. EPA will work with TCEQ during remedial design to determine the substantive requirements for the Clean Water Act. During a pre-design phase, it is anticipated that collection of samples from the target material would be obtained and analyses such as porewater concentrations would be performed to identify the concentrations of the COCs, which were identified in the risk assessment conducted at the Site, in the untreated discharge wastewater and that based on those results an adequate water treatment system would be designed.*

2.5.4 Comment: Based on the excavation volumes and the number of truck trips projected for remedial alternative 6N, it appears that the EPA is considering the use of 12-cubic yard trucks for the transportation of waste material. The TCEQ suggests the use of larger trucks, if feasible, to reduce the number of truck trips. The TCEQ also suggests that truck routes be determined prior to issuance of the ROD, to identify the neighborhoods impacted by the removal actions, if any.

Response: *The use of larger vehicles may be feasible considering that access to I-10 is only about 1½ miles from the site via the East Freeway Service Road, which is primarily used for non-residential, commercial/industrial traffic and trucking. Transportation of the removed material will be determined as a part of the Remedial Design. The design will consider equipment availability, decontamination requirements, road conditions, traffic near the site, access and staging requirements, and other factors. If transport is performed by trucks, some road improvements and repair may need to be considered in the Remedial Design. The design will evaluate truck routes in an effort to minimize impacts on the local communities. During the design phase, the location of treatment facilities (if necessary) and disposal facilities will be reviewed and selected along with acceptable truck routes. Such transportation details are normally addressed during the Remedial Design.*

2.5.5 Comment: For the preferred remedial alternatives 6N and 4S, the EPA did not specify the location for staging and possible stabilization for the excavated sediment and soil prior to their final disposal. Please provide this preliminary information along with the final disposal facility name and location prior to issuance of the ROD.

Response: *The items requested are normally established during the design phase. Materials disposed in a landfill must pass the paint filter test. Mechanically excavated sediments often pass the paint filter test without adding stabilizing agents; however, if stabilizing agents are needed, they may be added in a staging area at the site for a separate off-site staging area.*

The waste materials and stabilizing agents can be mixed as they are loaded onto trucks for transport to a disposal facility. Identification of staging areas and final disposal sites will be performed during the Remedial Design.

As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. This approach will modify the sediment treatment and handling requirements compared to dredging prior to disposal. A thorough assessment of handling, treating, storing, and transporting will be performed during the design phase.

2.5.6 Comment: Under remedial Alternative 6N, it is not clear if the excavated areas would be backfilled prior to placement of the residual management layer of clean cover; we request clarification. The USAGE report specified three methods of backfill placement – dump placement, rain placement, and best practice placement. We request information on the placement method selected by the EPA and the rationale for the selection, prior to issuance of the ROD.

Response: *The cleanup level for the waste pits area is 30 ng/kg for dioxins. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. It is not anticipated that a backfill or cover layer will be required as was the case with the former 200 ng/kg remedial goal because all of the waste will be removed.*

2.5.7 Comment: Estimated construction time for remedial Alternative 6N is 19 months. That appears to be a radical under-estimate of the true construction time. And if EPA has underestimated the construction time of Alternative 6N, it will make that remedy even less cost-effective than it otherwise appears. The TCEQ requests the EPA explain how this construction time is estimated.

- Does the construction period include the time required for best management practice (BMPs) installations prior to the commencement of work?
- Is the construction expected to occur on a 7-days per week schedule or a 5-day per week?
- How many work shifts are estimated and what are the durations of shifts?
- Were allowances made for stoppage of work during hurricane season, storms, etc.? If so, what are the allowances?

Response: *The construction time estimate for the Alternative 6N presented in the Proposed Plan and the Feasibility Study was 19 months. However, with the evaluation of a BMP such as excavation in the "dry" behind a cofferdam, the construction times have increased based on input from the U.S. Corps of Engineers. Further, the construction time estimate will be reviewed during the design phase and updated as appropriate as the more detailed design is developed. The construction time for the selected remedy is currently 27 months. The total time required for construction is equal to the time required to install the cofferdam (19.3 months), to complete removal activities (4.3 months), and to dismantle the cofferdam (3.3 months), assuming 10-hour work days and 6-day work weeks.*

There are many project case histories which demonstrate that the former 19-month schedule is within reason. One example is the Sheboygan Harbor Sediment Dredging project. This project occurred in upstate Wisconsin. Dredging of 170,000 cubic yards of PCB contaminated sediment was completed in 8 months. The construction season in upper Wisconsin is drastically affected by cold weather. Clearly a construction schedule of 19 months falls within the realm of reason. But as with any construction project there are always conditions that are not anticipated, which require schedule adjustments. A second example is provided by Ashtabula Sediment Removal. Construction funding for the project was received in December 2005. In late May 2006, the construction of the onsite landfill including water treatment system for sediment dewatering in geotubes was completed. The final dredge plan was approved in June 2006. Dredging commenced in September 2006. At the end of October 2007, 413,530 cubic yards of PCB contaminated sediment had been successfully removed from the river. A third example is the Passaic River Phase I Removal, which was completed in 18 months, involving mechanical dredging of approximately 40,000 cubic yards of dioxin contaminated sediment and debris inside a sheet pile wall enclosure with sealed joints, structural reinforcement of an adjacent bulkhead, hydraulic conveyance of dredged material slurry within 1,400 feet of pipeline to a constructed water treatment and sediment processing facility, and transportation/off-site disposal of processed dredged material. Work occurred between July 2011 and January 2013.

These above-mentioned case studies demonstrate the appropriateness of a 19-month schedule for purposes of the Feasibility Study at this Site. Actual work schedules are established by the contractor and typically are set at 6 days per week and 10 hours per day. The contractor also will account for repairs and downtime for weather related issues in the overall construction schedule.

2.5.8 Comment: Under Primary Balancing Criteria on Page 34, excavation volume for alternative 6N was listed as 200,100 cubic yards. It appears that it is a typographical error and it should be 162,000 cubic yards.

Response: *Typo noted; the quantities will be clarified in the Record of Decision. The excavation volume for the selected remedy 6N is 162,000 cubic yards reflecting a reduction of the cleanup level to 30 ng/kg.*

2.5.9 Comment: Estimated costs for remedial alternative 3N and 3aN should include present worth cost for repairing cap erosion from weather events expected during the life of the armored cap (the US Army Corps of Engineers report). Evaluation of the San Jacinto Waste Pits Feasibility Study Remediation Alternatives dated August 2016 modeled a potential for an 80% erosional loss during a major storm). Multiple erosional events are possible over centuries so major repairs should be accounted for in the proposed costs associated with these alternatives. Present worth costs for repairing damages to the armored cap due to all projected events are necessary to ensure that adequate funds are available for the life of the armored cap.

Response: *As detailed in the Record of Decision, the cost estimates for the containment alternatives, including Alternatives 3N and 3aN as well as the others, incorporate a cap maintenance cost of $100,000 per year for the first two years. However, the EPA agrees that additional cap maintenance costs are appropriate to provide for the costs associated with cap repairs, exposed waste, and repairs of riverbed erosion as has been experienced in the 6 years following completion of the cap, and also to provide for future repairs that may be necessary following hurricanes. Additional cap maintenance costs would have been appropriate had any of these other alternatives been selected.*

2.5.10 Comment: Under remedial alternative 4N, the EPA proposed construction of an upgraded armored cap, as described in alternative 3N, over solidified and stabilized waste material. To ensure better containment of waste material, EPA should consider construction of an enhanced armored cap per remedial alternative 3aN, in accordance with the US Army Corps of Engineers recommendations. This change would reflect a change in cost from 3N to 3aN.

Response: *There are a number of environmental conditions that affect the long-term permanence of a cap in the San Jacinto area. Even with the Alternative 3aN design, the principal threat waste and the potential for release of dioxin containing waste is not eliminated as with Alternative 6N. However, an enhanced armor cap in accordance with Alternative 3aN would have been appropriate had Alternative 4N had been selected.*

2.5.11 Comment: Under remedial alternative 5N, the EPA proposed construction of an upgraded armored cap, as described in alternative 3N, over the excavated area. To ensure better containment of waste material, please consider construction of an enhanced armored cap per remedial alternative 3aN in accordance with the US Army Corps of Engineers recommendation. Also, please revise the costs to reflect this change from 3N to 3aN.

Response: *There are a number of environmental conditions that affect the long-term permanence of a cap in the San Jacinto area. Even with the Alternative 3aN design, the principal threat waste and the potential for release of dioxin containing waste is not eliminated as with Alternative 6N. However, an enhanced armor cap in accordance with Alternative 3aN would have been appropriate had Alternative 5N had been selected.*

2.5.12 Comment: Under remedial alternative 5aN, following the removal of waste material, the EPA proposed covering the waste material removal area with a residuals management layer of clean cover. It is not clear if the excavations would be backfilled prior to placement of the residuals management layer; please clarify.

Response: *Under Alternative 5aN the removed material would not be backfilled and only a residuals management layer would be used to cover the dredge residuals. This will be clarified in the Record of Decision.*

2.5.13 Comment: The Proposed Plan does not provide specific plans for transportation of the dioxin waste, disposal of the dioxin waste at an authorized waste disposal facility, or preventing and responding to the release of the dioxin waste into the environment during transit to the dewatering and stockpile staging area. According to the feasibility study, the sludge and sediment at the Site do not contain a listed hazardous waste and do not meet the characteristics of hazardous waste. It is recommended the EPA perform a thorough hazardous waste determination and classification, including a listed waste review, to ensure the dioxin waste is disposed of per the Resource Conservation and Recovery Act (RCRA), if applicable, and/or the Texas Solid Waste Disposal Act (TSWDA). Furthermore, it is recommended a waste management plan be developed that utilizes Best Management Practices (BMPs) for waste transport. Harris County requests that the following BMPs be included in the waste management plan: enclosed transportation vehicles to prevent leaks or loss of material; maintaining a contract with an entity capable of cleaning up and properly disposing of the dioxin waste in the event that a spill/release occurs; and an EPA approved formal contingency plan should a release occur during transit to the approved disposal facility.

Response: *Site remediation is required to meet applicable or relevant and appropriate requirements, thus waste and sediment testing and disposal will meet the applicable State and Federal regulatory standards required by State and Federal regulations. The requests listed in the comments are standard components of a Superfund sediment remediation design and work plans. The spill plan includes a notification and response plan for any transport spills as well as contingencies to address spills, leaks and accidents. Transport vehicles will be lined, covered, or sealed to prevent losses during transport.*

2.5.14 Comment: The Proposed Plan does not address the prevention and management of potential releases during the dewatering of the dioxin waste in the processing areas. The processing areas should meet the location standards required by State and Federal regulations. In order to prevent releases of dioxin waste to the environment, the dewatering area should be completely enclosed. Harris County requests that a formal contingency plan be prepared in case of a major storm event. Furthermore, a spill prevention and control plan should be in place that requires secondary containment, and that the processing area be designed to contain and prevent spills from leaving the Site. In order to prevent nuisance conditions to nearby receptors, the staging area should be isolated from residential properties and odor/dust control measures should be taken. Contaminated water or other wastes generated during the treatment process should be minimized and disposed of at an authorized facility.

Response: *Site remediation must meet applicable or relevant and appropriate requirements, thus, the processing areas must meet applicable State and Federal regulatory standards required by State and Federal regulations. Contingency/spill/dust/decontamination/air monitoring plans will be prepared for the implementation work plan during the Remedial Design or will be developed as part of contractor plans in accordance with design specifications. Appropriate secondary containment would be required to capture contaminated water for treatment, and contaminated materials for disposal at an authorized facility. These practices are standard for remediation of Superfund sites. EPA acknowledges the comment from Harris County and recognizes the concern for Harris County residents and nearby citizens. These concerns will be taken into consideration throughout the remedial design. There are a number of options which can be implemented to contain and control the excavated material including the use of passive and active technologies. Odor and dust are an issue that is of concern at all excavation sites. As mentioned above the design documents will be available for review prior to accepting a final design.*

2.5.15 Comment: Harris County endorses EPA's Proposed Plan to develop a comprehensive erosion and dust mitigation strategy prior to mobilization including temporary cover(s) within the exposed waste pit area(s) during the excavation process. We encourage the EPA to develop a sustainable execution plan that incorporates use of these temporary cover materials into the permanent cover and fill for the Site.

Response: *There are a number of techniques that are used to minimize erosion and control fugitive dust emissions from contaminated sites. These techniques along with other best management practices will be fully explored, assessed, and included in the design plans as necessary. The work plan developed for implementing the remedy will include provisions for containing and controlling losses from excavated waste material. EPA acknowledges Harris County's comment regarding sustainable elements and its request to include those elements into the remedial design when possible.*

2.5.16 Comment: Although Harris County agrees with the "dry" excavation approach, we recommend that the EPA investigate the use of single mobilization/demobilization including installation of the sheet pile cofferdam around the entire excavation footprint. The work within the cofferdam could be performed in multiple stages to reduce risk of erosion of contaminated sediment in the event a flood occurred during remediation. However, we do not see a need to perform mobilization and sheet pile installation in multiple stages, which would increase costs.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that*

EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. Best Management Practices, which may include sheet piles, cofferdam, excavation in the "dry", and/or other measures, as determined during the Remedial Design, will be used around all areas to be removed to reduce and control resuspension of the waste material.

2.5.17 Comment: Harris County agrees with the EPA that onsite passive/active dewatering of the excavated waste material would decrease subsequent costs of transportation and disposal by decreasing the mass of material as well as decrease risk(s) of spills during transportation to an off-site disposal facility. Unless mandated by the designated disposal facility, on-site stabilization by the addition of Portland Cement or another bulking agent would increase the mass of material to be transported and disposed of in an off-site landfill. Harris County recommends dewatered sediment that meets a designated dryness threshold (e.g. pass paint filter test and no free liquid in transport vehicles) be sealed in "burrito bags" and safely transported by truck and/or rail to an appropriate disposal facility.

Response: *Materials disposed in a landfill are required to pass the paint filter test. Mechanically excavated sediments may pass the paint filter test without adding stabilizing agents but these organic sludges are not typical of sediments and may require a mechanical dewatering process. If stabilizing agents are needed, they may be added in a staging area within the site without the need of a separate off-site staging area. Similarly, the waste materials and contaminated sediment could be stockpiled within the site to permit the free drainage of water from the materials to satisfy the dewatering requirements. Use of "burrito bags" (liner for containing waste materials during transportation) is also an option. Off-site processing using belt filter presses or other mechanical means is also an option for dewatering excavated materials. Methods and materials for dewatering will be developed during the Remedial Design. All water generated from the excavated sediment would be collected, treated, and disposed of according to approved methods. The waste materials and stabilizing agents can be mixed as they are loaded onto trucks for transport to disposal. Information on off-site staging areas and final disposal sites are not available at this time. Identification of staging areas and final disposal sites is performed during the Remedial Design. EPA acknowledges Harris County's comment and will consider the approach during design development and preparation of the transportation plan.*

2.5.18 Comment: Harris County requests that the EPA require the Potentially Responsible Parties to undergo third-party oversight as part of any final remedy for the Dioxin Pits.

Response: *EPA plans to provide an oversight contractor during construction activities. In addition, EPA personnel along with other state and local agencies will likely be reviewing ongoing activities throughout construction.*

2.5.19 Comment: What measures will be taken to armor the active excavation against flooding?

Response: *As described in the Feasibility Study, the Remedial Design will include elements to prevent the flooding. The exact elevation for sheet pile installation, or other cofferdam approach, will be determined during the design phase.*

The Feasibility Study states "Containment structures to reduce resuspension would consist of berms and sheet pile walls or caissons to an elevation of about +10 NAVD88 (protection from 25-year or 50-year flood stage).

2.5.20 Comment: I'm concerned about digging it up and the trucking of the waste to another location. I'm wondering if there's not more risk moving it due to wrecks while transporting it. What's going to happen if it floods while the construction is occurring?

Response: *A health and safety plan will be prepared during the Remedial Design for the site to deal with any contamination during excavation, transportation, and dumping of the waste. An extensive experience base has been developed from contaminated sediment sites throughout the United States and provides examples of many successful operations. The potential spills of the wastes and contaminated sediments do not pose substantial short-term risks. The materials are not ignitable/flammable, corrosive, reactive or toxic as characteristic of hazardous materials. Risks are based from the long-term dermal exposure or ingestion of the contaminants. The Remedial Design will develop contingency plans to prevent long-term exposure and spill control plans, including those resulting from vehicle accidents. The wastes would be transported in sealed and covered trucks.*

2.5.21 Comment: In 2011 the temporary cap was placed over the waste area. It was my understanding that it's holding much better than what I've heard tonight; and knowing that a permanent cap would only reinforce what is there, why would we open ourselves and more people up to the damage this waste could cause if it is disturbed?

Response: *The long-term effectiveness of this alternative depends upon the continued integrity of the armored cap and well as the river dynamics including subsidence and geomorphological changes. The dioxin within the waste pits was generally isolated from potential receptors by the temporary cap, but the temporary cap has required many repairs and extensive maintenance. Examples include, in December 2015, an area of missing rock that was found by the EPA Dive Team. This area was not identified by the regular inspections that had been done since the temporary cap construction was completed. Dioxin at 43,000 ng/kg was under water, thus exposing the environment and potential receptors to the dioxin. Repairs to this area were completed in early 2016. Other instances of thin or absent rock cover were identified in 2012, 2013, and in 2016. No flood since the cap was constructed in 2011 has exceeded a 100-*

year return period design flood. As indicated in section 4.3.3a the Feasibility Study, there is a high degree of uncertainty regarding the long-term permanence of the cap even with the improvements (Alternative 3aN) for an enhanced cap.

The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. Alternative 6N provides a more certain outcome than Alternative 3aN with lower overall potential for release.

2.5.22 Comment: I'd also like to know more about how you're going to contain it when a hurricane comes through when you've got it dug up for us further down the road?

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

The remedial design phase will include provisions to address potential problems associated with storm events. There are remedial approaches that could include the use of temporary cover with a geomembrane or geotextile as well as geotubes for temporary containment prior to disposal. Various approaches will be considered to address the problems and risks associated with dredged material in various stages of transportation, treatment, and storage.

2.5.23 Comment: Our office is aware of some of the concerns with dredging. We are also aware that the EPA will put in place controls that will limit possible spreading of contaminated soil during the cleanup and follow best management practices recommended by the Army Corps of Engineers, including doing the cleanup in stages to limit exposure from potential storms.

Response: *EPA recognizes the importance of protecting the general public from all risks associated with the cleanup of the contamination at the San Jacinto River Superfund Site. Necessary precautions will be used to minimize potential exposure of the local residents to site contaminants during remedy implementation.*

As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.

2.5.24 Comment: We request that the third party oversight personnel report directly to and work directly with the EPA and not the PRPs. In the past 12 months, the EPA has held the PRPs to higher standards and this could not have come soon enough for those who live and work near the Pits. Additionally, the EPA took over the completion of the Remedial Investigation/Feasibility Study after multiple attempts by the PRP's consultants. We cannot stress enough the importance of EPA to continue to hold the PRPs to the highest standards to ensure the process continues moving forward with compliance and objective quality assurance.

Response: *EPA will manage the oversight of the remedy design, implementation, and monitoring. The TCEQ and the Corps of Engineers may assist EPA in these activities.*

2.5.25 Comment: We ask that the EPA produce an on-site safety plan and consider a decontamination zone for equipment and vehicles leaving the Site. It has been reported to the Coalition that equipment used on Site to-date has not undergone decontamination before it is returned to the rental company. That would not only potentially transport contaminated material off-site, but it would also potentially expose those who then clean the equipment without proper personal protective equipment (PPE). Additionally, we ask the EPA to ensure that on-site workers are wearing appropriate PPE. The health of nearby off-site workers should also be considered.

Response: *A site safety plan will be prepared as part of the remedial design process. This plan will include provisions for controlling the spread of contaminated sediment from the site. Typically, the site should have tire wash basins for trucks leaving the site. Also, if rental equipment is used, a process will be implemented to ensure the appropriate steps are taken to decontaminate rented equipment before returning to the vendor. EPA will include appropriate measures in the remedy design to address these important factors.*

2.5.26 Comment: The Coalition is confident in the EPA's proposal for removal of the San Jacinto River Waste Pits, however, we acknowledge that there are risks associated with removal. Such risks are more predictable than risks associated with all other remedial alternatives but we encourage the EPA to take every possible measure to mitigate risks and ensure Best Management Practices (BMP) are employed. The Proposed Plan states that BMPs will be used but it does not explain what the BMPs are. The US Army Corps of Engineers Evaluation of the San Jacinto

Waste Pits Feasibility Study Remediation Alternatives offers BMPs to minimize potential loss that could occur during remediation. We want to stress the importance of using BMPs to safeguard the environment, the health of community members and site/nearby workers, as well as Galveston Bay.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

2.5.27 Comment: The Proposed Plan states the estimated construction time for Alternative 6N is 19 months and 7 months for Alternative 4S. We ask that you time the start of construction with careful consideration. Community members have suggested starting the early stages (building berms, etc) during hurricane season so once we are cleared from that hurricane season, dewatering of the site, removal of the TCRA and excavation of the waste material can begin.

Response: *The scheduling of activities will be developed in the work plan after the Remedial Design is completed. The site will remain covered with the armored cap until the appropriate BMPs is implemented, maintaining the current level of protection at the site. As indicated in other comment responses, incremental or phased removal would occur to control the amount of open excavation area exposing waste materials. The work plan will consider typical river flows, water stages, storm seasons, construction steps, durations and logistics as well as other factors to optimize the production and project performance. The design will include provisions and steps for implementation to minimize releases resulting from flood conditions.*

2.5.28 Comment: We support the plan for the waste to be transported to a permanent permitted facility but we encourage all options to be identified during the design phase.

Response: *Comment noted.*

2.5.29 Comment: It should be known that we do not support incineration. We do not want this to be a "not in my backyard" issue.

Response: *Comment noted. Incineration is not a technology currently under consideration for waste treatment. The dredged material will be sent to an appropriate permitted landfill.*

2.5.30 Comment: The temporary cap was designed to withstand a 100-year flood event, which we have not experienced in recent years. Yet the cap has undergone several repairs and has failed to meet design expectations during the 5 years it has been in place. Most concerning was the 25 x 22ft deficiency in the temporary cap discovered in December of 2015, which validates concerns that the cap is insufficient in the long-term. These concerns are strengthened by the uncertainty of how the deficiency was created or when. Sediment samples grabbed near the deficiency referenced above confirmed upwards of 43,000 ppt of dioxin openly exposed in the River, further supporting the concern that containment is not a solution.

Response: *Comment noted. EPA shares this concern about the long-term effectiveness of the temporary cap currently covering the contaminated sediment. In section 4.3.3a of the Feasibility Study, EPA also expresses concern about the stability and integrity of the cap even with upgrades adding more cap armoring.*

2.5.31 Comment: In the immediate vicinity of the San Jacinto River Waste Pits are four large shipyards and barge facilities. Tug boats, barges and privately owned boats navigate past the site on a regular basis. Any given day residents can count upwards of 70 barges in the immediate vicinity of the Pits. The U.S. Army Corps of Engineers (USACE) estimates there is about a 1 in 100 probability of a significant strike and about a 1 in 12 probability of a minor strike within a given year. Due to heavy barge traffic in close proximity to the Waste Pits, we feel that the probability of a strike is greater than the USACE Report estimates. Furthermore, the USACE estimations are based on national averages and not actual local data.

Response: *Comment noted. The US Army Corps of Engineers has included many assumptions for a variety of assessments in the report. Barge strikes are only one of the concerns regarding the long-term success of a permanent cap, which has not been selected as the final remedy for the Site. The barge traffic will be taken into account during as the remedial design is prepared.*

2.5.32 Comment: Interstate 10, a major federal highway, straddles the SJRWP site between the northern and the southern impoundments. The vulnerability for barge strikes in this area is further confirmed by the 5 dolphin bridge protection structures directly across the river channel from the northern impoundment. The structures were constructed in 2006 by the Texas Department of Transportation to protect the Interstate 10 bridge from a barge strike. At some point in the future. Interstate 10 will be need significant maintenance work or will need to be expanded.

Response: *Comment noted. Removal of the waste materials per Alternative 6N will avoid conflicts that may otherwise occur for capped areas compared to the footprint of future infrastructure expansion.*

2.5.33 Comment: How are the objectives met when the sediments will be disturbed during full removal? Objectives include prevent releases of dioxins from the former impoundments; reduce human exposure to dioxins from consumption of fish; reduce human exposure to dioxins from contact with contaminated materials; and reduce exposures of benthic macroinvertebrates (clams, crabs, etc.) to dioxin. In all candor, the proposed plan fails to clearly demonstrate how any of these objectives will be met.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

EPA shares the commenters' concerns about providing for a remedy that addresses risks to the health and wellbeing of everyone who lives near the site, and the remedial design of the selected alternative will address these concerns. To reduce human exposure to dioxins from consumption of fish; reduce human exposure to dioxins from contact with contaminated materials; and reduce exposures of benthic macroinvertebrates (clams, crabs, etc.) to dioxin, the selected alternative is the most protective by removing the waste material. There are no preliminary remediation goals for fish tissue because the required sediment cleanup measures at the Site will reduce contaminant concentrations in tissue, but these concentrations will continue to be affected by factors outside the scope of the Superfund cleanup, including upstream and downstream PCB and dioxin inputs from other sources. Measuring trends against target tissue concentrations is useful for assessing risk reduction and for risk communication, but tissue preliminary remediation goals are not required to evaluate these trends. The continued containment of the waste beneath an enhanced cap will not remove the threat of a potential release to the environment.

2.5.34 Comment: What will be the final disposition (waste disposal) of the removed material?

Response: *The removed material will be transported to and disposed of at an approved permitted disposal facility. The disposal facility will be determined during the Remedial Design.*

2.5.35 Comment: How will transportation of the removed material to the disposal facility be managed?

Response: *Excavated waste material would be gravity dewatered and stabilized by the addition of Portland Cement or other additive at the Site or offloading location, as necessary, to eliminate free liquids during transportation. Treatability studies will be conducted during the Remedial Design to determine the appropriate type and amount of stabilization amendments to treat the waste materials and meet the disposal standards of the receiving facility. The agents for stabilization may include fly ash, cement, soil, or other materials. The material removed during* *the remediation will be tested to comply with the applicable requirements. Treatment of a portion of the paper mill waste by solidification with cement was successfully performed during the Time Critical Removal Action (TCRA) on a portion of the Western Cell materials. Alternatively, the remedial design may determine that mechanical dewatering approaches such as filter presses are appropriate for dewatering and waste volume reduction. Approximately 13,300 truck trips (northern impoundment) may be required to transport the waste material under the scenario of gravity dewatering and stabilization with Portland Cement. Several factors, such as weight capacity of the road, size of the truck, most direct route, and potential alternative means of transportation will be evaluated and determined during the Remedial Design.*

2.5.36 Comment: Are there any in-place or on-site treatment options?

Response: *Yes. Several treatment technologies, including thermal (in-pile thermal desorption) and chemical (solvated electron technology and base catalyzed decomposition) processes, were also considered for use at the Site but were not included as a remedial alternative, as discussed further in the Feasibility Study. The Feasibility Study contains a detailed analysis of each alternative against the criteria and a comparative analysis of how the alternatives compare to each other.*

2.5.37 Comment: Who will repair, maintain, and pay for this work through the life of the cap?

Response: *CERCLA provides an enforcement mechanism to require potentially responsible parties to fund all response actions at the Site including all maintenance and repairs to the cap.*

2.5.38 Comment: Why remove the material from the north pits but not the south pits?

Response: *The area south of I-10 will be excavated as indicated on Page 31 of the Proposed Plan. It is estimated that approximately 50,000 cubic yards of material will be removed as part of Alternative 4S.*

2.5.39 Comment: The EA Memorandum states 76% of the material is assumed to be removed in the "dry" and in other locations assumes that 100% of the material will be removed in the "dry".

Response: *The selected remedy will remove 100% percent of the waste above the cleanup level of 30 ng/kg in the northern impoundment.*

2.5.40 Comment: As part of the Operation, Maintenance, and Monitoring (OMM) Plan, cap maintenance has been performed in small discrete areas of the armored cap as contemplated by the OMM Plan, and supplemental security measures have been implemented.

Response: *The area discovered by EPA in 2015 revealed the rock cap was not present over the waste material in an area measuring approximately 400 square feet. The lack of the* *rock cap exposed dioxin material containing dioxin concentrations over 40,000 nanogram/kilogram (ng/kg), which is many times higher than the risk based sediment protective level of 30 ng/kg. This area was not underlain by geotextile material and rock was found to have sunk several feet or more into the waste material. This occurrence points to the need to carefully consider the load bearing capacity of the waste, especially with the potential addition of weight from the addition of several feet of larger armor stone over much of the cap, as envisioned for the upgraded cap in Alternative 3aN.*

Bulk sediment sampling downslope from the exposed area did not find any indications of a gross release of paper mill wastes; however, EPA must make clear that this area was underwater and no data is available to evaluate how much dioxin was transported away from the site by the flow of the river during the unknown amount of time the waste was exposed due to the failed area of the cap.

2.5.41 Comment: Region 6 discounts the significant releases that the US Army Corps of Engineers concludes (and Region 6 acknowledges) will result from Alternative 6N.

Response: *The release of waste during removal was not discounted in the evaluation and selection of Alternative 6N. In fact, a range of best management practices were considered and evaluated to reduce releases to a minimum during implementation of Alternative 6N. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

2.5.42 Comment: The August 2016 Corps of Engineers report concluded that excavation of the waste material will necessarily result in significant releases of dioxin in the San Jacinto River, even with the use of enhanced BMPs.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering* *assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

2.5.43 Comment: Alternative 3aN features will enhance its long-term protectiveness and reduced the need for future maintenance.

Response: *There are concerns regarding the long-term performance of the cap even with the additional armoring specified in Alternative 3aN. While the additional capping features will help improve the effectiveness of the cap, a cap does not adequately and reliably contain the waste for the long term. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

2.5.44 Comment: The Proposed Plan minimizes the implementability challenges associated with its preferred alternative.

Response: *The Proposed Plan provides a summary of the challenges associated with the preferred alternative. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. The use of cofferdams is a proven technology previously implemented at multiple sites. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. While the final BMPs will be determined during the remedial design, EPA and USACE have demonstrated that there is at least one technology (cofferdams) that is implementable and would be effective in preventing releases from the Site during removal. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

2.5.45 Comment: Does EPA have any plans to resample the Sand Separation Area prior to fleshing out the details of the corrective action plans? This is based on the damage to the vegetated east bank of the river and eroded significant portions of Short and Long Islands during the May and June 2016 floods.

Response: *Yes, the Sand Separation area will be resampled during the Remedial Design. A standard practice includes collection of samples in the design phase to address various design elements and determine the limits of the impacted area. The capped area and areas immediately adjacent to the capped area will be reviewed to determine any necessary sample collection to fill data gaps as necessary to complete the design.*

2.5.46 Comment: In the event that restrictive covenants are placed on the Sand Separation Area and other areas with a preliminary remediation goal of 30 ng/kg, would these "restrictive covenants" be administered equally to all barge fleeters and operators?

Response: *Yes. The restrictive covenants would apply to all users that may impact the area.*

2.5.47 Comment: We would like to see a more aggressive approach to addressing the Sand Separation Area that will allow this area to have unrestricted use of the area, except as imposed by other regulating entities. Combine with 2.3.50

Response: *Comment noted. However, the selected remedy includes monitoring for this area for the reasons outlined in the Record of Decision including lower concentration levels and concerns about sediment residuals and resuspension during removal.*

2.5.48 Comment: Please clarify the inconsistencies concerning the protective berms being left in place after construction. Page 28-29 of the Proposed Plan indicates; "in place after construction to provide a barrier, limiting barge and boat traffic over the site". The closing statement of Alternative 6N indicates; "The current temporary cap has had no impact on navigation, and this alternative is not expected to be different".

Response: *The final remedy will not have an impact on navigation, although there may be short-term impacts on navigation during construction. EPA has clarified this issue in the Record of Decision. The BMPs can be designed to not impact navigation.*

2.5.49 Comment: Is there going to be a "safe zone" around the Site to restrict barge and boat traffic in the vicinity of the protective berms during post closure care?

Response: *Barge and boat traffic routes around the Site will be evaluated during the Remedial Design phase and will be coordinated with the proper regulatory agencies. Based on the conceptual design of the selected remedy, the existence of long-term protective berms is not anticipated. Aids to navigation maybe required during construction and will be developed as necessary during the design phase.*

2.5.50 Comment: How far from the berm will the armor extend and how will it affect barge and boat traffic?

Response: *Not all of the armor cap will be removed because the underlying material is already below the remediation goals. These areas are well outside of the river channel and barge routes.*

2.5.51 Comment: How will the berm armoring be structured to remain stable under extreme storm events in light of the fact the current cap has not been able to do so?

Response: *The comment addresses an alternative that is not being considered for implementation. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

2.5.52 Comment: We operate only shallow draft vessels (barges and tugs) that have minimal impact on sediment resuspension or redistribution. In weighing the risks and rewards, we believe that retaining the berms after the removal action is complete may be unnecessary.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. The final disposition of the existing berms will be determined during the remedial design.*

2.5.53 Comment: Since we will be the only operating river fleet in the vicinity of the Site, we will, in effect, serve as post closure care custodians of the Site.

Response: *The post closure care custodians for the Site will be the Potentially Responsible Parties and regulatory authorities charged with protection of the environment.*

2.5.54 Comment: The elimination of the berms as part of the post closure remedy could potentially make the Site vulnerable to major flood events but the berms will have the unintended consequences of achieving the very thing they are designed to prevent – a cap breach. Installing any structure that directs flood flow away from the Site will have the unintended effect of restricting flood flow in the San Jacinto River. This will create a funnel or nozzle effect that increases flow velocity and erosive power, which translates into river scours around the sheet piles as well as the Interstate 10 bridge piers. Based on observations of the effects of flooding along the San Jacinto River, there is little confidence that any post closure structures will survive in the long-term.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. The BMPs are expected to be in place for roughly two years; therefore, the potential for impacts on flow and erosion would be a short-term consideration, leading to a low probability of impacts compared to a permanent cap. There will not be any post-closure structures because BMPs such as a cofferdam will be removed or cut off at the mud line following removal of the waste material.*

2.5.55 Comment: Based on observations of the effects of flooding along the San Jacinto River, there is little confidence that any post closure structures will survive in the long-term.

Response: *No post closure structures are anticipated at this time. Ongoing evaluation of cap performance will be performed as part of the Operation, Maintenance and Monitoring Plan and be the responsibility of the Potentially Responsible Parties for maintaining the structures until the final remedial action is implemented.*

2.5.56 Comment: Is EPA's object here to totally prevent flood waters from inundating the Site or to just minimize scour potential from unabated flood currents? EPA states on page 35 of the Proposed Plan that the sheet pile walls are currently planned at no higher than 10-feet NAVD88 and no lower than 5-feet NAVD88. Based on these specifications and the May and June 2016 flood events (classified as 500-year events) and visually observed river levels at the 12-foot mark of the flood gauge, we have little confidence in the long-term viability of sheet piles or caissons.

Response: *The exact elevation for the sheet pile walls/cofferdams will be determined during the design phase, with the goal of minimizing flood impacts.*

2.5.57 Comment: Does EPA have any plans to work with TXDOT in making improvements to the I-10 right-of-way feeder that will accommodate the high traffic volume and alleviate delays due to high water events?

Response: *A final determination of transportation options will be made during the Remedial Design phase. State and local transportation agencies will be involved with planning to ensure safety and reliable mobility.*

2.5.58 Comment: Any restrictions to barge operations in the area of the Site could upset the tenuous equilibrium in river and inter-coastal water way traffic that would not only worsen traffic problems in the Houston, Texas City, and Galveston ship channels, but would also impact incoming traffic as far away as Mississippi and Brownsville. In addition, this could force barge operators to park in areas of "no-parking" or scofflaw areas south of the I-10 bridge.

Response: *Comment noted. These waterway operations will be given full review during the design phase in order to minimize potential conflicts with waterborne commerce. It is anticipated that the footprint of the remedy should not change a great deal from the existing footprint.*

2.5.59 Comment: How many trucks will be necessary to transport the waste material to another landfill? How far away is this other landfill? What is the probability of a traffic accident during transportation and disposal?

Response: *The location and type of final disposition for the waste has not been determined but will be during the Remedial Design. Based on the preliminary estimate, approximately 13,300 truck trips maybe required. There is always the potential for traffic accidents and a transportation plan will be developed to reduce that potential.*

2.5.60 Comment: USEPA did not adequately justify the rejection of an in-place containment remedy that would isolate the waste material in perpetuity and prevent the migration of dioxins and minimize human health and environmental risks during construction.

Response: *EPA disagrees with this comment. The best method to protect human health and the environment is through removal. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. The current historical cap performance* *demonstrates that caps may not effectively contain the wastes particularly during extreme weather events, and removal of the dioxins would have better long-term results.*

The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. Alternative 6N provides a more certain outcome than Alternative 3aN with lower overall potential for release.

2.5.61 Comment: In-place containment would minimize risks of a catastrophic failure during a large-scale mass removal remedy that has not been quantified nor appreciated by USEPA.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. This approach minimizes the risk of releases both during the remedy construction phase and over the long-term by removing the mass of contaminants in the system.*

The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. Alternative 6N provides a more certain outcome than Alternative 3aN with lower overall potential for release. *The implementation of an alternative that removes the waste minimize the potential for future releases and protects the river in the long-term.*

2.5.62 Comment: Does USEPA believe the in-place containment alternative is a viable option for the San Jacinto River waste pit sites?

Response: *EPA does not believe that in-place containment is an effective option for the Site due to the potential for future catastrophic weather events, the fact that the Site is located in* *a dynamic river, failures to the cap, and the unpredictable nature that an enhanced cap can maintain structural integrity for the long-term.*

2.5.63 Comment: Does USEPA believe the in-place containment alternative, as implemented throughout the US in similar waterways, is a minimally invasive, reliable, durable, and well-understood remedial alternative?

Response: *Each site has different environmental conditions and constraints. EPA believes that in-place containment is a viable alternative under appropriate environmental and site settings that will support stable remedy conditions that achieves the intended goals and which requires minimal operations and maintenance over the long-term. EPA evaluates each site on an individual basis and not on a one design fits all.*

2.5.64 Comment: Does USEPA disagree with the detailed analysis provided by the US Army Corps of Engineers that the in-place containment alternative would be able to withstand a barge strike with minimal impact to the environment?

Response: *The US Army Corps of Engineers does report that barge strikes can pose the potential for contaminant loss. The predicted contaminant loss is low but EPA is concerned with any loss no matter the size. The US Army Corps of Engineers report is for one barge strike when there is the potential for simultaneous multiple barge strikes based on the number of barges that are staged upstream in near proximity to the Site. The removal of the waste as identified under Alternative 6N will eliminate the concern of a release associated with a barge strike and will be more protective in the long-term.*

2.5.65 Comment: As documented by the US Army Corps of Engineers, residual dioxin waste will be released during construction of the proposed plan and these residuals will remain in the environment and will be transported downriver into Galveston Bay.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. The potential for a release will still exist if a cap system is utilized and the damage downstream will be greater than any release during the construction phase.*

2.5.66 Comment: EPA's analysis of the Alternative 6N is incorrect, because the number of bucket passes and the size (used to dredge) of the buckets used in the calculations of the release/resuspension of sediment was wrong, and the number of passes was also incorrect. This is based on the Corps of Engineers use a 10-cubic yard dredge bucket when a 2 to 3.5 cubic yard bucket is more appropriate for the particle size and the ability of vessels to operate in the shallow draft around the impoundments.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. Comments regarding bucket size and calculations of release/resuspension no longer apply to the selected remedy since BMPs will be utilized to comply with ARARs. The selected removal alternative is a viable alternative that is implementable. It reduces the volume of material in the environment, it has excellent long-term effectiveness, and it improves the human health and environmental protectiveness.*

2.5.67 Comment: The anticipated schedule appears to be set based upon installation of BMPs as stated in the Proposed Plan, except without considering any of the questions regarding "where feasible," "if practicable," or "as appropriate." If just one of the many variables at the site turns out not to be feasible or practicable, what happens then? Redesign, reorder equipment, get new approvals, and try something else? These take time and effort, and there appears to be no contingency built into the 19 months listed in the Proposed Plan as the construction period.

Response: *Use of BMPs such as a cofferdam for a removal in the "dry" approach are considered to be effective engineering control measures to reduce releases and residuals at the San Jacinto River Waste Pits. Cofferdams offer flexibility in construction methods and material to accommodate the local site conditions and project goals. Additionally, the cofferdam can be placed outside of the armored cap to prevent disturbance of the contaminated sediment prior to containment. Cofferdams have been constructed in similar locales for excavation and construction activities such as at Formosa Plastics, the Texas site for contaminated sediment removal, at Matagorda Bay for archeological recovery and at numerous coastal sites for construction. Removal in the "dry" was performed to control organic chemical liquid releases in the upper 1½ miles of the Housatonic River site using cofferdams and by-passing the river flows. Cofferdams have been used in a large sediment removal in the "dry" project in the Grand Calumet River in Indiana to control organic chemical liquid releases. The Phase I Removal Action in the Passaic River utilized a sheet pile enclosure with sealed joints for dioxin contaminated sediment removal. Berms have been employed to form cofferdams to control* *resuspension at Hooker Chemical site in New York. The construction time will be re-assessed during the Remedial Design since construction of the cofferdam and dewatering the site will be more time consuming than implementation of other best management practices. Additionally, the impact of maintaining a dewatered condition and treating water considering precipitation/weather at the site will be evaluated during the design phase. It is commonly recognized that changes to the estimated time can occur due to unexpected conditions or extreme events.*

2.5.68 Comment: The expectation that subsequent re-dredging and removal of recently installed clean fill over the excavated or dredged areas has not been considered in the dredging duration. The EPA has not recognized the higher levels of resuspension and residuals that will occur on this site due to the armor cap. Therefore, it has not considered the consequential impacts to schedule due to the re-dredging and additional clean-up efforts.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

2.5.69 Comment: It is clear that EPA does not have an understanding of how Alternative 6N will be accomplished and still meet relevant environmental criteria, such as being protective of human health and the environment and not releasing dioxins/furans into the surrounding area and river. This is a product of the fact that no such remedy (the removal of an existing engineered armor rock cap and underlying waste, adjacent to and in a dynamic riverine environment) has ever been attempted, to our knowledge.

Response: *EPA disagrees with the commenters' assertion regarding Alternative 6N protectiveness of human health and the environment and the means to achieve the remedial action objectives. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering* *assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. BMPs such as cofferdams have been constructed in similar locales for excavation and construction activities*

2.5.70 Comment: The extent of dredging or excavation in the "dry" behind sheet piles is quite unclear and is based upon those key phrases "where feasible" and "to the extent practical."

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. The use of cofferdams is a proven technology previously implemented at multiple sites. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. While the final BMPs will be determined during the remedial design, EPA and USACE have demonstrated that there is at least one technology (cofferdams) that is implementable and would be effective in preventing releases from the Site during removal. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

2.5.71 Comment: Removal in the "dry" will be conducted where feasible or practicable, and EPA hopes that will be in the Western Cell and the shallow water portion of the Eastern Cell. However, EPA does not actually know if dredging behind sheet pile walls in the shallow water portion of the Eastern cell can be accomplished. If it cannot, the estimates of releases of resuspended contaminants and residuals are wrong, and the basis for selection of Alternative 6N is erroneous.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

These topics are standard components of all remediation projects. Acceptance criteria will be established at that time, including target depth, residuals management, emissions, effluent quality, production, water management, containment, site closure, and other items. EPA disagrees with the commenter's conclusion that the selection of Alternative 6N is erroneous. The selection process consists of an evaluation and balancing of nine CERCLA criteria which include overall protectiveness of human health and the environment, compliance with ARARs, long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, short-term effectiveness, implementability, cost, and state and community acceptance.

Use of BMPs such as a cofferdam for a removal in the "dry" approach are considered to be effective engineering control measures to reduce releases and residuals at the San Jacinto River Waste Pits. Cofferdams offer flexibility in construction methods and material to accommodate the local site conditions and project goals. Additionally, the cofferdam can be placed outside of the armored cap to prevent disturbance of the contaminated sediment prior to containment. Cofferdams have been constructed in similar locales for excavation and construction activities such as at Formosa Plastics, the Texas site for contaminated sediment removal, at Matagorda Bay for archeological recovery and at numerous coastal sites for construction. Removal in the "dry" was performed to control organic chemical liquid releases in the upper 1½ miles of the Housatonic River site using cofferdams and by-passing the river flows. Cofferdams have been used in a large sediment removal in the "dry" project in the Grand Calumet River in Indiana to control organic chemical liquid releases. The Phase I Removal Action in the Passaic River utilized a sheet pile enclosure with sealed joints for dioxin contaminated sediment removal. Berms have been employed to form cofferdams to control resuspension at Hooker Chemical site in New York

2.5.72 Comment: The US Army Corps of Engineers presumes that removal in the "dry" will release almost nothing to the river environment in the way of contaminants. This may be true for some remediation sites, but it is just plain incorrect for this site, given its characteristics.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. The use of cofferdams is a proven technology previously implemented at multiple sites. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. While the final BMPs will be determined during the remedial design, EPA and USACE have demonstrated that there is at least one technology (cofferdams) that is implementable and would be effective in preventing releases from the Site during removal. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the* *remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

2.5.73 Comment: The issue is which BMPs are to be used and where will they be placed? This is a complex site, and different BMPs would be appropriate in given areas of the site. Each must be evaluated separately to determine feasibility. Simply making lists of potential BMPs in both the US Army Corps of Engineers' report and EPA's Proposed Plan does not constitute a proper evaluation of the actual steps to be taken; thus an accurate estimate of implementability, risk, release, and cost is not possible.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. Additional best management practices will be included as necessary to control various steps in the construction, treatment, handling, and transportation processes. These are issues that will be addressed in the design phase. EPA disagrees that an accurate assessment is not possible. The design phase is the appropriate time to develop the necessary best management practices either individually or in combination to achieve the required outcome and minimize contaminant releases.*

2.5.74 Comment: EPA has not demonstrated an understanding of the technical challenges (e.g., underwater removal of the rock, how to cut the geotextile, how to pick it up without creating a dispersion of residuals, how to remove the cap and geotextile in small sections, and how to peel back the rock and geotextile to install sheet pile) nor evaluated the environmental ramifications associated with the actual removal of the cap, geotextile and waste.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas*

Surface Water Quality Standards. The construction steps mentioned in the comment are detailed elements that are included in the Remedial Design and specifications.

2.5.75 Comment: EPA's identification of BMPs constructed to elevation 5 feet NAVD88 appears to be protective of storms with less than a 10-year return interval. BMPs constructed to elevation 10 feet NAVD88 might only be protective of a 25-year storm, which is inconsistent with EPA's statement that BMPs would provide protection from a 25- or 50-year return interval storm (Proposed Plan, p. 35). Given these inconsistencies, EPA could not possibly have prepared an accurate evaluation of the impact of storms during construction of Alternative 6N.

Response: *Establishing the top elevation for sheet pile walls/cofferdams is most appropriately left for the design phase. However, for costing purposes, the cofferdam and sheet piles were estimated to be set at an elevation equivalent to the 100-year flood, or 14-feet above sea level.*

2.5.76 Comment: Removal of the TCRA cap is unprecedented, world-wide. The TCRA cap was designed and installed to isolate the waste materials in the waste pits. EPA guidance on installation of interim measures like the TCRA cap requires that such measures be consistent with the final remedy. The cap was not designed to be removed; it was designed with EPA approval in accordance with engineering practices that would isolate the wastes from the river environment and withstand 100 year storms. There is no experience from which to draw regarding the removal and the attendant generation and release of resuspended contaminants.

Response:

As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. The use of cofferdams is a proven technology previously implemented at multiple sites. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. While the final BMPs will be determined during the remedial design, EPA and USACE have demonstrated that there is at least one technology (cofferdams) that is implementable and would be effective in preventing releases from the Site during removal. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.

A BMP such as a cofferdam would be placed outside and surrounding the existing armored cap so as not to disturb, resuspend and release contaminated sediment during construction of the cofferdam nor complicate and interfere with armored cap removal. The armor stone would need *to be disposed in a landfill with the contaminated sediment unless the stone can be washed and reused. The entire capped area will be completely encircled during removal.*

2.5.77 Comment: The predictive models used by the US Army Corps of Engineers are based upon empirical data about conventional excavation activities. In this case, the removal of an engineered armor cap consisting of rock and geotextile from impacted sediments has never been attempted, which means that there is no experience for estimating the resulting resuspension, residuals, and collateral contamination.

Response:
As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. The use of cofferdams is a proven technology previously implemented at multiple sites. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. While the final BMPs will be determined during the remedial design, EPA and USACE have demonstrated that there is at least one technology (cofferdams) that is implementable and would be effective in preventing releases from the Site during removal. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.

A BMP such as a cofferdam would be placed outside and surrounding the existing armored cap so as not to disturb, resuspend and release contaminated sediment during construction of the cofferdam nor complicate and interfere with armored cap removal. The armor stone would need to be disposed in a landfill with the contaminated sediment unless the stone can be washed and reused. The entire capped area will be completely encircled during removal.

2.5.78 Comment: EPA fails to adequately address the releases associated with all the sub-phases of this removal effort, including site preparation, mobilization of people and equipment, potential releases from storms, and the continual decontamination efforts on and around the site. More importantly, removal in the wet involving dredging wholly mischaracterizes the significant releases and expansion of the contamination footprint around the site by exposing the currently contained waste protected by the armor cap.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize* *the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. Excavation activities, operations, and treatment are well known.*

2.5.79 Comment: It is not made clear in the Final Interim Feasibility Study or Proposed Plan whether the target is stability against an event with a 500-year return interval or against multiple events that might occur during that period.

Response: *Achieving protection of human health and the environment requires that a capping remedy be able to reliably contain the wastes under the site conditions for as long as necessary to provide the required protectiveness. That was assessed through the simulation of a Category 2 hurricane and the 1994 flood. This resulted in a flow that was somewhat larger (at 390,000 cubic feet per second) than the 1994 flood (360,000 cubic feet per second), which was approximately equal to a 100-year flood. Category 4 or 5 hurricanes can possibly occur with their associated more intense wind, storm surge, and wind driven waves. However, attempting simulate these storms would add another layer of uncertainty to the results because there is no actual storm data for these hurricanes in the area.*

2.5.80 Comment: Most structures, even those designed for protection of life and property, such as dams and levees, are not designed to withstand a 500-year event. We cannot and do not design projects such as flood control levees or dams or coastal protection features against such events; therefore, selecting a remedy approach or designing a remedy for CERCLA on such a basis is inequitable and technically inappropriate in my view.

Response: *The current temporary cap is designed for a 100-year flood event but since its completion, it has had integrity issues during flood events below the 100-year flood level. EPA believes that a capping system without removal of the waste material will continue to be a maintenance issue and the repeated need for repair of damage can lead to the release of the waste material into the river and surrounding environment and the creation of a large contaminated sediment site.*

The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. Alternative 6N provides a more certain outcome than Alternative 3aN with lower overall potential for release.

2.5.81 Comment: The US Army Corps of Engineers Report does not include mention of any modeling done for the Alternative 3aN Enhanced Cap. Since the real decision on the preferred remedy is Alternative 3aN versus Alternative 6N, it is very puzzling that EPA did not choose to model the Enhanced Cap for Alternative 3aN.

Response: *Even though Alternative 3aN consists of an upgraded cap, it is still subject to the uncertainties of severe floods, a dynamic river, and adequate maintenance over the centuries that the waste will remain toxic. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

2.5.82 Comment: Another aspect of releases from the Site is an issue of odor from the exposed waste during the removal operations. There is no mention of this issue in either the Final Interim Feasibility Study or Proposed Plan.

Response: *There are a number of techniques that are used to control fugitive emissions from contaminated sites. These techniques along with other best management practices will be fully explored, assessed, and included in the design plans as necessary.*

2.5.83 Comment: EPA states that the goal is "dry" excavation to the extent possible, with dredging as required. But dewatering will be difficult since the excavation will extend approximately 5 to 10 feet below the water table. Drying an exposed surface of fine grained material takes months at best, and then the drying does not extend to depth. So, in areas with high water content, the excavation will be a slow and sloppy operation even if done "in the dry."

Response: *The dewatering system will be developed during the design phase, however, it is expected to include a sump excavated along the edge below the depth of contamination to collect runoff, seepage and drainage, and improve dewatering. The sump would be pumped down as needed to maintain a dewatered site. All of the water pumped from the Site, including site water, storm water, wash water and seepage, would be treated prior to discharge at the Site.*

Excavation in the "dry" refers to removal in an unflooded state. A best management practice being proposed is a cofferdam with sealed joints and filled with low permeability soil to control seepage through the cofferdam. The foundation soils include at least 10 feet of low permeability soft silt and clay immediately below the waste layer and underlain by a sand layer of similar thickness. The sand layer is underlain by more than 25 ft of hard, dense Beaumont clay. The cofferdam would be anchored in the Beaumont clay layer and would cut off the sand layer and limit the potential seepage. Upwelling through the clay layer is expected to be slow.

The majority of the waste is expected to be soft and saturated. Construction activities on saturated sediments is also commonplace and techniques for working on soils with low ground strength are available such as use of swamp mats, marsh excavators, marsh cargo buggies, slide pontoons and other amphibious equipment. Similar equipment and techniques were used to place the armored cap at the San Jacinto River Waste Pits.

2.5.84 Comment: The approach of incremental removal and capping is in conflict with US Army Corps of Engineers recommendations. The US Army Corps of Engineers Report states: "The entire cap within the sheet pile enclosure should be removed prior to solidification, excavation or dredging to limit contamination of the TCRA armor cap material." (US Army Corps of Engineers Report, p. 118). The point made by the US Army Corps of Engineers with this statement relates to the difficulty in excavating a portion of the waste material without tracking over clean capped areas to transport the excavated material out of the work area. Also, the incremental excavation of sub-areas requires excavation to depth and placement of the residuals cap while still maintaining the surrounding areas without slumping and deeper slope failures.

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. Using a BMP such as a cofferdam reduces the complexity of staging and phasing of BMP controls, cap removal, waste removal and residuals management in an incremental manner throughout the site and reduces the need for precision construction for residuals management.*

2.5.85 Comment: EPA did not provide an accurate description of stability of jetties and breakwaters in the context of evaluations of Alternative 3aN cap armor. EPA presents a partial quote from the US Army Corps of Engineers Report in the Proposed Plan: "There appears to be no documented cases of any armored cap or armored confined disposal facility breaches. However, there have been many occurrences of breaches and slope failures of armored dikes, jetties, and breakwaters, with some of those structures confining dredged material." (Proposed Plan, p. 8, quoting US Army Corps of Engineers Report, p. 82). However, EPA conveniently fails to provide the second part of the same statement from the US Army Corps of Engineers Report which states: "None of the listed cases completely breached or failed and were discovered by routine inspections. Repairs and rehabilitation measures, when documented, were easily made." (US Army Corps of Engineers Report, p. 82). This is a classic example of taking a statement out of context, to skew the message. This tactic of presenting partial information in an unbalanced fashion is clearly an example of inequitable comparison of alternatives.

Response: *The message is that breaches occur. A breach of the cap may result in the release of a hazardous substance, while a breach of a dike will not. Dikes, jetties, and breakwaters are all easily observed from the land and potential failures are more easily observed and recognized than existing or impending failures to a subaqueous cap. The fact that the dikes can be repaired, as can a cap, does not address the issues associated with a release of a hazardous substance.*

2.5.86 Comment: What is the potential for catastrophic loss of contamination at the site during construction due to bank failure and/or severe storm events and associated flooding during excavation of the waste pits?

Response: *The potential for a loss of waste material will be minimized using best management practices. The potential applications are described below, however, the actual approach will be developed during the design phase.*

As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.

If a BMP such as a cofferdam is utilized, the site will remain covered with the armored cap until the cofferdam encircling the site is completed, maintaining the current level of protection at the site. The height of the sheet pile walls is a design decision that will require further evaluation. The proposed elevation of 10 ft NAVD 88 was based on modeled elevations presented in the Feasibility Study for a design flood with a 25- to 50-year return period. Actual flood elevations at the northern San Jacinto waste pits are uncertain and require more study and modeling. For costing purposes, the cofferdam top height was set at 14-feet above sea level, or 2-feet above the 100-year flood elevation to allow for wave protection. The intent of the proposed cofferdam elevation is to reduce the probability and frequency of inundation, limit the scour potential if inundated, reduce the potential volume of water to be treated from multiple dewatering events, and restrict the size of delays in production.

The armored cap would be incrementally removed as the waste material is excavated to depth. The armored cap above a small section of the site along the northern edge would be removed first and then the entire depth of waste material in that small section would be removed next.

The excavation would then proceed in an adjacent section using the same approach. The size of the section would be dependent on the reach of the equipment and the slumping of the waste materials. Thus, only a small sloped face of contaminated material would be exposed at any time, limiting the potential contaminant releases. Removal operations would be stopped during hurricanes and flooding and would not resume until flooding has receded and the site has been dewatered. If the site is inundated by flooding, whether associated with a hurricane or not, the height of the proposed cofferdam and the short fetch length within the cofferdam would reduce flows and waves across the site and consequently the resulting bottom shear stress. The resulting shear stress would be too small to erode the remaining armored cap or residuals from the depths post-excavation.

2.5.87 Comment: The US Army Corps of Engineers concluded that removing the existing armored cap and excavating the capped waste would inevitably result in significant releases of dioxins to the environment. The US Army Corps of Engineers detailed the hazards of taking the unprecedented action to remove an armored cap and the technical challenges of "excavating in the dry," as called for by the new alternative the US Army Corps of Engineers was directed by Region 6 to develop.

Response: *They Corps of Engineers and EPA agree with the comment when removal is performed in the wet where water is able to be transported through the Site as occurs with dredging. To eliminate material contaminant releases and residuals associated with removal operations, the removal could be performed in the "dry" by dewatering the site. Consequently, a BMPs for the site could be a double-walled cofferdam surrounding the Site. The cofferdam may consist of a ringed structure constructed with two walls of sheet piles with sealed joints driven into a low permeability foundation layer and filled with soil to limit seepage. Portions of the sediment at the base of the cofferdam would be armored to prevent erosion at the base of the outer wall. Additionally, the cofferdam must be of sufficient height to prevent overtopping from most flooding events. All of the water pumped from the site, including site water, storm water, wash water and seepage, would be treated prior to discharge at the site. Removal in the "dry" eliminates the potential for resuspension and release of contaminants and contaminated water. It also prevents the formation of residuals from sedimentation and allows removal to "clean" by preventing the fluidization and spreading of the sediment in an uncontrolled manner. Additionally, removal in the "dry" facilitates the sampling, monitoring and testing of the site to ensure compliance.*

2.5.88 Comment: For Alternative 6N, Region 6's Final Interim Feasibility Study does not address constructability and the many challenges to "removal in the dry" articulated by the US Army Corps of Engineers. Failure to address this means that selection of Alternative 6N based on the Final Interim Feasibility Study and the current Administrative Record would be arbitrary and capricious.

Response: *The EPA and US Army Corps of Engineers are aware of these challenges associated with the constructability of Alternative 6N. These challenges are not addressed in the Proposed Plan because these details will be addressed during the remedial design. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the* *waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

A cofferdam was considered as a possible best management practice for implementing excavation in the "dry". Excavation of waste in the "dry" has been implemented at numerous sites and are therefore considered to be technically feasible. A cofferdam would be placed outside and surrounding the existing armored cap so as not to disturb, resuspend and release contaminated sediment during construction of the cofferdam nor complicate and interfere with armored cap removal.

2.5.89 Comment: The Proposed Plan's unprecedented and inappropriate proposal to completely remove an existing engineered cap that was constructed with U.S. EPA approval under the CERCLA Time Critical Removal Program, despite the fact that it has been proven effective in containing the existing waste and contaminated sediment, would undermine one of the key, well-accepted Superfund remediation tools -- capping. We are not aware of any precedent for the removal of an installed engineered cap. Such a decision would set a terrible precedent, which could have serious repercussions at many other sites nationally, not the least of which would be at least two "mega sites," the Lower Passaic River and the Willamette River.

Response: *The purpose of the time critical removal action was to stabilize the site, temporarily abating the release of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (and possibly PCBs) into the waterway, until the site is fully characterized and a remedy is selected. This removal action was necessary to address an imminent and substantial endangerment to public health and the environment.*

Under the correct environmental setting capping is an appropriate technology for isolation of contaminated sediments. However, in the particular geographic setting of the San Jacinto River Site, EPA does not believe that capping is an adequate long-term remedy. Since the cap was completed in 2011 the cap has needed several repairs and maintenance. Given that Houston is prone to hurricanes, severe storms and flooding events, leaving the wastes in the river covered by a cap is not sufficiently protective of human health and the environment in the long-term.

2.5.90 Comment: Among other things, potentially responsible parties will be less likely to participate in time critical removal actions or other interim remedies when there is so little assurance that the work performed (and costs incurred) will be consistent with the final cleanup plan. In addition, requiring the removal of this cap, at a substantial additional expense, will trade a working remedy that has been demonstrated to be effectively controlling the risk, for a removal remedy that the Army Corps has confirmed will result in unavoidable releases of contaminants during its construction. This trade-off is not acceptable, nor is it consistent with CERCLA's nine remedy selection criteria, or the NCP.

Response: *The purpose of the time critical removal action was to stabilize the site, temporarily abating the release of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (and possibly PCBs) into the waterway, until the site is fully characterized and a remedy is selected. This removal action was necessary to address an imminent and substantial endangerment to public health and the environment. Every site is unique, and the conditions at the San Jacinto River Waste Pits Site make capping less reliable as a long-term remedy. EPA does not consider the exposure of dioxin contaminated waste as occurred in 2015, nor the need for repeated maintenance, as demonstrating the effectiveness of capping for the Site. The original cap was a temporary measure until the final remedy could be selected; EPA never agreed that a cap would be the long-term remedy that it would select.*

As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. Regarding unavoidable releases during removal, implementation of BMP such as a cofferdam around the capped area allowing excavation in the "dry" could prevent the typical releases that occur during wet dredging. There is no trade off on risk; the selected remedy will effectively control the short-term risks as well prevent long-term risks, unlike the capping alternatives, because the waste will be removed from the Site.

2.5.91 Comment: The standard U.S. EPA Region 6 is using to reject retaining the existing cap – that there must be virtually complete certainty about the permanent integrity of the cap – establishes an unrealistic and unachievable standard for risk-based cleanup decisions to meet. In fact, based on the Army Corps Report, the ONLY certainty is that removal of the existing cap and underlying waste will result in some releases, and that there is a likelihood that significant releases of dioxin could occur based on historical heavy rain frequency and major storm events. Not only is this inconsistent with the approach applied by all U.S. EPA Regions at all other contaminated sediment sites, this standard will amount to a de facto mandate for complete sediment removal at all contaminated sediment sites– a result that would be disastrous for the many sites, including the San Jacinto River Waste Pits, where the environment and the local community can be better protected from risk by enhancing the existing engineered and installed cap.

Response: *It is important to point out that the San Jacinto River Waste Pits site is not a "contaminated sediment" site. The site consists of a set of impoundments built in the mid-1960s for the disposal of solid and liquid pulp and paper mill wastes, and the surrounding areas containing sediments and soils impacted by waste materials disposed of in the impoundments. The northern set of impoundments, approximately 14 acres in size, are located on a partially submerged 20-acre parcel on the western bank of the San Jacinto River, immediately north of the I-10 bridge over the San Jacinto River. Currently, approximately half of the northern 20-acre parcel, including the abandoned waste disposal ponds, is now submerged below the adjacent San Jacinto River's water surface. The current temporary cap is designed for a 100-year flood event but since its completion, it has had integrity issues during flood events below the 100-year flood level. EPA believes that a capping system without removal of the waste material will continue to be a maintenance issue and the repeated need for repair of damage can lead to the release of the waste material into the river and surrounding environment and the creation of a large contaminated sediment site.*

Regarding certainty, EPA does not have a requirement for a "complete certainty" to evaluate capping effectiveness; instead capping, or any remedial action, must be protective in the long-term. However, the current cap's history, the likelihood of future exposure to repeated hurricanes and severe storms, and the U.S. Corps of Engineers model results for an upgraded cap do not demonstrate that capping would be sufficiently protective in the long-term.

The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic.

The need to contain the waste over a long term to realize protectiveness, and the questionable performance of the existing cap do not provide assurance that a capping remedy would be successful over the long-term. The demonstrated river morphology history and future storms were factors that introduced substantial uncertainty about the long-term effectiveness of a capping remedy. Each site has different environmental conditions and constraints. EPA evaluates each site on an individual basis and not on a one design fits all. EPA believes the selected remedy, Alternative 6N, will be the best approach for the Site considering the CERCLA remedy selection criteria.

As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be *determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

2.5.92 Comment: The dredging and removal of some 150,000 cubic yards of material will overwhelm the available construction infrastructure. There is only a single roadway to access the Northern Impoundments and that this roadway can become flooded during high water. Therefore, it appears that some additional surface access will have to be constructed, along with obtaining the necessary right(s)-of-way. In addition, off-site transportation facilities will need to be built to accommodate the Proposed Plan. These implementability issues have not been adequately evaluated in the Proposed Plan.

Response: *Transportation access is a common issue for all Superfund sediment removal projects. Access to I-10 is only about 1½ miles from the site via the East Freeway Service Road, which is primarily used for non-residential, commercial/industrial traffic and trucking. The number of trips per day depends of the size of the trucks used. If small trucks are used for disposal, the maximum round trips per day would be about 200, including disposal trucks, deliveries and workers. For a 12-hour work day, it would be a vehicle about every four minutes. If 20 cubic yard trucks were used, there would be one truck every 10 to 15 minutes, or about one vehicle every six minutes including worker traffic and deliveries. There is little other traffic over most of the route. The traffic volume is inconsequential for I-10 and its ramps, representing about 0.1 percent of the average daily traffic on I-10 and less than three percent of the ramp capacity. Consequently, it is unlikely that additional surface access would need to be constructed; however, the access may need to be improved to provide relief from flooding potential. Transportation of the removed material and implementation will be determined as a part of the Remedial Design. If transport is performed by trucks, some road improvements and repair will probably need to be considered in the Remedial Design. Details for the transportation issue identified in the comment are details that will be covered in the design phase.*

2.5.93 Comment: It must also be recognized that even under the proposed removal action, some contaminated material will remain in place and secured by an engineered cap. Regardless of the target concentration of contaminated material that will remain, given EPA's dismissal of the enhanced cap endorsed by the COE, a detailed justification of how the remaining wastes will be secured under EPA's pessimistic assumptions of cap performance in the future should be part of any risk assessment of the proposal. The fact that waste will remain on site also presumes that the responsible parties will maintain an ongoing obligation to ensure the security and performance of whatever cap in in place. But to directly address EPA's concerns about long-term security of the enhanced cap, that obligation on the part of the responsible parties will exist just as effectively if all of the waste is secured on site.

Response: *EPA is lowering the cleanup level to 30 ng/kg. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best*

Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. This approach would eliminate the dioxin release that frequently occurs during underwater dredging because dredging will not be performed.

An enhanced cap would at least initially, reduce the mobility of the wastes. However, over the long term with the potential for significant cap damage as a result of hurricanes, the long term mobility reduction is not likely to remain. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

2.5.94 Comment: EPA states in the Proposed Plan that approximately 13,300 truck trips may be required to transport the waste material to the off-site approved permitted facility; however, capacity of roads to handle the loads will impact the truck size that can be used. The method of transportation and number of trips will be determined during the Remedial Design, as well as other transportation alternatives, including rail transport. The material will require dewatering by removal and/or treatment so that there are no free liquids. San Jacinto River Fleet is close enough to the Site to provide a convenient staging area for offloading freshly excavated material without having to haul it over public highways. Additionally, San Jacinto River Fleet has sufficient space available on their property to handle any capacity of dewatering operation developed by EPA. To this end, San Jacinto River Fleet is willing to lease land to EPA for stockpiling and dewatering operations, with the condition that no impact to the San Jacinto River Fleet property remain after Site cleanup is complete. Further, San Jacinto River Fleet would be willing to provide input in developing procedures for dewatering and materials handling.

Response: *The site stakeholders appreciate the option of using the San Jacinto River Fleet property to support the site remediation. Transportation of the removed material will be determined as a part of the Remedial Design. As noted in the Proposed Plan, approximately 13,300 truck trips may be required to transport the waste material to the off-site approved permitted facility. However, the capacity of roads to handle the loads will impact the truck size that can be used and therefore the number of trips required. Barge transport may be a viable option and use of the San Jacinto River Fleet property would facilitate that option. Multiple options also exist for staging, stockpiling and dewatering that will be evaluated and selected* *during the Remedial Design. If transport is performed by trucks, some road improvements and repair may need to be considered in the Remedial Design.*

2.5.95 Comment: In addressing the dilemma on how to protect the post closure cap without berms, San Jacinto River Fleet proposes an alternative solution that will eliminate the need for the post closure cap and berms. Presumably the reason for the cap and berms in post closure care is to protect soil that will be left in place with dioxin concentrations up to 200 ng/kg. Also, the presumable reason for leaving dioxins in place at 200 ng/kg or less is the added expense of removal and transport under a clean closure scenario. As an alternative to trucking contaminated soil to the disposal facility, San Jacinto River Fleet is offering to provide barges as an inexpensive means to transport the impacted soil to a location as close to the waste disposal facility as possible and then truck it the rest of the way. The cost savings for this scenario may be sufficient to pursue a clean closure of the Site so that the post closure cap and berms are not required. The Site could then be delisted and become part of the navigable waters of the San Jacinto River.

Response: *EPA is lowering the target concentration to 30 ng/kg for the waste pits to pursue a closure of the site without the need for a residuals cap and berms. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. A variety of transportation options including barge transport will be considered during Remedial Design of the transportation and disposal components using a number of factors including costs, feasibility and implementability. EPA appreciates the offer of assistance from the surrounding communities and businesses. However, the final method of transportation and disposition will be identified in the Remedial Design phase.*

2.5.96 Comment: The EPA states on page 32 of the Proposed Plan that permits are not required for on-site CERCLA actions. This, then, is followed up with a commitment to use the Clean Water Act as Applicable or Relevant and Appropriate Requirements (ARAR) in order to "avoid, minimize, and mitigate adverse effects on the waters of the U.S. and, where possible, select a practicable ... alternative with the least adverse effects". In this context, San Jacinto River Fleet, as the immediate neighbor, requests that they be apprised of any and all actions that could impede or affect their daily operations. To accomplish this with minimal interference to both parties, San Jacinto River Fleet proposes the following: (1) Afford San Jacinto River Fleet the opportunity to provide input to the remedial design so that EPA's Site remedial operations can be coordinated with fleet operations; (2) Assign point-of-contact personnel for EPA and San Jacinto

River Fleet to avoid miscommunication and unexpected work events that affects either's operations.

Response: *EPA will provide public notices and updates to all interested parties throughout the design and construction of the selected alternatives.*

2**.5.97 Comment:** As per the Proposed Plan, Alternative 6N will be a sizable undertaking entailing the removal and processing of over 150,000 cubic yards of material over a period exceeding a year and a half - assuming remediation progresses as scheduled. Unforeseen delays such pre- and post-storm mitigation efforts, equipment failures, or extended ramp-up times in streamlining dewatering and materials handling procedures or failures on the downstream end such as insufficient trucking capacity or Treatment/Storage/Disposal facility capacity could extend the time line to well over two years. As the immediate neighbor, San Jacinto River Fleet would like to have a managerial voice in on-site remedial design and implementation. This could greatly benefit EPA in that San Jacinto River Fleet would be serving as an ally for resolving logistical obstacles to Site remediation that may also interfere with San Jacinto River Fleet operations.

Response: *During the design phase, EPA will review the requirements for treating, handling, temporarily storing, and transporting the contaminated material. This will include all possible options to minimize potential problems that could occur from on-site operations as well as improve site logistics. EPA appreciates the offer made by the San Jacinto River Fleet, however, EPA will maintain overall management of the Site. EPA will provide public notices and updates to all interested parties throughout the design and construction of the selected alternatives.*

2.5.98 Comment: EPA states on page 35 that the sheet pile walls are currently planned at no higher than 10' NAVD 88 and no lower than 5' NAV088. Is EPA's object here to totally prevent flood waters from inundating the Site or to just minimize scour potential from unabated flood currents? In the two most recent floods (May and June, 2016), San Jacinto River Fleet personnel observed water at the 12 ft mark on the flood gauge. San Jacinto River Fleet has little confidence in the long-term viability of sheet piles or caissons.

Response: *The height of the sheet pile walls/cofferdams is a design decision that will require further evaluation. The proposed elevation of 10 feet NAVD 88 was based on modeled elevations presented in the Feasibility Study for a design flood with a 25- to 50-year return period. Actual flood elevations at the northern San Jacinto waste pits are uncertain and require more evaluation. For cost estimation purposes, the top elevation of a BMP such as a cofferdam was set at 14 ft NAVD89 to prevent inundation by a 100-year or smaller flood, with a flood stage at the Site for a 100-year flood at approximately 12 ft NAVD89. The intent of the proposed cofferdam elevation is to reduce the probability and frequency of inundation, limit the scour potential if inundated, reduce the potential volume of water to be treated from dewatering of the site, and restrict the size of delays in production. The height of a proposed cofferdam would be greater than the proposed sheet pile wall presented in the US Army Corps of Engineers* *evaluation report (2016) since all of the removal would be performed in the "dry" with a cofferdam.*

2.5.99 Comment: EPA indicates on page 29 of the Proposed Plan that approximately 13,300 truck trips may be required to transport the waste material to the off-site disposal facility. This is followed up with the caveat that road capacity will impact the truck size that can be used. San Jacinto River Fleet knows from experience that the I-10 feeder roadway is currently in poor condition and becomes partially covered by extreme high tide events. Barring other transportation alternatives, does EPA have any plans to work with TXDOT in making improvements to the I-10 right-of-way feeder that will accommodate the high traffic volume and alleviate delays due to high water events?

Response: *Access to I-10 is only about 1½ miles from the site via the East Freeway Service Road, which is primarily used for non-residential, commercial/industrial traffic and trucking. The number of trips per day depends of the size of the trucks used. If small trucks are used for disposal, the maximum round trips per day would be about 200, including disposal trucks, deliveries and workers. For a 12-hour work day, it would be a vehicle about every four minutes. If 20 cubic yard trucks were used, there would be one truck every 10 to 15 minutes, or about one vehicle every six minutes including worker traffic and deliveries. There is little other traffic over most of the route except for the San Jacinto River Fleet traffic. The access may need to be improved to provide relief from flooding potential from high flows and extreme high tides. Superfund projects commonly include road repairs due to site traffic but seldom include road improvements such as raising the road or providing drainage. Stakeholders will need to meet with the Texas Department of Transportation to discuss road improvement and repair issues. Discussions regarding transportation of the removed material and implementation will be determined as a part of the Remedial Design. If transport is performed by trucks, some road improvements and repair will probably need to be considered in the Remedial Design.*

2.5.100 Comment: The original Time Critical Removal Action cap was enhanced in January 2014 in response to an evaluation of the cap's design and construction by Dr. Paul Schroeder, one of the leading experts on in-situ caps and one of the principal authors of the US Army Corps of Engineers 2016 Report.

Response: *There have been continuing problems with the temporary cap and the waste material is considered a principal threat waste representing a source area. EPA acknowledges that capping can be suitable remedy in many environmental settings. However, there are multiple riverine forces which are affecting the cap integrity and stability and ultimately the long-term effectiveness at this San Jacinto site. Although the referenced cap enhancements were made as recommended by the USACE, those recommendations did not have the benefit of an in-depth model simulation study. Based on the model simulations performed by the USACE, the 2014 enhanced cap was projected to suffer significant cap erosion over 80% of its area. In addition, the USACE performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane*

Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

2.5.101 Comment: In December 2015, an EPA Dive Team inspection identified areas in the Western Cell of the cap that were the subject of the US Army Corps of Engineers Cap Report. The US Army Corps of Engineers Cap Report concluded that these areas were associated with construction defects rather than erosion post-construction. No evidence of a barge strike was noted and the presence of deposition in the area of defects indicated "the long-term presence of the defect, the stability of the sediment at the defect, and no significant release of contaminants from the deficient area."

Response: *A shallow underwater area was discovered by the EPA Dive Team in late 2015 where the armor cap material was missing. The USACE reviewed that data and found that the area of missing rock was most probably associated with the construction of the cap. Further, the USACE reported that ground surveys showed subsidence over time in the deficient rock area and concluded that the defect was caused by the sinking of the cap over time into the underlying waste material due to either an improper filter/support layer under the rock cap or unusual decomposition of organic matter under the area. Sampling of the waste material found dioxin present at a concentration of over 40,000 ng/kg that was exposed to the San Jacinto River. The amount of time that this dioxin was exposed to the river is unknown, therefore, it is not possible to definitively conclude that no "significant" release occurred. Repairs of the area were completed in early 2016 with the placement of geotextile covered by armor rock material.*

2.5.102 Comment: The evaluation of the current cap showed that there were localized areas where the armor rock thickness did not meet design standards. These areas do not appear to be the result of ongoing cap disturbance and degradation but were most likely associated with cap construction and post-construction settling issues.

Response: *The long-term river bed stability is an issue of concern. There have been instances of changes in river morphology over time due to a variety of events. While the cap itself may be repaired, there is concern regarding the stability of the adjacent channel sediments.*

2.5.103 Comment: There is no evidence that the current cap integrity is changing significantly with time, or that a cap of the type constructed would ultimately fail.

Response: *Capping technology is considered an acceptable remedy in the correct environmental setting. Based on the historical performance it appears that the San Jacinto River forces which are demonstrated in the aerial photographs offer significant challenges to the long-term effectiveness of maintaining a stable cap. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the* *wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic.*

2.5.104 Comment: The 2007 National Academies study of the effectiveness of environmental dredging was unable to conclude that dredging alone could achieve long-term risk reduction due primarily to the inability to fully remove contaminants and avoid sediment resuspension or residual contamination.

Response: *The findings of the 2007 National Academies study of the effectiveness of environmental dredging reflects the performance of environmental dredging in the "wet", often with limited best management practices, without residuals management, and with a goal of mass removal rather than immediate achievement of risk reduction.*

As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.

In recognition of the difficulty in achieving risk reduction by environmental dredging, a BMP such as a cofferdam and sheetpile wall could be used to completely enclose the capped area for removal in the "dry" by excavation rather than "wet" dredging. Excavation in the "dry" will facilitate monitoring, testing and sampling of the final surface to achieve long-term risk reduction.

2.5.105 Comment: Often risk reduction after dredging is achieved with residuals management, for example, placement of a post-dredging cap or backfill layer. Such a residuals management layer, however, is not normally designed for stability under even modest flow conditions and is unlikely to remain in place under conditions for which the caps under Alternative 3N or 3aN are designed. Alternative 6N requires installation of a sand and armored cap to contain residuals following removal operations, so the same monitoring, maintenance and potential release mechanisms will exist for both alternatives, although it is difficult to envision that the residual containment would be designed to the same degree of protectiveness as the Alternative 3aN cap.

Response: *EPA is lowering the target concentration to 30 ng/kg for the waste pits to pursue a closure of the site without the need for a residuals cap and berms. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during* *the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

Excavation prevents the formation of residuals from sedimentation and allows removal to the cleanup level by preventing the fluidization and spreading of the sediment in an uncontrolled manner. Additionally, excavation in the "dry" facilitates meeting the target depth of removal, permitting visual inspection of residuals, which may be evident by differences in color, texture and consistency. Removal in the "dry" facilitates the sampling, monitoring and testing of the site to ensure compliance since the residuals are not mobile on a dewatered site. Residuals transported by runoff would be collected in the drainage sump and removed before site closure. The target concentration for residuals will be decreased to 30 ng/kg to pursue a closure of the site without the need for a residuals cover. In practice, the dioxin concentration remaining in the sediment after removal is likely to be much lower since excess material will be removed below the target depth to ensure that the target is met.

2.5.106 Comment: The releases and residuals from the Alternative 6N cannot be predicted with the precision implied by the US Army Corps of Engineers 2016 Report and they could potentially be much greater. As noted in the US Army Corps of Engineers 2016 Report, for example, potential releases and implementation issues will be exacerbated during storm events that will occur during the construction period.

Response: *The predictions are meant to be characteristic of the proposed operations and are suitable for comparing operations or approaches and technologies. Actual releases and residuals would be a function of the actual design, equipment, scheduling, operation, site conditions and weather. To eliminate the effects of these variables, the removal will be performed in the "dry" by dewatering the site. The Remedial Design will consider these variables when scheduling and sequencing operations.*

2.5.107 Comment: Conducting the removal remedy in stages can reduce the impact of small storm events but would be unlikely to provide significant control of resuspension and residuals if a major storm event were to occur during construction.

Response: *This comment assumes removal in the wet without complete containment where water is able to be transported through the site. EPA is lowering the target concentration to 30 ng/kg for the waste pits to pursue a closure of the site without the need for a residuals cap and berms. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that*

EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. However, the final method of transportation and disposition will be identified in the Remedial Design phase. Removal in the "dry" eliminates the potential for resuspension and release of contaminants and contaminated water. It also prevents the formation of residuals from sedimentation and allows removal to the cleanup level by preventing the fluidization and spreading of the sediment in an uncontrolled manner. Additionally, removal in the "dry" facilitates the sampling, monitoring and testing of the Site to ensure compliance.

2.5.108 Comment: The Proposed Plan suggests that there may be negative consequences of the additional rock placement including settling or expression of waste material beyond the cap. Settling of the current cap has not led to observable negative consequences and has likely led to some consolidation and strengthening of the underlying waste material. The expression of waste material beyond the cap is highly unlikely given the observed need for gentle slopes on armoring material that will extend the cap far beyond the boundaries of the waste.

Response: *The EPA notes that the area of missing cap found by the EPA Dive Team in 2015 was caused by the armor cap sinking into the waste material and resulted in exposing dioxin at over 40,000 ng.kg to the San Jacinto River. It is possible that additional loads on the capped area may result in further sinking or movement of the underlying materials.*

2.5.109 Comment: An additional concern expressed by EPA regarding Alternative 3aN is the failure to treat Principal Threat Waste exhibiting dioxin concentration greater than 300 ng/kg (although the preferred remedy also provides no treatment of the Principal Threat Waste). EPA considers material at the Site to be Principal Threat Waste due to its toxicity and potential mobility. Mobility of the waste materials should not be of concern for Alternative 3aN since it was designed to protect against even very low probability events now and in the future. The use of an armoring rock with a median diameter of 15-inches exceeds the US Army Corps of Engineers suggested 12-inch which would be expected to be protective under the hypothetical event of maximum river discharge and a simultaneous storm surge similar to that observed with Hurricane Ike.

Response: *Capping poses concerns with long-term effectiveness/permanence from disruption from barge strikes, erosion, and channel realignment. The US Army Corps of Engineers believes that the hydrodynamic and sediment transport modeling was sufficient to establish concerns regarding the site stability. Demonstration of shear stresses sufficient to erode larger than 8-inch stone as shown in the modeling suggests that channel migration could initiate. As evidenced by the scouring during 2016 flooding, extensive armoring or hardening of the area surrounding the site would likely be needed to prevent undercutting of the cap slopes.*

The scouring could undermine the perimeter slopes and lead to slope failures, particularly in areas with steeper slopes. Even though Alternative 3aN consists of an upgraded cap, it is still subject to the uncertainties of severe floods, a dynamic river, and adequate maintenance over the centuries that the waste will remain toxic. Climate models (Knutson and others, 2010) predict an increase in the intensity of tropical cyclones and hurricanes in the Gulf, meaning greater risk of flooding and storm surges over the long time frame that the dioxin waste would remain hazardous.

The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

2.5.110 Comment: Partial losses of a cap would not compromise its effectiveness like partial losses to a building or even a harbor protection structure (where partial losses might expose the harbor to full storm surges).

Response: *Partial losses of the cap may result in a release of dioxin to the environment; the purpose of the cap is to prevent such releases and prevent impacts to human health and the environment.*

2.5.111 Comment: Describing a best management practice in the Proposed Plan and tagging it with if practicable, if necessary, or if feasible means that EPA does not know whether the identified best management practices will actually work or are implementable to control releases of dioxin/furans and other contaminants into the San Jacinto River.

Response: *The best management practice is identified with qualifiers because the scope of past geotechnical investigation was limited and additional pre-design investigations may be necessary to assess the feasibility of certain best management practices such as water-tight sheet pile walls. The use of a cofferdam is considered to be the most effective best management practice to control releases and residuals for complete removal of the waste sludge and contaminated sediments at the San Jacinto River Waste Pits. Cofferdams offer flexibility in construction methods and material to accommodate the local site conditions and project goals. Additionally, the cofferdam can be placed outside of the armored cap to prevent disturbance of the contaminated sediment prior to containment. Cofferdams have been constructed in similar locales for excavation and construction activities such as at the Formosa Plastics, Texas site for contaminated sediment removal, at Matagorda Bay for archeological recovery and at numerous coastal sites for construction. Removal in the "dry" was performed to control organic chemical liquid releases in the upper 1 ½ miles of the Housatonic River site using cofferdams and by-passing the river flows. Sheet pile wall cofferdams have been used in a large sediment removal* *in the "dry" project in the Grand Calumet River in Indiana to control organic chemical liquid releases. Berms have been employed to form cofferdams to control resuspension at Hooker Chemical site in New York.*

2.5.112 Comment: EPA's seemingly simple and theoretical approach to remove the rock cap and geotextile is technically flawed. There is no precedent for removal of an engineered armor rock cap and the underlying geotextile. As stated by Dr. Todd Bridges, the U.S. Army's Senior Research Scientist for Environmental Science and Director of the Center for Contaminated Sediments at the Engineer Research and Development Center (ERDC) with respect to the proposed removal of the rock cap and geotextile at the Site, "It's never been done. It will result in a huge mess of turbidity, re-suspended sediments, and residuals."

Response: *The comment is based on removal in the wet where water is able to be transported through the site. To eliminate this potential exposure during removal operations, the removal would need to be performed in the "dry" by dewatering the site. The US Army Corps of Engineers agrees that the armor rock cap and underlying geotextile cannot be removed efficiently without simultaneously removing contaminated sediment.*

EPA is lowering the target concentration to 30 ng/kg for the waste pits to pursue a closure of the site without the need for a residuals cap and berms. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.

A BMP such as a cofferdam would be placed outside and surrounding the existing armored cap so as not to disturb, resuspend and release contaminated sediment during construction of the cofferdam nor complicate and interfere with armored cap removal. The armor stone would need to be disposed in a landfill with the contaminated sediment unless the stone can be washed and reused. The entire capped area will be completely encircled during removal.

2.5.113 Comment: EPA has not demonstrated an understanding of the technical challenges (e.g., underwater removal of the rock, how to peel back the rock and geotextile to install sheet pile, how to remove the geotextile from the entire site, how to pick it up without creating a large dispersion of residuals and suspended sediments, how to remove the cap and geotextile in small sections, and how to deal with the cement used to treat and stabilize the waste in the western area) nor evaluated the environmental ramifications associated with the actual removal of the cap and geotextile.

Response: *This comment assumes removal in the wet where water is able to be transported through the site. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

A BMP such as a cofferdam would be placed outside and surrounding the existing armored cap so as not to disturb, resuspended and release contaminated sediment during construction of the cofferdam nor complicate and interfere with armored cap removal. The removal operation will be developed during the Remedial Design but removal of the armored cap is likely to progress continuously with removal of the contaminated sediment. The armor stone would need to be disposed in a landfill with the contaminated sediment unless the stone can be washed and reused. The solidified sediment in the western cell would be expected to have an unconfined compressive strength of about 60 psi, comparable to the strength of a moderately stiff clay. Conventional excavating equipment should be readily able to break and remove the sediment that had been stabilized with cement during armored cap construction. Appropriate excavating equipment that can accommodate the solidified sediment should be selected during the Remedial Design.

2.5.114 Comment: The US Army Corps of Engineers estimated releases of dioxin/furans to the San Jacinto River from Alternative 6N was 2.0-2.37 grams, which is 0.34% of the total dioxins/furans to be removed from the pits. By just considering the additional releases from blocked open buckets spilling their contents, the total released to the San Jacinto River from dredging in the Northwest Area and the deep water portion of the Eastern Cell would be 32 grams, which is greater than 5% of the dioxins/furans in the pits. (Bean Consulting)

Response: *As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. Removal of the armored cap could have much greater impacts on resuspension and releases when removal in the wet is performed.*

It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. Residual release will be minimized through the use of BMPs determined during the Remedial Design.

2.5.115 Comment: The US Army Corps of Engineers stated that Alternative 6N would "still" set back the natural recovery of the site to existing conditions by up to a decade considering the time required for design, construction and assimilation of the releases into the sediment bed below the bioactive zone (US Army Corps of Engineers 2016 page 5). Importantly, this statement does not take into account the additional significant sources of resuspended contaminants and residuals that were not adequately considered in the release calculations, i.e., releases from dredging and auxiliary vessels, geotextile removal, more dredging passes, and loss of residuals under silt curtains. If these releases were adequately addressed, how many more decades would the recovery be set back?

Response: *Greater releases than estimated would increase the time that recovery would take to achieve background contaminant concentrations when using dredging to achieve removal. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. Excavation in the "dry" would minimize the potential release of contaminant and prevents any set back in the natural recovery of the site.*

2.5.116 Comment: Due to the ambiguous identification of the proposed best management practices and their location, the constructability of Alternative 6N cannot be determined. These are critical to understanding the technical feasibility of 6N, the extent of impacts to the San Jacinto River, and the costs. These are not areas for research and development at the Remedial Design stage. If they don't work, that would mean that Alternative 6N has been selected and justified on a faulty basis.

Response: *The EPA and US Army Corps of Engineers are aware of the challenges associated with the constructability of Alternative 6N. These challenges are not detailed in the Proposed Plan because these details will be addressed during the Remedial Design. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional*

Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. A cofferdam is proposed as a best management practice for implementing excavation in the "dry". Excavation in the "dry" has been implemented at numerous sites and is therefore considered to be technically feasible. A cofferdam would be placed outside and surrounding the existing armored cap so as not to disturb, resuspend and release contaminated sediment during construction of the cofferdam nor complicate and interfere with armored cap removal. The exact placement location of the cofferdam is a design issue to be addressed during the design phase.

2.5.117 Comment: Excavation in the "dry" is a misnomer for this project. For example, excavation of the first two feet or so in the Western Cell will be in the "dry", being above the river level. Below that level, the wastes will start to become water logged and saturated. Pumps will attempt to dewater the wastes, and keep up with the seepage through the sheet piles, but the wastes will remain saturated. The other source that will keep the wastes in a wet condition is the seepage from upwelling from below the waste pits. The depth of the wastes in the pits was estimated to be 10 feet (US Army Corps of Engineers 2016, page 99).

Response: *Excavation in the "dry" refers to removal in an unflooded state. The best management practice being considered is a cofferdam and sheetpile wall with sealed joints and the cofferdam will be filled with low permeability soil to control seepage through the cofferdam. The foundation soils include at least 10 feet of low permeability soft silt and clay immediately below the waste layer and underlain by a sand layer of similar thickness. The sand layer is underlain by more than 25 feet of hard, dense Beaumont clay. The cofferdam would be anchored in the Beaumont clay layer and would cut off the sand layer and limit the potential seepage. Upwelling through the low permeability clay layer is expected to be slow. The majority of the waste is expected to be soft and saturated. Construction activities on saturated sediments is also commonplace and techniques for working on soils with low ground strength are available such as use of swamp mats, marsh excavators, marsh cargo buggies, slide pontoons and other amphibious equipment. Similar equipment and techniques were used to place the armored cap at the San Jacinto River waste pits.*

2.5.118 Comments: Storms and flooding events are also not adequately considered in the EPA's 19-month construction period. No doubt, no crystal ball exists to predict the weather, but the US Army Corps of Engineers considered storms to be a real threat during construction. The US Army Corps of Engineers suggested that construction only occur during the offseason for hurricanes and tropical storms, i.e., when there is a lower probability of tropical storms and flooding conditions (US Army Corps of Engineers 2016, page 186). Due to the many implementation issues, the disturbed waste will be exposed for longer periods of time than contemplated by EPA.

Response: *Weather related impacts on construction duration is a common issue for all Superfund waste removal projects. The use of best management practices will minimize these impacts at the site. For example, a BMP such as a cofferdam and sheetpile wall could surround the site. A cofferdam may consist of a ringed structure constructed with two walls of sheet piles with sealed joints driven into a low permeability foundation layer and filled with soil to limit seepage. The cofferdam can be placed outside of the armored cap to prevent disturbance of the contaminated waste. The intent of the cofferdam elevation is to reduce the probability and frequency of inundation, limit the scour potential if inundated, reduce the potential volume of water to be treated from multiple dewatering events at the site, and restrict the size of delays in production. The site will remain covered with the armored cap until the cofferdam encircling the site is completed, maintaining the current level of protection at the site. The amount of waste exposed at any time will be greatly reduced by incremental removal of the armor cap and the waste material. As such, only a small sloped face of contaminated material would be exposed at any time, limiting the potential for contaminant releases. Removal operations would be stopped during hurricanes and flooding and would not resume until flooding has receded and the site has been dewatered. However, excavation is not likely to be the limiting process, but multiple excavators could be used if needed. Instead, transportation, decontamination, and the rate that the landfill is able to accept wastes are likely to be the controlling factors for construction time. A final schedule will be developed during the design phase. Weather related issues will be included in the operations plan as will appropriate contingencies.*

2.5.119 Comments: EPA reports various deficiencies in the TCRA cap, resulting from erosion, deficiencies in operation, maintenance and monitoring (OMM), and construction deficiencies. It is recommended that EPA describe in more detail why correct actions in the cap design would not sufficiently address the threats to human health and the environment under a permanent remedy for the Site.

Response: *Even though Alternative 3aN consists of an upgraded cap, it is still subject to the uncertainties of severe floods, a dynamic river, and adequate maintenance over the centuries that the waste will remain toxic. Climate models (Knutson and others, 2010) predict an increase in the intensity of tropical cyclones and hurricanes in the Gulf, meaning greater risk of flooding and storm surges over the long time frame that the dioxin waste would remain toxic. The cap design uncertainty arises from the potential increase in storm intensity by an unknown amount over the centuries that a cap would need to maintain its effectiveness. The storm intensity uncertainty, coupled with the inherent uncertainties of the models used to predict the future performance result in a highly uncertain prediction of the ability of a cap to reliably contain the waste.*

The Corps of Engineers did perform a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike). However, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the *waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

2.5.120 Comment: It is recommended that EPA further describe the potential short and long-term releases associated with Alternative 4N, which proposes additional solidification, in comparison to the full removal Alternative 6N.

Response: *A description of Alternative 4N is included in the Record of Decision. In general, Alternative 4N would be subject to both the potential long term releases associated with a cap failure, (especially for the areas that are not stabilized), and the potential releases associated with removal of the cap.*

2.5.121 Comment: EPA summarizes the US Army Corps of Engineers Report on page 8 of the Proposed Plan, stating that the US Army Corps of Engineers recommended a 15-inch stone, but the US Army Corps of Engineers report appears to references a 12-inch armor stone.

Response: *The US Army Corps of Engineers did discuss 12-inch armor stone in their "Evaluation of the San Jacinto Waste Pits Feasibility Study Remediation Alternatives" (2016) report, but ultimately the US Army Corps of Engineers recommended 15-inch armor stone for the Alternative 3aN upgrades as reported in the Proposed Plan.*

2.5.122 Comment: EPA's summary of Remedial Alternatives (Proposed Plan, page 21) should note that the TCRA costs for the present solidification and cap, reported to be $9 million, are not included in estimated costs for Alternatives 1N and 2N.

Response: *The costs for the time critical removal are not included in the costs, nor were the past operation, monitoring, and maintenance cost included, because the Proposed Plan addresses the final remedy decision for the Site, and considers the future costs required to implement each of the alternatives, for comparison.*

2.5.123 Comment: The draft NRRB Recommendations is a helpful review of the record. Although EPA has responded to issues raised in the NRRB Recommendations in its Proposed Plan, it is recommended that EPA expand its response to the statement made in the NRRB Recommendations, Remedy Effectiveness, page 11 that treatment alternatives have not been sufficiently evaluated. While EPA notes that the EPA Feasibility Study addresses solidification in Alternative 4N, it is recommended that EPA develop the record to more thoroughly support its rejection of the possibility of solidifying more waste as a permanent remedy. Solidified waste would be far less susceptible to the flood events for which EPA expresses concerns for alternatives in which wastes are left on the Site.

Response: *The solidified areas in Alternative 4N are less susceptible to flood events, however, removal of the armor cap required to perform the solidification would expose the waste material to the same potential releases as the other alternatives that include removal of the cap. The areas that are outside of the solidified area would still be subject to the same long term* *uncertainty associated with cap stability as the other capping alternatives. The Record of Decision describes the considerations for Alternative 4N.*

2.5.124 Comment: The Final US Army Corps of Engineers Report pre-dates the final EPA Feasibility Study and the final US Army Corps of Engineers Review did not include review of the final EPA Feasibility Study analyses. It would be helpful if EPA could make a determination with respect to the potential effectiveness of specific recommendations made in the US Army Corps of Engineers Review for improvements of the TCRA cap or other aspects of possible remedies in its additional analyses of removal alternatives. In other words, if proposed modifications were made to the alternatives (e.g. as a deeper cap with larger stone), would EPA's determination with respect to the Proposed plan remain the same? (PHA/HDR)

Response: *EPA considered the proposed modifications, which were included in Alternative 3aN. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. EPA has selected Alternative 6N using the nine CERCLA remedy selection criteria as described in the Record of Decision.*

2.5.125 Comment: Both the US Army Corps of Engineers models and the Anchor QEA models use vertically mixed assumptions with no stratification of flow. This is a serious limitation of the models being used to simulate sediment transport. An analysis to demonstrate whether or not the well-mixed circulation models used are appropriate and reliable for this sediment transport application is advisable.

Response: *The US Army Corps of Engineers report discussed the model assumption regarding stratification and found that the using a depth average mode, as did Anchor QEA (AQ), would have negligible impact on the predicted sediment transport during a severe event. As stated in the report:*

> *"Due to the lack of vertical salinity data to be able to quantify the degree of salinity-induced stratification and the combination of hydrologic conditions and tidal flows during which at least partially stratified flows occur in the SJR estuary, it was decided to run LTFATE in the depth-average mode like AQ did with their models. Thus, both models assumed that the San Jacinto River (SJR) estuary was well mixed, so it was not possible to quantify the impact of this assumption. This assumption is thought to have negligible impact on the predicted sediment transport during a severe event such as a flood or storm surge because the combined energy from the waves and wind-, river- and tide-generated flows would be more than sufficient to vertically mix the water column."*

2.5.126 Comment: As noted in previously submitted comments, neither the EPA Feasibility Study nor the US Army Corps of Engineers Report has noted the importance of bottom conditions on sediment stability or potential for remediation. It is recommended that EPA consider bottom conditions and their impacts on removal effectiveness and cost.

Response: *The US Army Corps of Engineers report discussed the bottom conditions and found that the bottom assumption did not have a significant impact on the results obtained by AQ's models. According to the report:*

> *"Use of hard bottom in the Houston Ship Channel (HSC) and in the upper reach of the SJR: The effect of this assumption in AQ's model framework was tested by determining the differences in the composition and thickness of the sediment bed at the SJR Site as predicted by AQ's models and LTFATE in which a hard bottom was not assumed in these two waterways. The differences were within the range of uncertainty associated with these models. The uncertainty associated with the limited sediment data in these waterways that were used to specify the sediment bed properties in LTFATE was included in this analysis. As a result, this assumption was not found to have a significant impact on the results obtained by AQ's models."*

2.5.127 Comment: It is recommended that a pre-design investigation (PDI) be conducted during the remedial design for each of the treatment or removal alternatives (Alternatives 4N-6). This is important for the northern impoundment, to confirm the physical nature of sediments, condition of the Site (topography/bathymetry), and extent of constituents of concern (COCs) in sediment/soil exceeding PRGs. The PDI would provide recent information for the remedial design phase, such as if contaminant levels in surface sediment and soil have been affected by land use such as the installation of new upland asphalt and local dredging) or weather events such as flooding or alterations in channel geometry, which may have spread or incidentally contained contamination. The MNR periodic sampling program can also be refined during the PDI. ICs, such as fencing, signage, and buoys and BMPs, such as erosion control, silt curtains, and storm water pollution protection associated with the selected remedy, can also be more fully scoped during the PDI.

Response: *An investigation during the Remedial Design is anticipated to clarify the various design factors associated with implementation of Alternative 6N. The current condition of the Sand Separation Area and the ground water will also be assessed during the design phase. However, the Remedial Investigation has already determined the nature and extent of the contamination at the Site and there are no plans to repeat this. Topographic and bathymetric surveys are being conducted on a quarterly basis as a part of the ongoing quarterly Site inspections, and these surveys will continue.*

2.5.128 *Comment:* EPA asserts that sonar tests in a 130-foot section south of the I-10 Bridge located adjacent to the Site found about 10 to 12-feet of erosion from the bottom of the river bed. Channel scour downstream from bridges (such as that observed downstream of the I-10 bridge as a result of the 1994 flood) or other hard structures is not indicative of scour processes that will be operative at the Northern impoundments in the future, unless a bridge is built immediately upstream. Sonar examinations of the riverbed in the vicinity of the Interstate 10 crossing after the 1994 flood are described by NTSB (1996): "The Texas Department of Transportation evaluated the extent of scour around the substructure of critical sections of the two Interstate 10 bridges (east- and west-bound). The results of the sonar tests performed on October 21-22, 1994, documented 12 locations in the main channel for distances up to 130 feet south of the east-bound Interstate 10 bridge." During this extreme event, scour was limited to a region in the main channel 130 ft south (downstream) from the east-bound bridge. Scour was not reported upstream from the crossing, between the bridges or outside the main channel. The Northern and Southern Impoundments were not scoured during the 1994 flood, despite the 10-12 ft of scour in the main channel downstream from the bridge and the fact that the Northern Impoundments were not capped at the time. The peninsula containing the Southern Impoundment is immediately downstream from the Interstate 10 crossing, but it would be impacted by bridge scour only in the event of a major realignment of the San Jacinto River main channel. As noted above, that channel has been stable and nearly static for a century and exhibits characteristics similar to stable rivers found elsewhere. Such a major realignment would be highly unlikely.

Response: *EPA agrees that a major realignment of the San Jacinto River channel would be unlikely. However, about 8-feet of riverbed scour along the eastern side of the site was discovered following the flooding in 2016, which raises concerns regarding the potential for long-term undermining of a portion of the cap. The extent of scouring at or near the waste pits during the 1994 flood is also an unknown, as no measurements were made in this area. These factors contribute to uncertainty in long-term performance.*

2.5.129 ***Comment:*** EPA asserts that changes to the site *(i.e., loss of land at the waste pits site due to erosion and subsidence)* will likely continue in the future. As noted above, the major driver of historical land loss at the Site was subsidence, which has been arrested by institutional controls such as those on groundwater extraction. Additional historical land loss was due to sand mining and in-channel dredging, which are now also restricted or banned in this area. It follows that land loss due to these factors should not continue in the future unless the driving factors are re-activated. At any rate, scientific data and tools are available to quantify risk regarding future morphologic changes impacting the Site (Hayter et al. 2014).

Response*: EPA agrees that much of the changes in elevation of the site that occurred previously have been arrested by institutional controls (restrictions on ground water pumping); although past capping and potential future capping may induce additional subsidence or slope stability concerns in some sections of the site. Additionally, diverting flow around the waste pits may have resulted in scour along the eastern side of the site during flooding in 2016. Additional armoring and slope/toe protection could provide additional protection; however, long-term monitoring and maintenance would be required. The extent of scouring at or near the waste pits during the 1994 flood is an unknown, as no measurements were made in this area. This contributes to uncertainty in long-term performance. The history of erosion of the San Jacinto River is pointed out in the National Transportation Safety Board's report (PB96-917004, NTSB/SIR-96/04) on the October 1994 San Jacinto River flooding; the NTSB report stated:*

> *"The flooding caused major soil erosion in the flood plain and river channel, including the creation of water channels outside the San Jacinto River bed. The flood waters scoured the riverbed and banks, destabilized roads and bridges, and inundated area*

homes. The largest new channel (approximately 510 feet wide and 15 feet deep) was created when the river cut through the Banana Bend oxbow just west of the Rio Villa Park subdivision. A second major channel cut through Banana Bend just north of the channel through the oxbow. Both these channels cut through areas where sand mining had been performed previously."

2.5.130 ***Comment:*** EPA asserts that Corps (Hayter et al. 2016) models (and any existing sediment transport model) cannot simulate river channel changes due to bank erosion, shoreline breaches, etc. during a high flow event caused by a major flood or hurricane. Therefore, the model predictions should be considered as having a very limited long-term reliability. Models are developed to evaluate specific situations or answer specific questions. Models themselves do not represent predictions; however, interpretations of model output can be used to predict future outcomes. Models can also be used to simulate a hypothetical scenario in order to evaluate a possible future state. Model uncertainty can be evaluated and quantified. As noted in the Proposed Plan, the Corps' hydrodynamic simulation model (Hayter et al. 2016) does not predict lateral movement or avulsion of the channel. Accordingly, the 2D hydrodynamic models (Hayter et al. 2016, AQ 2012) have not been used to evaluate potential larger scale river processes such as localized bank erosion, channel migration, or avulsion. To date, the models have been used to answer specific questions related to conditions directly adjacent to the cap. However, notwithstanding their limitations, these and similar models can quantify shear stresses impinging on the Northern and Southern Impoundments under "worst-case" extreme events (or more frequent) events. Evaluation of these stresses in light of critical stresses needed to erode the channel boundaries and floodplains can give an indication of the potential for channel migration or avulsion to initiate. Such an evaluation should consider reaches up- and downstream from the Site. In fact, models developed by Hayter et al. (2016) in support of the Proposed Plan might have been used to perform such an analysis if they captured stresses on the floodplain during overbank flow conditions. However, the work plan presented by Hayter et al. (2016), as requested by the EPA, did not include this task. The current version of HEC RAS 5.0 includes the USDA-ARS Bank Stability and Toe Erosion Model (BSTEM). Although it cannot simulate large-scale channel change, it can simulate bank erosion. This model could have been used to examine bank erosion rates and erosion potential under various scenarios. Recently-developed, "morphodynamic" simulation models (e.g., Langendoen et al. 2015 and 2016) simulate lateral channel migration and predict future channel alignments. Thus, contrary to EPA's assertion, simulation of avulsions (cutoffs) and subsequent channel response would have been possible.

Response*: The US Army Corps of Engineers did not attempt to perform morphodynamic simulations during its modeling of cap stability and erosion. The US Army Corps of Engineers found that the hydrodynamic and sediment transport modeling was sufficient to establish concerns regarding the site stability. Demonstration of shear stresses sufficient to erode larger than 8-inch stone as shown in the modeling was sufficient to indicate the potential for channel migration to initiate.*

2.5.131 ***Comment:*** EPA asserts that future storm intensity and flooding may be even more intense due to climate change, sea level rise, and continued urban development. Greater submergence due to sea level rise may further reduce hydraulic loads during the most extreme events. The Northern Impoundments' location just upstream of the I-10 crossing and rising sea level will place it under backwater conditions and in a depositional rather than erosional environment for the most extreme events. In fact, considering a wide range of events, the Site is already depositional. Hayter et al. (2016) found that net average long-term sedimentation rate averaged over the area of the existing cap is 1.3 cm/yr.± 0.8 cm/yr. Similar findings were reported by AQ (2012). It is assumed that as additional information becomes available about storm intensity and hydraulic loadings under future climate and sea level scenarios, these data could provide a basis for quantitative analysis. If appropriate engineering analyses indicate potential for unacceptable hydraulic loading on the Impoundments or river channel movement over the period of interest, there are structural measures (river training structures such as groins, spurs, jetties, revetments or bank protection structures) that could be designed, in accordance with standard guidance and with appropriate factors of safety, to address such conditions.

***Response**: Greater storm intensity would lead to larger impacts from waves, particularly in shallow locales. While the site is net depositional as a whole, specific points are not; localized scour of about 8-feet has been observed adjacent to the cap. Structural measures such as groins, spurs, jetties, revetments, or bank protection structures would be subject to the same uncertainties as an armored cap, would increase the construction costs related to the capping alternatives, and would need to be monitored and maintained, as well as the site.*

Climate models (Knutson and others, 2010) predict an increase in the intensity of tropical cyclones and hurricanes in the Gulf. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

2.5.132 *Comment*: The Final Interim Feasibility Study and Proposed Plan reflect a clear bias in Region 6 against containment as an effective remedy approach. Alternative 3aN was not selected as the preferred alternative based on EPA concerns over an ultra-extreme flow condition, based on a 500-year reliability benchmark. The use of a 500-year event is extreme and is inconsistent with EPA technical guidance for capping.

***Response**: EPA does not agree that ultra-extreme flow conditions were used to assess the San Jacinto site. Technical guidance does not provide a specific design or evaluation criteria for flood return period, but rather states that it should be appropriate for the risk posed by a failure. For comparison purposes, the guidance states that the design life for a bridge or dam is 50 years and that the ability to predict forces or conditions for events with a return period greater than 100 years is restricted by the available data from historic records. However, timeframes of hundreds of years have been considered for calculations of contaminant flux and adsorption. Additionally, nuclear waste disposal facilities are designed for tens of thousands of years. Again,* *the required permanence is dependent on the risk posed. The waste pits site poses considerable uncertainty due to the frequency of flooding and tropical storms. The flood rates used to assess the San Jacinto waste pits are not unusual for the location of the site; the conditions modeled in the August 2016 US Army Corps of Engineers Report resulted in a river flow rate of 390,000 cubic feet per second, which is only 8 percent greater than the 360,000 cubic feet per second flow rate reported during the October 1994 flood. Further, there were two other San Jacinto River floods during the 20th Century of greater intensity than the 1994 flood based on the Sheldon river gauge station (flood stage as follows: 32.90-feet on May 1, 1929; 31.50-feet on November 16, 1940 compared to 27.09-feet on October 19, 1994). Finally, the recent flooding associated with Hurricane Harvey resulted in a 500-year flood in the San Jacinto River based on Harris County's Flood Warning System.*

The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would most likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike), however, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic.

2.5.133 *Comment:* EPA dismisses the fact that a containment remedy approach can be designed and implemented at this Site to provide secure and permanent isolation of the waste.

***Response**: A containment remedy approach can be designed and implemented at this Site. However, containment presents a number of challenges as well as monitoring, maintenance and repair. Analysis of the site shows significant potential for erosion and considerable uncertainty in the range of potential shear stresses that the site will experience.*

2.5.134 *Comment:* Alternative 3aN contains provisions that would ensure stability against very extreme events. This Alternative was essentially dismissed by EPA for the same reasons they rejected Alternative 3N, even though 3aN is a significantly more robust containment alternative.

***Response**: Containment also presents a number of challenges as well as monitoring, maintenance and repair. Analysis of the site shows significant potential for erosion and considerable uncertainty in the range of potential shear stresses that the site will experience. The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike). However, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

2.5.135 ***Comment:*** The Proposed Plan indicates that the preferred remedy was selected based on the Final Interim Feasibility Study as supported by the US Army Corps of Engineers Report. But, the details on long term effectiveness and implementability for the alternatives in both the Final Interim Feasibility Study and Proposed Plan were selectively cited from the US Army Corps of Engineers Report to support a removal alternative. In plain language, the Proposed Plan cherry picked statements from the US Army Corps of Engineers Report to support removal, while largely ignoring considerations in the US Army Corps of Engineers Report that clearly supported a containment alternative.

Response*: The US Army Corps of Engineers report contains information on the shortcomings and strengths of all of the alternatives without providing a recommendation or preference for the selection of an alternative. Capping would yield very low short-term releases while leaving the potential for failure under extreme events or stream bed morphological changes. Removal could also yield very low short-term releases under favorable construction conditions with the most stringent best management practices and would eliminate the potential for failure in the future. Removal with less than the most stringent best management practices would likely yield considerable short-term releases.*

As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.

2.5.136 ***Comment:*** There is no precedent for a remedy similar to Alternative 6N that involves de-construction of a secure containment and subsequent removal and transport of hazardous waste under these site conditions. The existing Time Critical Removal Action cap has soundly contained the waste since its construction. Repairs made to the existing cap have been minor and appear to be consistent with either flaws during the construction of the cap or a barge strike. There have been no documented releases of dioxin from the containment now in place.

Response*: The existing temporary cap was constructed as an interim measure to stabilize the waste pits while a final remedy could be developed. While the waste has been contained for the five years that the temporary cap has been in place, the cap has undergone a number of repairs that shows some of the weaknesses of containment. First, repairs were made on the western berm due to sloughing of the armor stone. Second, a 400 to 500-sq feet section of the cap in the Northwestern Area was repaired due to a failure that appeared to be caused by a bearing capacity failure from a poor filter layer and soft waste materials. Third, numerous locations in the Eastern Cell were repaired because the geotextile was exposed from apparent* *shifting or movement of the armor cap. Lastly, an area of scour nearly adjacent to the Eastern Cell was filled and armored from the edge of the cap to the outer limit of the scour hole. Consequently, the temporary cap appears to be less than secure containment.*

2.5.137 *Comment:* The comparison of Alternatives 3aN and 6N was developed on an inequitable basis. EPA's comparison of alternatives was pre-disposed toward removal as a remedy approach and so inequitably exaggerated the disadvantages of a containment approach and dismissed the disadvantages of the removal approach.

***Response**: The Record of Decision evaluated the remedial alternatives against the nine criteria. Based on the evaluation of alternatives the ROD selected alternative 6N as the remedy.*

As discussed in the ROD, EPA considered several options for contaminated materials. EPA selected a remedy that includes removal of contaminated materials above cleanup levels for the waste impoundments and MNR for the lower contamination level in the Sand Separation Area for the following reasons:

- *The material is highly toxic and under conditions in the San Jacinto River may be highly mobile and therefore is considered a Principal Threat Waste.*
- *The location of materials, either partially submerged within the San Jacinto River (northern impoundments) or on a small peninsula on the San Jacinto River (southern impoundment), result in limited ability to treat the waste in place without the threat of a release during the remedial action.*
- *The area has a high threat of repeated storm surges and flooding from hurricanes and tropical storms, which if the material was left in place, could result in a release of hazardous substances.*
- *Surface water sampling conducted in July 2016 indicated that tetra-dioxin and tetra-furan both more than tripled going over the cap. Removal of the source material will prevent this increase.*
- *Performing the dioxin removal using Best Management Practices, as determined during the Remedial Design in consultation with the U.S. Army Corps of Engineers and TCEQ, will reduce the short-term impacts and prevent any material release during the removal.*
- *Removal of the source waste material in the impoundments will eliminate the potential for a future release to the environment, which is a long-term benefit that outweighs the cost of removal. Dioxin is very persistent in the environment and is expected to remain toxic for a long time. Any cleanup approach involving capping would have to reliably achieve containment in perpetuity. Given that the Site is partially submerged in a river subject to extreme floods and hurricanes, containment is not a reliable solution for the Site.*

- *Based on historical performance of the temporary cap and surrounding area, concerns remain regarding past damage to the cap, the underwater exposure of dioxin wastes that occurred in 2015, and the sediment erosion adjacent to the capped area. The potential release and transport of the dioxin over the long-term would further impact ecological and human receptors. The long-term performance of the cap as well as the efficacy of maintenance for hundreds of years into the future is uncertain.*

For all of these factors, the Selected Remedy provides greater permanence in comparison to other alternatives. Less costly alternatives rely on remedies that have a higher chance of failure by leaving Principal Threat Waste source materials in the river, resulting in greater uncertainty as to their long-term effectiveness.

2.5.138 ***Comment:*** Alternative 3aN holds significant advantages over Alternative 6N since it has no short-term impacts, a lower risk of a catastrophic release of dioxin, and no implementability issues.

Response*: EPA disagrees that Alternative 3aN has a lower risk of a release of dioxin, and no implementability issues. Capping poses greater risk of a release of dioxin from erosion, scouring adjacent to the cap and channel realignment than from removal within a BMP such as a cofferdam. Capping also has implementability issues with the filter layer and slope stability in the Northwestern Area, as well as bearing capacity of the waste material to allow greater thicknesses and size of armor stone.*

The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike). However, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

2.5.139 ***Comment:*** Alternative 3aN would entail modification of the current cap to meet the low probability barge strike and ultra-extreme storm and flow events described previously. This would involve placement of at least 24 inches of armoring material with a median diameter of 15 inches (which exceeds the US Army Corps of Engineers recommended median of 12 inches) as well as pilings to protect against barge strikes. This alternative involves enhancing the existing armored cap and would not involve disturbance of the underlying waste. It would be easily constructed, and there should be no associated release of waste materials. The remedy is expected to require 15 months to implement according to the Final Interim Feasibility Study and Proposed Plan prepared by EPA. During this period, however, the Northern Impoundments at the Site would be protected by armoring that is at least equivalent to the current armoring which the US Army Corps of Engineers suggests has effectively contained contaminants over the past 6 years despite small areas of the cap that have required maintenance. The Proposed Plan suggests that there may be negative consequences of the additional rock placement including settling or expression of waste material beyond the cap. Settling of the current cap has not led to observable negative consequences and has likely led to some consolidation and strengthening of the underlying waste material. The expression of waste material beyond the cap is highly unlikely given the observed need for gentle slopes on armoring material that will extend the cap far beyond the boundaries of the waste.

***Response**: Placement of a thicker cap poses uncertainty and difficulties, particularly in the Northwestern Area. A 400 to 500-sq feet section of the cap in the Northwestern Area was repaired due to a failure that was apparently caused by a bearing capacity failure from a poor filter layer and soft waste materials. Greater thicknesses and size of armor stone increase the potential for additional failure in this area. Additionally, the slope in the Northwestern Area is steep and susceptible to slope failure with the additional loadings from a much thicker armored cap. Considerable construction difficulties were encountered in placing the temporary cap in this area and additional difficulties should be expected from construction of Alternative 3aN. The slope cannot be readily flattened to a gentle slope of 1:3 or 1:5 without adding a very large quantity of material. Regarding the US Army Corps of Engineers recommendations for larger rock for Alternative 3aN, the US Army Corps of Engineers did consider 12-inch rock in their report (2016). However, the USAGE ultimately recommended the use of a larger 15-inch rock.*

2.5.140 *Comment:* Any effect of future storm events and potential climatic changes, expressed as a concern by EPA, will push the river toward adapting to future flows by erosion of the weakest portions of the river, namely the soft, fine-grained sediments and banks, rather than the highly armored cap structure. One could envision a situation, should a hypothetical event of maximum discharge and Hurricane Ike occurred simultaneously, that the Alternative 3aN cap would be the only engineered structure still largely in place along the San Jacinto River. In addition, partial losses of a cap would not compromise its effectiveness like partial losses to a building or even a harbor protection structure (where partial losses might expose the harbor to full storm surges). Failures of such structures generally occur not through erosion of a cap but by undermining of the structure through erosion of the softer material underneath. This is avoided in the proposed cap by extending the cap with modest slope well beyond the edges of the sediment desired to be contained.

***Response**: EPA does not agree that partial losses of a cap would not compromise its effectiveness because partial losses may result in releases of toxic dioxin to the environment. There will be locations on or adjacent to the cap that will be subjected to much greater shear stresses due to site geometries and convergence of flow around or over the site. As evidenced by localized scouring along the eastern edge of the East Cell during 2016 flooding, extensive armoring or hardening of the area surrounding the site would likely be needed to prevent undercutting of the cap slopes. The scouring could undermine the perimeter slopes and lead to slope failures, particularly in areas with steeper slopes.*

The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane

(Hurricane Ike). However, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

2.5.141 Comment: Digging up the waste and removing it will re-suspend the waste in the process. The Proposed Plan discounts the significant releases that the U.S. Army Corps of Engineers concludes will result from Alternative 6N, even with the use of enhanced Best Management Practices (BMPs). Some releases are inevitable despite use of BMPs and significant releases are likely to occur during heavy rain events or other storms that have been documented to occur locally at a regular frequency. In fact, the US Army Corps of Engineers Report notes that contaminant mobilization from resuspension is expected to release 400,000 times as much contaminants as currently occurs with the intact cap and possibly five times higher than that if a flood event occurs.

***Response**: This comment assumes removal in the wet where water is able to be transported through the site. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. Consequently, the remedial action for the Site would need to include a BMP such as a cofferdam completely surrounding the Site. The cofferdam may consist of a ringed structure constructed with two walls of sheet piles with sealed joints driven into a low permeability foundation layer and filled with soil to limit seepage. Portions of the sediment at the base of the cofferdam would be armored to prevent erosion at the base of the outer wall. Additionally, the cofferdam must be of sufficient height to prevent overtopping from most flooding events. All of the water pumped from the site, including site water, storm water, wash water and seepage, would be treated prior to discharge at the site. Removal in the "dry" eliminates the potential for resuspension and release of contaminants and contaminated water. It also prevents the formation of residuals from sedimentation and allows removal to the cleanup level by preventing the fluidization and spreading of the sediment in an uncontrolled manner. Additionally, removal in the "dry" facilitates the sampling, monitoring and testing of the site to ensure compliance.*

2.5.142 *Comment:* Alternative 6N is acknowledged by EPA to result in short term releases of dioxin during implementation. Under the selected removal option potential exposure to the contaminants of concern will be 4,000 times greater than with a secure closure in place.

Response*: This comment assumes removal in the wet where water is able to be transported through the site. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. Removal in the "dry" eliminates short-term releases of contaminants and will perform comparably to secure containment in place without the potential of future cap failures.*

2.5.143 *Comment:* The US Army Corps of Engineers raised issues related to implementability of Alternative 6N that were dismissed by EPA by a hand wave mention of Best Management Practices (BMPs). EPA has not adequately identified and evaluated the implementation challenges associated with Alternative 6N. To assess whether the project is practicably constructible and whether EPA's cost estimate and schedule reflect the potential complexity and challenges associated with its implementation, much more information is needed on best management practices, including descriptions of where proposed sheet piles will be installed. In general, Alternative 6N is a very inefficient remedy. It has a much higher cost, much higher short-term risk, significant implementation issues, and longer construction time.

Response*: EPA and US Army Corps of Engineers are aware of these challenges associated with Alternative 6N. These challenges are not detailed in the Proposed Plan because these details will be addressed during the Remedial Design. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards. A cofferdam is considered as a best management practice for implementing excavation in the "dry". The cofferdam would be placed outside and surrounding the existing armored cap so as not to disturb, resuspend and release contaminated sediment during construction nor complicate and interfere with armored cap removal. The foundation sediments outside of the boundaries of the* *armored cap may have greater strength and stability than the waste sludge which would further investigated in pre-design. The exact placement location of the cofferdam is a design issue that would consider foundation subsurface conditions, slopes, removal depths, potential for slumping and offset requirements. Refined estimates of costs and construction times will be developed during the Remedial Design.*

2.5.144 *Comment:* The result of EPA's "to be determined later" approach to best management practices and inadequate assessment of resuspension and residuals is a fundamentally flawed assessment of risks and prediction of the short and long term impacts of Alternative 6N.

***Response**: The best management practice is identified with qualifiers and is cited "to be determined later" because the scope of past geotechnical investigation was limited. Additional pre-design investigations may be necessary to assess the feasibility of certain best management practices such as sheet pile walls with sealed joints. As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

A cofferdam is considered to be an effective best management practice to control releases and residuals, both short- and long-term impacts, for complete removal of the waste sludge and contaminated sediments at the San Jacinto River waste pits. Cofferdams offer flexibility in construction methods and material to accommodate the local site conditions and project goals. Additionally, a cofferdam could be placed outside of the armored cap to prevent disturbance of the contaminated sediment prior to containment. Cofferdams have been constructed and dewatered in similar locales for excavation and construction activities such as at Formosa Plastics, Texas site for contaminated sediment removal, at Matagorda Bay for archeological recovery and at numerous coastal sites for flood gate, bridge and tunnel construction. Armor stone and geotextile removal are common in shoreline and coastal construction projects. Access, staging, off-site transport and off-site disposal are common to sediment removal projects and capping projects. Water treatment has also been used at many sediment removal sites such as Fox River, Ashtabula River, Onondaga Lake and Grasse River where hydraulic dredging has been employed. Construction activities on saturated sediments is also common and techniques for working on soils with low ground strength are available such as use of swamp mats, marsh excavators, marsh cargo buggies, slide pontoons and other amphibious equipment. Similar equipment and techniques were used to place the armored cap at the San Jacinto River waste pits. Removal in the "dry" eliminates the potential for resuspension and release of contaminants and contaminated water. All impacted water would be pumped from the site and treated before *being discharged. It also prevents the formation of residuals from sedimentation and allows removal to the cleanup level by preventing the fluidization and spreading of the sediment in an uncontrolled manner. Additionally, removal in the "dry" facilitates the sampling, monitoring and testing of the site to ensure compliance and prevent long-term impacts from residuals.*

2.5.145 ***Comment:*** Excavation of this waste will initially be accomplished by bulldozers and dry land excavators, but as the removal gets deeper, the removal will likely need amphibious vessels that can work in the muck and mud. As the waste material is removed from the deeper depths, the ability to effectively dewater the site becomes more difficult. In order to continue operations, the equipment will need the capability to work in both flooded and semi-dry conditions. This is a real complicating factor, resulting in extra time and cost working in and attempting to remove the muck (i.e. the saturated waste materials), and will result in serious construction issues including impacts on the schedule. While amphibious equipment provides the ability to operate under more adverse conditions, it is less productive. This very time intensive work will result in the disturbed waste being exposed for long periods of time even if the armor cap and geotextile are removed in sections.

Response*: The majority of the waste is expected to be soft and saturated. Construction activities on saturated sediments is common and techniques for working on soils with low ground strength are available such as use of swamp mats, marsh excavators, marsh cargo buggies, slide pontoons and other amphibious equipment. Similar equipment and techniques were used to place the armored cap at the San Jacinto River waste pits. Excavation is not likely to be the limiting process, but multiple excavators could be used if needed. Instead, transportation, decontamination, and the rate that the landfill is able to accept wastes are likely to be the controlling factors for construction time. The armored cap above a small section of the site would be removed first and then entire depth of waste material and contaminated sediment in that small section would be removed next. The excavation would then proceed in an adjacent section using the same approach. The size of the section would be dependent on the reach of the equipment and the slumping of the waste materials. Swamp mats can improve equipment mobility and increase efficiency. A sump would be excavated along the edge below the depth of contamination to collect runoff, seepage and drainage, and improve dewatering. The sump would be pumped down as needed to maintain a dewatered site.*

2.5.146 ***Comment:*** What would happen if a hurricane or flood occurred during construction activities? I would like to know more about how you're going to contain it when a hurricane comes through.

Response*: As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual*

BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.

The site will remain covered with the armored cap until a BMP such as a cofferdam encircling the site is completed, maintaining the current level of protection at the site. The height of the cofferdam is a design decision that will require further evaluation. The proposed elevation of 10 feet NAVD 88 was based on modeled elevations presented in the Feasibility Study for a design flood with a 25- to 50-year return period. Actual flood elevations at the northern San Jacinto waste pits are uncertain and require more study. For cost estimation purposes, the top elevation of the cofferdam was 14 ft NAVD89 to prevent inundation by a 100-year or smaller flood, with a flood stage at the Site for a 100-year flood at approximately 12 ft NAVD89. The intent of the proposed cofferdam elevation is to reduce the probability and frequency of inundation, limit the scour potential if inundated, reduce the potential volume of water to be treated from multiple dewatering events at the site, and restrict the size of delays in production. The armored cap would be incrementally removed as the waste material and contaminated sediment are excavated to depth. As such, only a small sloped face of contaminated material would be exposed at any time, limiting the potential contaminant releases. Removal operations would be stopped during hurricanes and flooding and would not resume until flooding has receded and the site has been dewatered. If the site is inundated by flooding, whether associated with a hurricane or not, the height of the proposed cofferdam and the short fetch length within the cofferdam would reduce flows and waves across the site and consequently the resulting bottom shear stress. The resulting shear stress would be too small to erode the remaining armored cap or residuals from the depths post-dredging.

2.5.147 ***Comment:*** Transport of 13,300 to 17,500 truckloads of dioxin/furans wastes through crowded neighborhoods and a highly populated county (Harris County) on the way to the disposal site (undetermined at this point) will result in transportation safety issues and environmental threats.

Response*: Concerns regarding transportation of contaminated wastes are common for all Superfund projects. Access to I-10 is only about 1½ miles from the site via the East Freeway Service Road, which is primarily used for non-residential, commercial/industrial traffic and trucking. The removal operation would fill one truck every 10 to 15 minutes and the total traffic at the operation would be about one vehicle every six minutes, including worker traffic and deliveries. There is little other traffic over most of the route to I-10. The traffic volume is inconsequential for I-10 and its ramps, representing about 0.2 percent of the average daily truck traffic on I-10 and less than 3 percent of the ramp capacity. Therefore, the operation would not be expected to result in transportation safety issues, but further evaluations of transportation issues will be performed during the Remedial Design. Potential spills of the wastes and contaminated sediments do not pose substantial short-term human health and environmental risk. The materials are not considered hazardous under RCRA and DOT regulations since the materials are not ignitable/flammable, corrosive, reactive or toxic as characteristic of hazardous materials. Risks develop from the long-term dermal exposure or ingestion of the contaminants.*

The Remedial Design will develop contingency plans to prevent long-term exposure and decontaminate any spills, including those resulting from vehicle accidents. The wastes would be contained in sealed and covered trucks and the trucks will be decontaminated before leaving the site to control releases of contaminants. The primary risks from the contaminated sediments are associated with the exposure in the aquatic environment where the contaminant is able to bioaccumulate in the tissues of aquatic organisms consumed by humans and predators.

2.5.148 *Comment:* Ensuring proper safeguards are in place and removal with best engineering practices is no doubt feasible. In fact, it has been completed successfully at other sites to date. With proper planning and third party oversight of the removal operation it can be a success.

Response: *EPA agrees with this comment. Comparable excavation within a cofferdam was performed at the Formosa Plastics site in Texas, DuPont Gill Creek (SH1) site in New York. Removal in the "dry" was performed to control organic chemical liquid releases in the upper 1½ miles of the Housatonic River site using cofferdams and by-passing the river flows through large culverts. Sheet pile wall cofferdams have been used in a large sediment removal in the "dry" project in the Grand Calumet River in Indiana to control NAPL releases. The Phase I Removal Action in Passaic River included sheet pile enclosure as a cofferdam for dioxin contaminated sediment. Berms have been employed to form cofferdams to control resuspension at Hooker Chemical site in New York. Consequently, employing a double-walled cofferdam surrounding the site as the principal best management practice is expected to perform successfully.*

2.5.149 *Comment:* To build a coffer dam around the site and dig it out is safest way to handle this situation. This can be done with best engineering practices without spreading anymore of the toxins than already have been.

Response*: As discussed in the Proposed Plan of Action, EPA and USACE indicated that a potential small release of the waste material may occur during removal activities under alternative 6N. Comments received during the Proposed Plan comment period requested that EPA consider the use of additional Best Management Practices (BMPs) to prevent or minimize the release of waste material during removal. To this end, the EPA worked with USACE to further evaluate the use of BMPs to minimize releases during remedial action. One of the BMPs proposed was the use of a cofferdam with excavation in the "dry" to prevent the re-suspension and residuals that typically result from under water dredging. It should be noted that the actual BMPs to be utilized will be determined during the Remedial Design phase after engineering assessment and evaluation. All final BMPs used as part of the remedial action will have to comply with ARARs, including the requirement that there be no discharges that exceed the Texas Surface Water Quality Standards.*

2.5.150 *Comment:* What is the impact of safety and personal protection gear on project efficiency and schedules? This was not addressed in EPA's timeline**.**

Response*: No significant impact on project efficiency and schedules are anticipated due to safety and personal protection gear. The construction time estimates incorporate the use of* *routine safety and personal protection equipment typically employed at Superfund sites. No unusual safety gear such as supplied air respirators is needed for the project.*

2.5.151 ***Comment:*** The Proposed Plan minimizes the implementability challenges associated with removal, for example – dewatering, incremental excavation, removal of the existing cap, access, off-site transport and off-site facility, and construction duration. There are significant unknowns posed by the prospect of removing an armored cap with contaminated media below it – something that has never before been performed at any site. In addition, although the Proposed Plan indicates that much of the work can be performed under "dry" conditions, the dewatering that will be required to obtain such "dry" conditions presents significant implementability issues, including the siting and construction of dewatering facilities in a manner that prevents the release of contaminants. Moreover, the wastewater that is generated by dewatering must be treated. The Proposed Plan fails to take into account these obstacles to implementation.

Response*: EPA and US Army Corps of Engineers are aware of these challenges and the Proposed Plan did not seek to minimize the components of excavation in the "dry". These components are not addressed in the plan because these details will be addressed during the Remedial Design. Despite the challenges, these remediation components have been implemented in many construction and sediment remediation projects. Cofferdams have been constructed and dewatered in similar locales for excavation and construction activities such as at Formosa Plastics, Texas site for contaminated sediment removal, at Matagorda Bay for archeological recovery and at numerous coastal sites for gate, bridge and tunnel construction. Armor stone and geotextile removal are common in shoreline and coastal construction projects. Access, staging, off-site transport and off-site disposal are common to sediment removal projects and capping projects. Water treatment has also been used at many sediment removal sites such as Fox River, Ashtabula River, Onondaga Lake and Grasse River where hydraulic dredging has been employed. EPA recognizes the concerns regarding the treatment and disposal of site generated water. The pre-design investigations will support development of applicable requirements that will be reviewed for CWA 401 water quality certification. Construction activities on saturated sediments is also commonplace and techniques for working on soils with low ground strength are available such as use of swamp mats, marsh excavators, marsh cargo buggies, slide pontoons and other amphibious equipment. Similar equipment and techniques were used to place the armored cap at the San Jacinto River waste pits.*

2.6 San Jacinto River Characteristics

EPA received numerous comments from individuals in the surrounding communities, industry, industry associations, and non-governmental organizations regarding the impacts of the San Jacinto River itself on performance of a remedial action.

2.6.1 Comment: Although the riverine environment at the San Jacinto River Waste Pits is traditionally a depositional environment, the River has shown its immense force by cutting new channels and eroding large areas of material around the Pits. Most recently, the PRPs repaired a scoured area that was 60 ft. long and 8 ft. deep along the eastern side of the TCRA.

Response: *The most substantial and dramatic changes to river or estuarine environments occur as a result of extreme events, the effects of which are difficult to predict. The San Jacinto River has experienced actual short-term changes in the past. For example, the October 1994 flood, reported by the National Transportation Safety Board, resulted in "major soil erosion in the flood plain and river channel, including the creation of water channels outside the San Jacinto River bed. The flood waters scoured the riverbed and banks, destabilized roads and bridges, and inundated area homes." (NTSB, 1996). The railroad and highway roadbeds and bridges sustained major damage during the 1994 flood (USGS, 1995). More recently, the river bed scour that was identified in 2016 adjacent to the temporary cap also points to the potential for change and the dynamic nature of the river. A tidal river is an inherently more dynamic environment than would be a more stable inland location not subject to currents, changes in stage, and the more focused effects due to flooding, storm surges, and hurricanes to which the current location is subject. The San Jacinto River has been prone to severe flooding with major floods occurring in 1907, 1929, 1932, 1935, 1940, 1941, 1942, 1943, 1945, 1946, 1949, 1950, 1959, 1960, 1961, 1972, and 1978 (NTSB, 1996). The actual history of the San Jacinto River is sufficient to raise concerns about the stability of structures constructed in the river over the long time frame that the dioxin waste would remain hazardous.*

2.6.2 Comment: Flooding via storm surge is the major threat to the waste pit site and surrounding properties. The position of the site close to the mouth of a river or freshwater inflow makes it especially vulnerable given the mechanics of a storm surge. There are actually two inundation events: first, the initial rise and pulse of water inundating the waste pit site; second, the backwash of water as the surge releases back into Galveston Bay and ultimately the Gulf of Mexico. The intense tidal flushing can essentially deliver a "double dose" of pollutants to upstream residents, as well as a single downstream dose as the water returns to the Bay. Based on the NOAA hurricane surge inundation zones, the waste pit site would be inundated by any hurricane and tropical storm due to its low elevation and vulnerable location. Given its vulnerability, the site will almost certainly experience repetitive erosive surge events in the coming years, further degrading the structural integrity of on-site protective devices.

Response: *EPA agrees with this comment. The low lying waste pits at the Site are subject to flooding from storm surges generated by both tropical storms (i.e., hurricanes) and other storms. Storm surges generated in the Gulf of Mexico propagate into Galveston Bay and into the Lower San Jacinto River. Storm surge modeling conducted by the National Oceanic and Atmospheric Administration (NOAA) predicted that category 3 and 5 hurricanes that hit*

Galveston Bay during high tide would produce surge levels of 23-feet and 33-feet, respectively, at the Site (Hayter and others, 2016). The San Jacinto River Waste Pits site is located in a Federal Emergency Management Agency (FEMA) designated "VE" Floodway Zone, meaning that it is prone to inundation by the 1 percent annual chance flood event with additional hazards due to storm induced waves (Brody and others, 2014). Finally, climate models (Knutson and others, 2010) predict an increase in the intensity of tropical cyclones and hurricanes in the Gulf, meaning greater risk of flooding and storm surges over the long time frame that the dioxin waste would remain hazardous.

2.6.3 Comment: The term "upstream" is often used in the supporting documents to describe water or sediment quality (contaminant) data. Professionals and lay readers may misinterpret this term to mean quality unaffected by the Site; however, that is not the case in a tidal estuary, such as the San Jacinto River. Tidal circulation and dispersion cause Site contaminants to move predominantly downstream, but they may also move upstream. EPA should explain this imitation of the term "upstream."

Response: *For the purpose of the study area, the term "upstream" is identified as "the river area in the opposite direction of the predominant river flow direction" and as identified visually on Figure 10 of the Proposed Plan. The actual river flow may reverse directions at times depending on the water volume being released from the dam, tidal effects, and storm surges. Sampling results in the vicinity of the Site are used to define the extent of contamination around the Site, both upstream and downstream, and not a designation of whether an area is upstream or downstream.*

2.6.4 Comment: Clarify the differences between a 100-year storm and a 100-year flood in the Proposed Plan and Feasibility Study. It would be helpful to identify that the "100-year" flood levels may change due to land subsidence, future changes in storm frequencies or intensities, or climate change.

Response: *A 100-year storm is a storm that, on average, has a 1% chance of occurring in any given year, or approximately once every 100 years. A 100-year flood is a flood that has a 1% probability of occurring in any given year. A 100-year storm does not necessarily result in a 100-year flood because there are several independent factors that can influence the relation between rainfall and river flow. These factors include the extent of rainfall in a watershed, the soil saturation before the storm, and the relation between the size of the watershed and the duration of the storm. Because the 100-year flood level is statistically computed using past data, as more data comes in, or when a river basin is altered in a way that affects the flow of water in the river, the level of the 100-year flood may change. Dams and urban development are examples of some man-made changes in a basin that affect floods. Clarification of the definition of a 100-year flood is included in the Record of Decision.*

2.6.5 Comment: Why are the barges allowed to park on the north side of the I-10 bridge near the site with the potential to strike the cap and who approved this?

Response: *EPA has no control over the positioning of the barges.*

2.6.6 Comment: The Proposed Plan relies heavily on the possibility that the river may change course and in so doing, will destabilize the existing or enhanced cap. This possibility was based in part on historical river aerial photos during different stage/tidal conditions but not based on a full geomorphic evaluation of the river.

Response: *The USGS performed a review of the geomorphic characteristics of the San Jacinto River based on review of historic documents. Hayter and others (2016) refer to "the dynamic nature of the flow regime in the SJR [San Jacinto River] estuary" in their assessment of the hydrology and hydrodynamics of the river, referencing the location of the Waste Pits within the FEMA designated 100-year floodplain, susceptibility to flooding from storm surges, and vulnerability of the Site due to sea level rise. While it is possible to evaluate a river as dynamic in terms of its tendency towards lateral channel migration and channel avulsion, a "dynamic system" could be considered a system subject to a wide range of flooding and storm surges, and this type of activity will continue irrespective of the additional impacts of subsidence or dredging that might occur in the area. The frequency of hurricanes along any 50-mile segment of the Texas coast is about 1 every 6 years; the annual average occurrence of a tropical storm or hurricane is about 1 per year (Roth, 1997). Hurricane Ike, which made landfall near the north end of Galveston Island as a Category 2 hurricane (wind speeds of 96-110 miles per hour) caused storm surges of 15-20 feet above normal tide levels in much of the Galveston Bay area (National Hurricane Center, 2017). Warner and Tissot (2012) conservatively estimate a sea level rise at Galveston Bay of 2.1 feet over the 21st Century, and continuously increasing risks of flooding from storm surges as the century progresses. By this definition, the river could be considered dynamic, and becoming increasingly more so over time.*

It may be true that the fluvial channel of the San Jacinto River in the area of the impoundments is relatively stable. However, a tidal river is an inherently more dynamic environment than would be a more stable inland location not subject to currents, changes in stage, and the more focused effects due to flooding, storm surges, and hurricanes to which the current location of the Waste Pits is subject. An analysis of San Jacinto River channel stability based on system history does not consider projected changing conditions, such as sea level rise, that could affect system stationarity and therefore stability.

While the argument can be made that the upstream channel changes due to the 1994 flood specific to the Banana Bend area did not occur downstream at the Site because channel conditions are different, this is not to say that there were no changes in size and flow paths of the river at the Site during the flood. Net erosion of 10-12 ft in the river bed downstream of the I-10 bridge (NTBS, 1996) suggests the erosive power of flow at the bridge and in the vicinity of the impoundments was significant. Simulation of the 1994 flood by Hayter and others (2016) using the hydrodynamic module in LTFATE predicted a maximum of 6.0 ft of scour in the reach of the San Jacinto River around and a short distance downstream of the substructure of the two I-10 bridges.

Despite being designed to withstand a 100-year flood, and in the absence of floods of this magnitude since the cap was in place, portions of the current armor cap have needed repair on an annual basis. Current models are not designed to simulate the potential combination of downstream dam releases due to flooding, onshore storm surges and flooding due to hurricanes, *decreased ground stability due to saturated conditions, and the increased occurrence of higher intensity storms, making the evaluation of erosion risk in the area of the impoundments problematic. The actual history of the San Jacinto River is sufficient to raise concerns about the stability of structures constructed in the river.*

2.6.7 Comment: The Proposed Plan should include evaluation of potential river changes that could occur and how quickly those changes could occur. That evaluation should then be the basis for development of an operations and maintenance plan. Rivers usually change over hundreds of years, which is why there is operation and maintenance.

Response: *The most substantial and dramatic changes to river or estuarine environments occur as a result of extreme events, the effects of which are more difficult to predict. The San Jacinto River has experienced actual short-term changes in the past. For example, the 1994 flood, reported by the National Transportation Safety Board, resulted in new channels eroding in the floodplain and undermining of pipelines in the area. Further, the river bed scour that was identified in 2016 adjacent to the temporary cap also points to the potential for change and the dynamic nature of the river. A tidal river is an inherently more dynamic environment than would be a more stable inland location not subject to currents, changes in stage, and the more focused effects due to flooding, storm surges, and hurricanes to which the current location is subject. The actual history of the San Jacinto River is sufficient to raise concerns about the stability of structures constructed in the river.*

A long term maintenance program would generally have the most application for a containment remedy, which would need to secure the impoundments for a long time. The ground water and the surface water would require regular sampling and review to confirm that there are no future releases, in addition to the regular containment structure inspections to confirm its continued integrity. Climate models (Knutson and others, 2010) predict an increase in the intensity of tropical cyclones and hurricanes in the Gulf, meaning greater risk of flooding and storm surges. Predicting long-term future conditions on which to base a maintenance plan would be uncertain.

2.6.8 Comment: A full geomorphic evaluation should be completed to assess the potential for the configuration of the river to change abruptly.

Response: *The USGS performed a review of the geomorphic characteristics of the San Jacinto River based on review of historic documents. However, geomorphic evaluations based on the behavior of upland river systems may not accurately simulate scenarios in a river downstream of a reservoir and in immediate contact with a tidal estuary. Also, what cannot be accurately predicted are the conditions that the impoundments and channels will be subjected to, given the need to secure the impoundments for the long time that the dioxin would remain hazardous. The San Jacinto River has experienced actual short-term changes in the past. For example, the 1994 flood, reported by the National Transportation Safety Board, resulted in new channels eroding in the floodplain and undermining of pipelines in the area. In addition, the river bed scour that was identified in 2016 adjacent to the temporary cap also points to the potential for change and the dynamic nature of the river. A tidal river is an inherently more dynamic environment than would be a more stable inland location not subject to currents,* *changes in stage, and the more focused effects due to flooding, storm surges, and hurricanes to which the current location is subject.*

2.6.9 Comment: What is the chance of the cap failing vs geomorphic change occurring? Performing a geomorphology analysis to evaluate the potential for abrupt changes in the river channel that might impact the Alternative 3aN cap and to determine whether engineering solutions exist for those potential impacts.

Response: *The USGS performed a review of the geomorphic characteristics of the San Jacinto River based on review of historic documents. A variety of models could be used to test potential effects to specific areas of the stream channel or impoundments with the application of specific stress conditions. However, the complex way in which the effects of these individual stresses interact and propagate through the river system in the area of the impoundments cannot be reliably simulated with existing models. The San Jacinto River has experienced actual abrupt changes in the past. For example, the 1994 flood, reported by the National Transportation Safety Board, resulted in new channels eroding in the floodplain and undermining of pipelines in the area. In addition, the river bed scour that was identified in 2016 adjacent to the temporary cap also points to the potential for change and the dynamic nature of the river. A tidal river is an inherently more dynamic environment than would be a more stable inland location not subject to currents, changes in stage, and the more focused effects due to flooding, storm surges, and hurricanes to which the current location is subject.*

2.6.10 Comment: Region 6 explicitly bases its rejection of Alternative 3aN on the possibility of a future abrupt change in the San Jacinto River's channel as a factor that could potentially cause the Alternative 3aN cap to fail. Region 6 did not, however, conduct a formal geomorphic evaluation of the river. In fact, the Administrative Record does not contain any credible support for concluding that the river could change course in the manner it speculates could occur.

Response: *The USGS performed a review of the geomorphic characteristics of the San Jacinto River based on review of historic documents. However, geomorphic evaluations based on the behavior of upland river systems may not accurately simulate scenarios in a river downstream of a reservoir and in immediate contact with a tidal estuary. Also, what cannot be accurately predicted are the conditions that the impoundments and channels will be subjected to, given the need to secure the impoundments for the long time that the dioxin would remain hazardous. The San Jacinto River has experienced actual short-term changes in the past. For example, the 1994 flood, reported by the National Transportation Safety Board, resulted in new channels eroding in the floodplain and undermining of pipelines in the area. In addition, the river bed scour that was identified in 2016 adjacent to the temporary cap also points to the potential for change and the dynamic nature of the river. A tidal river is an inherently more dynamic environment than would be a more stable inland location not subject to currents, changes in stage, and the more focused effects due to flooding, storm surges, and hurricanes to which the current location is subject. Finally, climate models (Knutson and others, 2010) predict an increase in the intensity of tropical cyclones and hurricanes in the Gulf, meaning greater risk of flooding and storm surges over the long time frame that the dioxin waste would remain hazardous.*

The Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike). However, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

2.6.11 Comment: Region 6's stated rationale for not undertaking such an evaluation is that modeling has limited applicability to geomorphic changes. Whatever the perceived limitations of modeling as a tool to evaluate such an event may be, that does not excuse Region 6 from performing a technical evaluation to support this claim. That is particularly true because Region 6 points to this argument as one of its primary reasons for rejecting capping as a protective remedy.

Response: *The USGS performed a review of the geomorphic characteristics of the San Jacinto River based on review of historic documents. A variety of models could be used to test potential effects to specific areas of the stream channel or impoundments with the application of specific stress conditions. However, the complex way in which the effects of these individual stresses interact and propagate through the river system in the area of the impoundments cannot be simulated with existing models. The San Jacinto River has experienced actual abrupt changes in the past. For example, the 1994 flood, reported by the National Transportation Safety Board, resulted in new channels eroding in the floodplain and undermining of pipelines in the area. In addition, the river bed scour that was identified in 2016 adjacent to the temporary cap also points to the potential for change and the dynamic nature of the river. The actual history of the San Jacinto River is sufficient to raise concerns about the stability of structures constructed in the river. A tidal river is an inherently more dynamic environment than would be a more stable inland location not subject to currents, changes in stage, and the more focused effects due to flooding, storm surges, and hurricanes to which the current location is subject. Finally, climate models (Knutson and others, 2010) predict an increase in the intensity of tropical cyclones and hurricanes in the Gulf, meaning greater risk of flooding and storm surges over the long time period that the dioxin waste would remain hazardous.*

2.6.12 Comment: With regard to Region 6's assertions about abrupt river channel migration: There is no support for Region 6's assertion that the river channel has "changed over time," based on a limited set of aerial photographs from 1956, 1966, 1973, and 1997. These photographs visually show inundated areas but not "channel migration" and do not support Region 6's assertion that they "clearly show that the river channel has changed over time." In fact, although the river is a dynamic system, which is subject to changes in size and flow paths, the main channel of the river is very stable.

Response: *A tidal river, as exists at the Site, is an inherently more dynamic environment than would be a more stable inland location not subject to currents, changes in stage, and the more focused effects due to flooding, storm surges, and hurricanes to which the current location* *is subject. Analysis of channel stability based on system history does not consider projected changing conditions, such as sea level rise, that could affect system stationarity and therefore stability. The San Jacinto River has experienced actual abrupt changes in the past. For example, the 1994 flood, reported by the National Transportation Safety Board (NTSB, 1996), resulted in new channels eroding in the floodplain and undermining of pipelines in the area. In addition, the river bed scour that was identified in 2016 adjacent to the temporary cap also points to the potential for change and the dynamic nature of the Site location. The actual history of the San Jacinto River is sufficient to raise concerns about the stability of structures constructed in the river. Finally, climate models (Knutson and others, 2010) predict an increase in the intensity of tropical cyclones and hurricanes in the Gulf, meaning greater risk of flooding and storm surges over the long time period that the dioxin waste would remain hazardous.*

To provide more detail to the response, the NTSB (1996) report refers to sonar tests performed around the substructure of critical sections of the I-10 bridge, but there was no specific reference in the NTSB (1996) report to tests over the entire area of the Northern Impoundment, or reference as to whether the impoundments were eroded. Despite a search of available literature, no additional references were found giving more detail about where the sonar tests referred to in the NTSB (1996) report were located. Thus the statement that "The Northern and Southern Impoundments were not scoured during the 1994 flood, despite the 10-12 ft of scour in the main channel downstream from the bridge and the fact that the Northern Impoundments were not capped at the time" cannot be evaluated. Classification schemes such as those by Lagasse and others (2004), used to establish channel stability, were designed to classify upland river systems. The San Jacinto River in this reach is downstream of a dam and is part of a coastal plain estuary. As such, there are additional forces acting on the river, such as downriver releases from the dam and upriver/onshore forces such as hurricanes and storm surges, which can affect the morphology of the area in ways not accounted for in an upland river classification scheme. A 2 ft rise in sea level (Warner and Tissot, 2012) and an increase in the frequency of high intensity hurricanes due to a rise in sea surface temperatures (Knutson and others, 2010), are among the changes predicted in the 21st Century that would affect the San Jacinto River in the area of the impoundments.

2.6.13 Comment: Region 6 has apparently made no effect to disaggregate the effects of subsidence, erosion and dredging on channel morphology.

Response: *The United States Army Corps of Engineers reported that changes in channel planform morphology due to bank erosion and shoreline breaches, etc., is beyond the ability of existing sediment transport models to simulate. However, the Corps' modeling did account for changes in morphology due to erosion and deposition. EPA is aware of the subsidence, erosion, and dredging that has occurred in the vicinity of the site. The erosion, as occurred during the 1994 flood and in 2016 adjacent to the temporary cap, for example, is one of the contributing factors raising uncertainties about the long term integrity of a structure meant to contain dioxin waste in the San Jacinto River. Regarding dredging, or sand mining, the National Transportation Safety Board in their report on the 1994 flood linked the erosion that occurred in the Banana Bend area with sand mining. EPA notes that sand mining also occurred immediately upstream and adjacent to the waste pits.*

A region of major subsidence is centered on the Site. Historical subsidence of up to 10 ft between 1906 and 1979 in the vicinity of the Site has been reported by the Harris Galveston Subsidence District, Bawden et al. (2012), and others. Subsidence has been arrested by institutional controls on groundwater extraction that are in place at the regional scale. The Corps of Engineers reported that the impact of any continued subsidence would be dependent on the rate of subsidence, which is not well known and cannot be predicted with any reliability. However, subsidence, and the slow rise of sea level, would both result in slightly deeper water depths in the area, but it is not believed that these effects would be substantial enough to affect the tidal, river, and wind induced circulation in the San Jacinto River estuary (Hayter and others, 2016).

2.6.14 Comment: While Region 6 asserts that the San Jacinto River is a very dynamic system, subject to changes in size and flow paths as experienced during the 1994 storm, in fact: examination of rectified aerial photos and maps show that the 1994 storm did not change the location or alignment of the main channel of the river within 2 miles of the Northern Impoundments.

Response: *While the argument can be made that the upstream channel changes due to the 1994 flood specific to the Banana Bend area did not occur downstream at the Site because channel conditions are different, this is not to say that there were no changes in size and flow paths of the river at the Site during the flood. Net erosion of 10-12 ft in the river bed downstream of the I-10 Bridge (NTBS, 1996) suggests the erosive power of flow at the bridge and in the vicinity of the impoundments was significant. Simulation of the 1994 flood by Hayter and others using the hydrodynamic module in LTFATE predicted a maximum of 6.0 ft of scour in the reach of the San Jacinto River around and a short distance downstream of the substructure of the I-10 bridge. More recently, in 2016, about 8-feet of riverbed scour occurred immediately adjacent to the temporary cap. While this scour area was repaired by covering it with armor rock, there is little certainty that a high intensity flood or a severe hurricane would not have resulted in significantly increased scour or damage to the temporary cap.*

Hayter and others (2016) refer to "the dynamic nature of the flow regime in the SJR estuary" in their assessment of the hydrology and hydrodynamics of the river, referencing the location of the Waste Pits within the FEMA designated 100-year floodplain, susceptibility to flooding from storm surges, and vulnerability of the Site due to sea level rise. A "dynamic system" could be considered a system subject to a wide range of flooding and storm surges, and this type of activity will continue irrespective of the additional impacts of subsidence or dredging. The frequency of hurricanes along any 50-mile segment of the Texas coast is about 1 every 6 years; the annual average occurrence of a tropical storm or hurricane is about 1 per year (Roth, 1997). Hurricane Ike, which made landfall near the north end of Galveston Island as a Category 2 hurricane (wind speeds of 96-110 miles per hour) caused storm surges of 15-20 feet above normal tide levels in much of the Galveston Bay area (National Hurricane Center, 2017). Warner and Tissot (2012) conservatively estimate a sea level rise at Galveston Bay of 2.1 feet over the 21st Century, and continuously increasing risks of flooding from storm surges as the century progresses. By this definition, the river may be considered dynamic, and becoming increasingly more so over time.

2.6.15 Comment: Changes associated with the 1994 storm consisted of erosion of high flow paths through floodplain sand mines (pits) and scour downstream from the I-10 bridge. Neither type of erosion resulting from the 1994 storm imperiled or caused erosion of the Northern Impoundments, even though there was no armored cap in place at the time; and neither type of erosion produced an avulsion [rapid abandonment of an existing river channel and creation of a new channel] in the main channel of the river. The extrapolation of rates of channel change from upstream reaches of the river (i.e., Banana Bend) to the reach immediately adjacent to the Northern Impoundments is not supported by evidence or logic.

Response: *While the argument can be made that the upstream channel changes due to the 1994 flood specific to the Banana Bend area did not occur downstream at the Site because channel conditions are different, this is not to say that there were no changes in size and flow paths of the river at the Site during the flood. Net erosion of 10-12 ft in the river bed downstream of the I-10 Bridge (NTBS, 1996) suggests the erosive power of flow at the bridge and in the vicinity of the impoundments was significant. Simulation of the 1994 flood by Hayter and others (2016) using the hydrodynamic module in LTFATE predicted a maximum of 6.0 ft of scour in the reach of the San Jacinto River around and a short distance downstream of the substructure of the I-10 bridge. More recently, in 2016, about 8-feet of riverbed scour occurred immediately adjacent to the temporary cap. While this scour area was repaired by covering it with armor rock, there is little certainty that a high intensity flood or a severe hurricane would not have resulted in significantly increased scour or damage to the temporary cap.*

2.6.16 Comment: The main channel of the river channel is stable with respect to the fluvial processes of lateral migration and avulsion and therefore cannot be characterized as "very dynamic."

Response: *It may be true that the fluvial channel of the San Jacinto River in the area of the impoundments is relatively stable. However, a tidal river is an inherently more dynamic environment than would be a more stable inland location not subject to currents, changes in stage, and the more focused effects due to flooding, storm surges, and hurricanes to which the current location of the Waste Pits is subject. An analysis of San Jacinto River channel stability based on system history does not consider projected changing conditions, such as sea level rise, that could affect system stationarity and therefore stability. Classification schemes such as those by Lagasse and others (2004), which can be used to establish channel stability, were designed to classify upland river systems. The San Jacinto River in this reach is downstream of a dam and is part of a coastal-plain estuary. As such, there are additional forces acting on the river, such as downriver releases from the dam and upriver/onshore forces such as hurricanes and storm surges, which can affect the morphology of the area in ways not accounted for in an upland river classification scheme. A 2 ft rise in sea level (Warner and Tissot, 2012) and an increase in the frequency of high intensity hurricanes due to a rise in sea surface temperatures (Knutson and others, 2010) are among the changes predicted in the next century that would affect the San Jacinto River in the area of the impoundments.*

While the argument can be made that the upstream channel changes due to the 1994 flood specific to the Banana Bend area did not occur downstream at the Site because channel conditions are different, this is not to say that there were no changes in size and flow paths of the *river at the Site during the flood. Net erosion of 10-12 ft in the river bed downstream of the I-10 bridge (NTBS, 1996) suggests the erosive power of flow at the bridge and in the vicinity of the impoundments was significant. Simulation of the 1994 flood by Hayter and others (2016) using the hydrodynamic module in LTFATE predicted a maximum of 6.0 ft of scour in the reach of the San Jacinto River around and a short distance downstream of the substructure of the two I-10 bridges.*

Sea level rise in the Galveston area is conservatively projected to be 2.1 feet over the 21st Century (Warner and Tissot, 2012), which will cause storm surge floods to progress further inland, and increase the frequency and intensity of flooding in the area of the impoundments. Despite being designed to withstand a 100-year flood, and in the absence of floods of this magnitude since the cap was in place, portions of the current armor cap have needed repair on an annual basis. Current models are not designed to simulate the potential combination of downstream dam releases due to flooding, onshore storm surges and flooding due to hurricanes, decreased ground stability due to saturated conditions, and the increased occurrence of higher intensity storms, making the evaluation of erosion risk in the area of the impoundments problematic.

Hayter and others (2016) refer to "the dynamic nature of the flow regime in the SJR estuary" in their assessment of the hydrology and hydrodynamics of the river, referencing the location of the Waste Pits within the FEMA designated 100-year floodplain, susceptibility to flooding from storm surges, and vulnerability of the Site due to sea level rise. A "dynamic system" could be considered a system subject to a wide range of flooding and storm surges, and this type of activity will continue irrespective of the additional impacts of subsidence or dredging.

2.6.17 Comment: Past "changes" in the river identified by Region 6 were highly influenced by conditions that no longer exist (e.g., subsidence and dredging), so there is no credible basis for Region 6's assertion that such "changes" will continue into the future.

Response: *Changes in the river are influenced by the location of the Waste Pits within the FEMA designated 100-year floodplain, susceptibility to flooding from storm surges, and vulnerability of the Site due to sea level rise. The system is subject to a wide range of flooding and storm surges, and this type of activity will continue irrespective of the additional impacts of subsidence or dredging.*

2.6.18 Comment: Future storm events and potential climate changes will push the river towards adapting to future flows by erosion of the weakest portions of the river's channel, the soft-fine-grained sediments and banks, rather than a highly armored structure, such as the Alternative 3aN enhanced cap.

Response: *Although the soft-grained sediments may be the first area of the river to erode during an extreme event, this does not preclude these changes from also compromising the cap. For example, the evaluation and modelling performed by the Corps of Engineers (Hayter and others, 2016) showed that the cap with additional upgrades (Alternative 3N), in addition to the 2012 upgrades, was still predicted to incur extensive erosion over 80 percent of the cap during a hurricane scenario. The Corps of Engineers performed a more recent model simulation to* *investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike). However, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.*

2.6.19 Comment: Tools (including models) exist that could be used to evaluate the potential for the kind of event that Region 6 posits might occur. For example, there are morphodynamic models that can be used to assess meander migration and existing 2-dimensional hydrodynamic models and their output can be used to assess channel boundary erosion potential during extreme events. There are also tools that can be used to address model uncertainty. ERDC, the section of the US Army Corps of Engineers that evaluated the remedial alternatives for Region 6, has staff with specific expertise in such assessments.

***Response**: The comment is correct that a variety of models could be used to test potential effects to specific areas of the stream channel or impoundments with the application of specific stress conditions. However, the complex way in which the effects of these individual stresses interact and propagate through the river system in the area of the impoundments cannot be simulated with existing models. The models suggested as candidates (HEC RAS 5.0 with BSTEM and the morphodynamic meander models of Langendoen and others (2015 and 2016)) were designed to model upland river systems. The need to simulate scenarios in a river downstream of a reservoir and in immediate contact with a tidal estuary introduces factors into the analysis not accounted for in these models. Also, what cannot be accurately predicted are the conditions that the impoundments and channels will be subjected to, given the need to secure the impoundments for the next 500 years. The impoundments are currently located in a tidal river, in an industrial area, which is also seeing increases in population – with concurrent needs for increased infrastructure and municipal water supplies. Climate models predict an increase in the intensity of tropical cyclones and hurricanes in the Gulf, meaning greater risk of flooding and storm surges. Accurately evaluating the uncertainty of model predictions would be problematic given uncertainties in long-term future conditions.*

2.6.20 Comment: If Region 6 selects its preferred remedy largely on the basis of the possibility of future channel migration, that would suggest that every other chemical plant, manufacturing facility, or hazardous waste storage location along the San Jacinto River and Houston Ship Channel could be held to this standard as well.

***Response:** A remedy selection is not based on channel migration or any other single factor; instead the selection is based on EPA's consideration of the nine Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA") criteria, including overall protection of human health and the environment; compliance with applicable or relevant and appropriate standards; long-term effectiveness and permanence; reduction of toxicity, mobility or volume; short-term effectiveness; implementability; cost; state acceptance; and community acceptance. The statement that any decision for the site would also apply to other* *manufacturing facilities, chemical plants, etc., is purely speculative; the requirements for these other facilities would depend on the applicable law, each site's characteristics and risks, what chemicals are potential threats to the environment, etc.*

2.6.21 Comment: Should Region 6 not select Alternative 3aN, it should defer selecting a remedy until a full geomorphic evaluation is completed to assess the potential for the configuration of the river to change abruptly, and to evaluate whether the Alternative 3aN cap includes or may be modified to include adequate safeguards against changes in the river channel if this is determined to be a real issue.

Response: *USGS performed a review of the geomorphic characteristics of the San Jacinto River based on review of historic document. However, the EPA does not agree that it would be appropriate to delay completing the final remedial action for the site to allow completion of additional studies. While a variety of models could be used to test potential effects to specific areas of the stream channel or impoundments with the application of specific stress conditions, the complex way in which the effects of these individual stresses interact and propagate through the river system in the area of the impoundments cannot be reliably simulated with existing models. Models designed to model upland river systems do not simulate scenarios in a river downstream of a reservoir and in immediate contact with a tidal estuary. Also, what can't be accurately predicted are the conditions that the impoundments and channels will be subjected to in the future given the need to secure the impoundments for the long term.*

Regarding the appropriateness of Alternative 3aN, the Corps of Engineers performed a more recent model simulation to investigate the performance of the upgraded cap, Alternative 3aN. The results of the Alternative 3aN modeling showed that erosion of the cap would likely occur over most of the cap during the extreme storm event modeled. This modeling considered the wave impacts from a Category 2 hurricane (Hurricane Ike). However, even stronger hurricanes capable of achieving Category 3, 4, or 5 levels are possible during the long term that the dioxin would remain toxic. The removal of the waste material will provide a long-term solution to protect the community, eliminate the potential for a release to the environment, and prevent the Site from becoming a large contaminated sediment site.

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TABLES

Table 1
Comparison of Average Surface Water TEQ Concentrations 2002–2016

		2002		2003		2004		2009		2016		
TMDL Station ID	**2016 Station ID**	**N**	**Average $TEQ_{DF,M}$ (pg/L)**	**N**	**Average $TEQ_{DF,M}$ (pg/L)**	**N**	**Average $TEQ_{DF,M}$ (pg/L)**	**N**	**Average $TEQ_{DF,M}$ (pg/L)**	**N**	**Average $TEQ_{DF,M}$ (pg/L)**	**Percent Change in $TEQ_{DF,M}$ Concentration**
11197	SJSW001					2	0.187			3	0.309	65
TCEQ2009_03[a]	SJSW003							2	8.61	3	0.681	-92
11193	SJSW004	2	1.61	1	3.15	4	1.42			3	0.458	-85
11261	SJSW005	2	0.418	1	0.584	2	0.802			3	0.319	-60
11264	SJSW006	1	0.519	1	0.462	2	0.674			3	0.356	-47

Notes

Field duplicates were averaged for this analysis.

$TEQ_{DF,M}$ = TEQ calculated using Van den Berg et al. (2006) toxicity equivalency factors for mammals

TEQ calculated with non-detects set to ½ the detection limit.

Percent change calculated as follows: [(2016 concentration - maximum past concentration) / (maximum past concentration)] * 100

A positive result represents a percentage increase; a negative result represents a percentage decrease.

TEQ = toxicity equivalent

TMDL = total maximum daily load

[a] Includes results from Location TCEQ2009_01 (sample Point#1&2), which was collected in close proximity.

Table 2

Comparison of Average Surface Water TCDD Concentrations 2002–2016

		2002		2003		2004		2009		2016		
TMDL Station ID	**2016 Station ID**	**N**	**Average TCDD (pg/L)**	**N**	**Average TCDD (pg/L)**	**N**	**Average TCDD (pg/L)**	**N**	**Average TCDD (pg/L)**	**N**	**Average TCDD (pg/L)**	**Percent Change in TCDD Concentration**
11197	SJSW001					2	0.0653			3	0.134	106
TCEQ2009_03[a]	SJSW003							2	4.58	3	0.386	-92
11193	SJSW004	2	1.11	1	2.16	4	0.929			3	0.195	-91
11261	SJSW005	2	0.214	1	0.328	2	0.488			3	0.146	-70
11264	SJSW006	1	0.270	1	0.241	2	0.395			3	0.164	-59

Notes

Field duplicates were averaged for this analysis.

TCDD = 2,3,7,8-tetrachlorodibenzo-*p* -dioxin

Percent change calculated as follows: [(2016 concentration - maximum past concentration) / (maximum past concentration)] * 100

A positive result represents a percentage increase; a negative result represents a percentage decrease.

TMDL = total maximum daily load

[a] Includes results from Location TCEQ2009_01 (sample Point#1&2), which was collected in close proximity.

Table 3

Concentration of Dioxins and Furans in Each 2016 Surface Water Sample

TMDL Station ID	**11197**			**SJSW002**			**TCEQ2009_03**			**11193**		
2016 Station ID	**SJSW001-1**	**SJSW001-2**	**SJSW001-3**	**SJSW002-1**	**SJSW002-2**	**SJSW002-3**	**SJSW003-1**	**SJSW003-2**	**SJSW003-3**	**SJSW004-1**	**SJSW004-2**	**SJSW004-3**
Analyte	**pg/L**	**pg/L**	**pg/L**	**pg/L**	**pg/L**	**pg/L**	**pg/L**	**pg/L**	**pg/L**	**pg/L**	**pg/L**	**pg/L**
2,3,7,8-tetrachlorodibenzo-*p* -dioxin	0.0668	0.156	0.180	0.0434	0.174	0.118	0.298	0.349	0.511	0.183	0.226	0.177
1,2,3,7,8-pentachlorodibenzo-p-dioxin	0.0117	0.0180	0.0185	0.0105	0.0205	0.0125	0.0157	0.0285	0.0236	0.0195	0.0220	0.0255
1,2,3,4,7,8-hexachlorodibenzo-p-dioxin	0.0169	0.0295	0.0435	0.0114	0.0280	0.0355	0.0330	0.0650	0.0465	0.0370	0.0815	0.0385
1,2,3,6,7,8-hexachlorodibenzo-p-dioxin	0.0679	0.0990	0.0871	0.0385	0.0915	0.0745	0.0706	0.246	0.0946	0.0770	0.133	0.0365
1,2,3,7,8,9-hexachlorodibenzo-p-dioxin	0.0973	0.208	0.110	0.0368	0.175	0.0615	0.137	0.189	0.133	0.131	0.218	0.0970
1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin	2.74	4.00	3.14	1.84	3.15	2.59	3.69	4.23	3.46	3.71	5.23	2.29
Octachlorodibenzo-p-dioxin	116	175	123	68.9	143	90.9	123	111	131	121	102	86.5
2,3,7,8-tetrachlorodibenzofuran	0.252	0.359	0.534	0.176	0.442	0.277	1.18	0.887	1.44	0.573	0.563	2.37
1,2,3,7,8-pentachlorodibenzofuran	0.0210	0.0170	0.0295	0.0179	0.0240	0.0230	0.0528	0.0495	0.0626	0.0385	0.0355	0.0320
2,3,4,7,8-pentachlorodibenzofuran	0.0190	0.0175	0.0275	0.0104	0.0245	0.0230	0.0399	0.0495	0.0472	0.0155	0.0355	0.0310
1,2,3,4,7,8-hexachlorodibenzofuran	0.0285	0.0499	0.0511	0.0325	0.0605	0.0405	0.176	0.0786	0.119	0.0860	0.0544	0.0496
1,2,3,6,7,8-hexachlorodibenzofuran	0.0240	0.0161	0.0282	0.015[a]	0.0370	0.0223	0.0454	0.0366	0.0450	0.0199	0.0381	0.0255
1,2,3,7,8,9-hexachlorodibenzofuran	0.0185	0.0210	0.0135	0.121	0.0195	0.0135	0.0195	0.0225	0.0115	0.0150	0.0120	0.0135
2,3,4,6,7,8-hexachlorodibenzofuran	0.0165	0.0195	0.0255	0.0325	0.0185	0.0125	0.0240	0.0295	0.0260	0.0350	0.0325	0.0215
1,2,3,4,6,7,8-heptachlorodibenzofuran	0.197	0.260	0.263	0.137	0.274	0.201	0.355	0.278	0.326	0.360	0.335	0.238
1,2,3,4,7,8,9-heptachlorodibenzofuran	0.0400	0.0250	0.0340	0.0388	0.0355	0.0305	0.0840	0.0565	0.0405	0.0587	0.0690	0.0315
Octachlorodibenzofuran	1.09	1.81	2.51	0.803	2.27	1.79	2.70	2.50	3.41	3.06	2.63	2.69
$TEQ_{DF,M}$ (ND=0)	0.169	0.322	0.338	0.0893[a]	0.308	0.207	0.527	0.572	0.781	0.349	0.422	0.474
$TEQ_{DF,M}$ (ND=½DL)	0.202	0.356	0.369	0.106[a]	0.367	0.247	0.576	0.634	0.832	0.384	0.460	0.530
$TEQ_{DF,M}$ (ND=DL)	0.236	0.389	0.400	0.123[a]	0.427	0.287	0.626	0.696	0.884	0.418	0.498	0.587

Notes

Field duplicates were averaged for this analysis.

DL = detection limit

ND = non-detect

$TEQ_{DF,M}$ = TEQ calculated using Van den Berg et al. (2006) toxicity equivalency factors for mammals

[a] The dissolved result was rejected during validation, so value represents the suspended fraction only.

Table 3
Concentration of Dioxins and Furans in Each 2016 Surface Water Sample

TMDL Station ID	**11261**			**11264**			**SJSW007**		
2016 Station ID	**SJSW005-1**	**SJSW005-2**	**SJSW005-3**	**SJSW006-1**	**SJSW006-2**	**SJSW006-3**	**SJSW007-1**	**SJSW007-2**	**SJSW007-3**
Analyte	**pg/L**	**pg/L**	**pg/L**	**pg/L**	**pg/L**	**pg/L**	**pg/L**	**pg/L**	**pg/L**
2,3,7,8-tetrachlorodibenzo-*p* -dioxin	0.152	0.139	0.147	0.184	0.157	0.151	0.262	0.303	0.248
1,2,3,7,8-pentachlorodibenzo-p-dioxin	0.0241	0.0135	0.0213	0.0235	0.0135	0.0216	0.0162	0.0310	0.0200
1,2,3,4,7,8-hexachlorodibenzo-p-dioxin	0.0457	0.0315	0.0435	0.0205	0.0510	0.0391	0.0590	0.0775	0.0415
1,2,3,6,7,8-hexachlorodibenzo-p-dioxin	0.0825	0.0624	0.0810	0.0795	0.0895	0.0806	0.118	0.317	0.0845
1,2,3,7,8,9-hexachlorodibenzo-p-dioxin	0.143	0.0930	0.104	0.119	0.151	0.0913	0.204	0.224	0.126
1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin	3.74	2.08	2.40	3.27	3.22	2.15	5.62	5.14	2.70
Octachlorodibenzo-p-dioxin	112	67.3	77.6	94.4	72.7	75.3	174	136	103
2,3,7,8-tetrachlorodibenzofuran	0.481	0.422	0.498	0.682	0.575	0.498	0.706	0.694	0.634
1,2,3,7,8-pentachlorodibenzofuran	0.0380	0.0304	0.0371	0.0425	0.0335	0.0381	0.0270	0.0455	0.0325
2,3,4,7,8-pentachlorodibenzofuran	0.0300	0.0305	0.0390	0.0425	0.0365	0.0378	0.0449	0.0505	0.0331
1,2,3,4,7,8-hexachlorodibenzofuran	0.0970	0.0526	0.0694	0.122	0.0872	0.0774	0.131	0.0868	0.0565
1,2,3,6,7,8-hexachlorodibenzofuran	0.0455	0.0294	0.0362	0.047	0.0376	0.0381	0.0250	0.0431	0.0313
1,2,3,7,8,9-hexachlorodibenzofuran	0.0145	0.0135	0.0145	0.0145	0.0145	0.0145	0.0295	0.0220	0.0115
2,3,4,6,7,8-hexachlorodibenzofuran	0.0380	0.0125	0.0260	0.0175	0.0290	0.0310	0.0985	0.0385	0.0240
1,2,3,4,6,7,8-heptachlorodibenzofuran	0.465	0.288	0.392	0.562	0.410	0.389	0.581	0.408	0.302
1,2,3,4,7,8,9-heptachlorodibenzofuran	0.0750	0.0385	0.0400	0.0860	0.0920	0.0485	0.126	0.0710	0.0355
Octachlorodibenzofuran	3.89	3.33	3.91	5.37	4.11	4.24	3.89	3.45	3.21
$TEQ_{DF,M}$ (ND=0)	0.322	0.228	0.272	0.354	0.296	0.271	0.497	0.561	0.400
$TEQ_{DF,M}$ (ND=½DL)	0.358	0.279	0.320	0.401	0.346	0.322	0.546	0.599	0.442
$TEQ_{DF,M}$ (ND=DL)	0.396	0.330	0.370	0.447	0.396	0.373	0.596	0.637	0.483

Table 4
Summary Statistics for Dioxin and Furan Concentrations in Surface Soil Samples from the TxDOT Right-of-Way and North of I-10

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
Area 1							
2,3,7,8-TCDD	ng/kg	31	13	42%	0.318	6.58	1.05
1,2,3,7,8-PeCDD	ng/kg	31	10	32%	0.159	1.96	0.294
1,2,3,4,7,8-HxCDD	ng/kg	31	18	58%	0.0802	2.5	0.585
1,2,3,6,7,8-HxCDD	ng/kg	31	24	77%	0.381	16.3	2.97
1,2,3,7,8,9-HxCDD	ng/kg	31	25	81%	0.169	8.03	2.03
1,2,3,4,6,7,8-HpCDD	ng/kg	31	31	100%	0.829	1,010	117
OCDD	ng/kg	31	31	100%	17.1	35,400	3,670
2,3,7,8-TCDF	ng/kg	31	22	71%	0.506	26	5.28
1,2,3,7,8-PeCDF	ng/kg	31	9	29%	0.114	4.91	0.483
2,3,4,7,8-PeCDF	ng/kg	31	14	45%	0.248	7.68	0.828
1,2,3,4,7,8-HxCDF	ng/kg	31	28	90%	0.071	29.2	3.07
1,2,3,6,7,8-HxCDF	ng/kg	31	16	52%	0.155	11.2	1.11
1,2,3,7,8,9-HxCDF	ng/kg	31	3	10%	0.0974	0.868	0.138
2,3,4,6,7,8-HxCDF	ng/kg	31	17	55%	0.119	4.42	0.834
1,2,3,4,6,7,8-HpCDF	ng/kg	31	29	94%	0.0805	103	16.2
1,2,3,4,7,8,9-HpCDF	ng/kg	31	19	61%	0.18	19.8	1.89
OCDF	ng/kg	31	30	97%	0.93	700	94.4
$TEQ_{DF,M}$	ng/kg	31	31	100%	0.456	27.2	5.7
Area 2							
2,3,7,8-TCDD	ng/kg	12	8	67%	0.434	46.5	6.39
1,2,3,7,8-PeCDD	ng/kg	12	7	58%	0.153	1.03	0.371
1,2,3,4,7,8-HxCDD	ng/kg	12	9	75%	0.103	1.65	0.650
1,2,3,6,7,8-HxCDD	ng/kg	12	11	92%	0.118	7.88	2.96
1,2,3,7,8,9-HxCDD	ng/kg	12	11	92%	0.221	5.47	2.12
1,2,3,4,6,7,8-HpCDD	ng/kg	12	12	100%	5.28	319	103
OCDD	ng/kg	12	12	100%	229	6,870	2,290
2,3,7,8-TCDF	ng/kg	12	10	83%	0.581	161	23.8
1,2,3,7,8-PeCDF	ng/kg	12	8	67%	0.19	5.47	0.983

Table 4

Summary Statistics for Dioxin and Furan Concentrations in Surface Soil Samples from the TxDOT Right-of-Way and North of I-10

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
2,3,4,7,8-PeCDF	ng/kg	12	8	67%	0.264	3.73	0.875
1,2,3,4,7,8-HxCDF	ng/kg	12	10	83%	0.677	6.12	2.37
1,2,3,6,7,8-HxCDF	ng/kg	12	8	67%	0.266	1.82	0.884
1,2,3,7,8,9-HxCDF	ng/kg	12	0	0%	NA	NA	0.0595
2,3,4,6,7,8-HxCDF	ng/kg	12	10	83%	0.219	2.94	1.08
1,2,3,4,6,7,8-HpCDF	ng/kg	12	11	92%	1.87	61.1	16.7
1,2,3,4,7,8,9-HpCDF	ng/kg	12	9	75%	0.347	4.29	1.32
OCDF	ng/kg	12	11	92%	6.39	347	85.5
$TEQ_{DF,M}$	ng/kg	12	12	100%	0.212	66.1	12.4
Area 3							
2,3,7,8-TCDD	ng/kg	9	9	100%	0.575	8,650	2,120
1,2,3,7,8-PeCDD	ng/kg	9	7	78%	0.369	57.2	17.7
1,2,3,4,7,8-HxCDD	ng/kg	9	3	33%	0.163	0.750	0.241
1,2,3,6,7,8-HxCDD	ng/kg	9	4	44%	0.910	6.54	1.44
1,2,3,7,8,9-HxCDD	ng/kg	9	8	89%	0.151	3.34	0.961
1,2,3,4,6,7,8-HpCDD	ng/kg	9	9	100%	3.00	191	49.0
OCDD	ng/kg	9	9	100%	118	2,350	799
2,3,7,8-TCDF	ng/kg	9	9	100%	2.88	20,600	6,680
1,2,3,7,8-PeCDF	ng/kg	9	8	89%	3.6	959	313
2,3,4,7,8-PeCDF	ng/kg	9	8	89%	2.48	465	156
1,2,3,4,7,8-HxCDF	ng/kg	9	9	100%	0.207	2,110	665
1,2,3,6,7,8-HxCDF	ng/kg	9	8	89%	1.70	498	149
1,2,3,7,8,9-HxCDF	ng/kg	9	6	67%	0.359	25.5	8.43
2,3,4,6,7,8-HxCDF	ng/kg	9	7	78%	1.14	69.7	23.9
1,2,3,4,6,7,8-HpCDF	ng/kg	9	8	89%	2.11	668	189

Table 4
Summary Statistics for Dioxin and Furan Concentrations in Surface Soil Samples from the TxDOT Right-of-Way and North of I-10

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
1,2,3,4,7,8,9-HpCDF	ng/kg	9	7	78%	2.83	244	72.9
OCDF	ng/kg	9	8	89%	3.74	363	104
$TEQ_{DF,M}$	ng/kg	9	9	100%	1.02	11,200	2,950

Notes

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Surface is defined as any sample with an upper depth of 0 feet.

NA = not applicable, no detected values

$TEQ_{DF,M}$ (ND=1/2DL) = Toxicity equivalent for 2,3,7,8-tetrachlorinated dibenzo-p-dioxin (TCDD) calculated using dioxins and furans and mammalian toxicity equivalency factors (Van den Berg et al. 2006) with nondetects set at one-half the detection limit.

TxDOT = Texas Department of Transportation

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 5
Summary Statistics for Dioxin and Furan Concentrations in Subsurface Soil Samples from the TxDOT Right-of-Way and North of I-10

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data Minimum	Detected Data Maximum	All Data Mean
Area 1							
2,3,7,8-TCDD	ng/kg	39	19	49%	0.268	144	5.18
1,2,3,7,8-PeCDD	ng/kg	39	17	44%	0.139	2.58	0.331
1,2,3,4,7,8-HxCDD	ng/kg	39	21	54%	0.118	3.11	0.529
1,2,3,6,7,8-HxCDD	ng/kg	39	31	79%	0.179	18.2	2.79
1,2,3,7,8,9-HxCDD	ng/kg	39	26	67%	0.291	8.34	1.86
1,2,3,4,6,7,8-HpCDD	ng/kg	39	39	100%	1.33	1,080	114
OCDD	ng/kg	39	39	100%	32.5	30,700	4,500
2,3,7,8-TCDF	ng/kg	39	32	82%	0.306	459	18.6
1,2,3,7,8-PeCDF	ng/kg	39	17	44%	0.154	10.8	0.862
2,3,4,7,8-PeCDF	ng/kg	39	20	51%	0.264	7.44	0.853
1,2,3,4,7,8-HxCDF	ng/kg	39	29	74%	0.188	21.5	2.63
1,2,3,6,7,8-HxCDF	ng/kg	39	26	67%	0.108	8.25	1.01
1,2,3,7,8,9-HxCDF	ng/kg	39	4	10%	0.0711	0.522	0.0981
2,3,4,6,7,8-HxCDF	ng/kg	39	23	59%	0.0707	6.69	0.864
1,2,3,4,6,7,8-HpCDF	ng/kg	39	36	92%	0.118	129	13.4
1,2,3,4,7,8,9-HpCDF	ng/kg	39	21	54%	0.201	12.9	1.33
OCDF	ng/kg	39	35	90%	0.229	777	73.2
$TEQ_{DF,M}$	ng/kg	39	39	100%	0.357	195	11.3
Area 2							
2,3,7,8-TCDD	ng/kg	2	1	50%	0.547	0.547	0.304
1,2,3,7,8-PeCDD	ng/kg	2	1	50%	0.152	0.152	0.105
1,2,3,4,7,8-HxCDD	ng/kg	2	1	50%	0.198	0.198	0.150
1,2,3,6,7,8-HxCDD	ng/kg	2	2	100%	0.185	0.476	0.331
1,2,3,7,8,9-HxCDD	ng/kg	2	1	50%	0.387	0.387	0.279
1,2,3,4,6,7,8-HpCDD	ng/kg	2	2	100%	6.82	18.6	12.7
OCDD	ng/kg	2	2	100%	247	484	366
2,3,7,8-TCDF	ng/kg	2	1	50%	1.74	1.74	0.876

Table 5
Summary Statistics for Dioxin and Furan Concentrations in Subsurface Soil Samples from the TxDOT Right-of-Way and North of I-10

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
1,2,3,7,8-PeCDF	ng/kg	2	0	0%	NA	NA	0.0282
2,3,4,7,8-PeCDF	ng/kg	2	0	0%	NA	NA	0.0297
1,2,3,4,7,8-HxCDF	ng/kg	2	0	0%	NA	NA	0.0307
1,2,3,6,7,8-HxCDF	ng/kg	2	0	0%	NA	NA	0.0268
1,2,3,7,8,9-HxCDF	ng/kg	2	0	0%	NA	NA	0.0271
2,3,4,6,7,8-HxCDF	ng/kg	2	0	0%	NA	NA	0.0215
1,2,3,4,6,7,8-HpCDF	ng/kg	2	0	0%	NA	NA	0.104
1,2,3,4,7,8,9-HpCDF	ng/kg	2	0	0%	NA	NA	0.0271
OCDF	ng/kg	2	1	50%	2.83	2.83	1.42
$TEQ_{DF,M}$	ng/kg	2	2	100%	0.441	1.22	0.831
Area 3							
2,3,7,8-TCDD	ng/kg	9	9	100%	3.32	11,300	4,560
1,2,3,7,8-PeCDD	ng/kg	9	8	89%	0.781	85.5	39.2
1,2,3,4,7,8-HxCDD	ng/kg	9	4	44%	0.657	1.15	0.504
1,2,3,6,7,8-HxCDD	ng/kg	9	7	78%	0.333	12.9	3.71
1,2,3,7,8,9-HxCDD	ng/kg	9	6	67%	0.321	3.49	1.66
1,2,3,4,6,7,8-HpCDD	ng/kg	9	9	100%	5.41	475	111
OCDD	ng/kg	9	9	100%	202	4,310	1,400
2,3,7,8-TCDF	ng/kg	9	9	100%	15.6	43,000	17,000
1,2,3,7,8-PeCDF	ng/kg	9	9	100%	0.544	1,450	642
2,3,4,7,8-PeCDF	ng/kg	9	8	89%	5.00	735	349
1,2,3,4,7,8-HxCDF	ng/kg	9	8	89%	12.6	3,060	1090
1,2,3,6,7,8-HxCDF	ng/kg	9	9	100%	0.256	691	256
1,2,3,7,8,9-HxCDF	ng/kg	9	7	78%	0.296	43.2	13.9
2,3,4,6,7,8-HxCDF	ng/kg	9	7	78%	2.71	92.7	41.6
1,2,3,4,6,7,8-HpCDF	ng/kg	9	9	100%	0.737	782	305

Table 5
Summary Statistics for Dioxin and Furan Concentrations in Subsurface Soil Samples from the TxDOT Right-of-Way and North of I-10

Analyte	Units	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
					Minimum	Maximum	Mean
1,2,3,4,7,8,9-HpCDF	ng/kg	9	8	89%	1.10	296	112
OCDF	ng/kg	9	9	100%	1.43	412	184
$TEQ_{DF,M}$	ng/kg	9	9	100%	5.21	16,200	6,560

Notes

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

Subsurface is defined as any sample with an upper depth greater than 0 feet.

NA = not applicable, no detected values

$TEQ_{DF,M}$ (ND=1/2DL) = Toxicity equivalent for 2,3,7,8-tetrachlorinated dibenzo-p-dioxin (TCDD) calculated

TxDOT = Texas Department of Transportation

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 6
Results of Groundwater Sampling North of I-10

	GWBU	C	C	C	A	A	A	B
	study_loc_id	SJMWD01	SJMWD02	SJMWD03	SJMWS01	SJMWS02	SJMWS03	SJMWS04
	sample_date	1/8/2011	1/5/2011	1/7/2011	1/8/2011	1/5/2011	1/7/2011	12/28/2011
	x	3216668.348	3217045.488	3217179.409	3216654.641	3217048.206	3217163.239	3216943.21
	y	13857340.83	13857702.27	13857082.67	13857356.47	13857716.27	13857082.92	13857673.38
	$^{GW}GW_{Class3}$							
PhysChem (mg/L)								
TSS		2.5 U	6.5	2.5 U	2.5 U	42	23	14
Metals (mg/L)								
Aluminum	7,300	0.056	0.12	0.17	0.043 J	0.205	0.12	0.48
Arsenic	1	0.0092	0.005	0.0016	0.0086	0.0073	0.0063	0.0075
Barium	200	0.15	0.52	0.45	0.19	0.21	3.8	0.47
Cadmium	0.5	0.0016 J	0.001 U	0.001 U	0.001 U	0.00265 J	0.001 U	0.0029 J
Chromium	10	0.001 U	0.001 U	0.001 U	0.001 U	0.0016 J	0.005 J	0.022
Cobalt	2.2	0.0017	0.002	0.00026	0.00038	0.00165	0.0031	0.0033
Copper	130	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0037 J
Lead	1.5	1.7E-05 J	8.40E-05	0.00011	2.4E-05 J	0.000245	0.00015	0.0032
Magnesium	--	490	210	38	350	330	330	370
Manganese	1,000	1.9	1.4	0.12	1.7	2	4.4	2
Mercury	0.2	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 UJ	0.00017 J
Nickel	150	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.078
Thallium	0.2	5E-06 U	5.30E-05	1.9E-05 J	5E-06 U	0.00022	8E-06 U	5E-06 U
Vanadium	0.51	3E-05 U	0.0005	0.0015	6E-05 U	0.000595	0.0024	0.0011
Zinc	2,200	0.0004 UJ	0.0054 J	0.0004 UJ	0.0004 UJ	0.0041 U	0.0004 UJ	0.14
Dissolved Metals (mg/L)								
Aluminum	--	0.05 J	0.048 J	0.015 U	0.037 J	0.058	0.031 J	0.052
Arsenic	--	0.0095	0.0049	0.0019	0.0085	0.00695	0.0072	0.0073
Barium	--	0.15	0.56	0.45	0.19	0.215	3.8	0.45
Cadmium	--	0.001 U	0.001 U	0.001 U	0.001 U	0.0026 J	0.002 J	0.0022 J
Chromium	--	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0028 J	0.001 U
Cobalt	--	0.0017	0.0019	0.00025	0.00035	0.00155	0.0031	0.0007
Copper	--	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lead	--	5.5E-06 U	2.4E-05 J	5E-06 U	5E-06 U	2.1E-05 J	3E-05 J	1.9E-05 J
Magnesium	--	490	210	37	350	330	330	370
Manganese	--	2	1.5	0.11	1.7	2	4.4	2
Mercury	--	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 U
Nickel	--	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0093 J
Thallium	--	5E-06 U	9.5E-06 U	8.5E-06 U	5.5E-06 U	1.1E-05 U	5.5E-06 U	5E-06 UJ
Vanadium	--	3E-05 U	0.0002 J	0.0014	3E-05 U	3E-05 U	0.0022	0.00023 J
Zinc	--	0.0004 UJ	0.0004 UJ	0.0004 UJ	0.0004 UJ	0.0004 UJ	0.0004 UJ	0.0004 UJ

Table 6
Results of Groundwater Sampling North of I-10

	GWBU	C	C	C	A	A	A	B
	study_loc_id	SJMWD01	SJMWD02	SJMWD03	SJMWS01	SJMWS02	SJMWS03	SJMWS04
	sample_date	1/8/2011	1/5/2011	1/7/2011	1/8/2011	1/5/2011	1/7/2011	12/28/2011
	x	3216668.348	3217045.488	3217179.409	3216654.641	3217048.206	3217163.239	3216943.21
	y	13857340.83	13857702.27	13857082.67	13857356.47	13857716.27	13857082.92	13857673.38
	$^{GW}GW_{Class3}$							
Semivolatile Organic Compounds (µg/L)								
Acenaphthene	440,000	0.013 U	0.013 U	0.013 U	0.013 U	0.013 U	0.013 U	0.013 U
Fluorene	290,000	0.014 U	0.014 U	0.014 U	0.014 U	0.014 U	0.014 U	0.03 J
Naphthalene	150,000	0.031 J	0.011 U	0.011 U	0.025 J	0.0295 J	0.033 J	0.046 J
Phenanthrene	220,000	0.011 U	0.029 J	0.011 U	0.011 U	0.011 U	0.011 U	0.099 J
Bis(2-ethylhexyl)phthalat	600	0.065 U	0.065 U	0.065 U	0.065 U	0.0975 J	0.065 U	0.49 J
Phenol	2,200,000	0.032 U	0.07 J	0.14 J	0.032 U	0.0795 J	0.032 U	1.1
Carbazole	10,000	0.009 U	0.009 U	0.009 U	0.009 U	0.018 J	0.009 U	0.054 J
PCBs (pg/L)								
Aroclor 1016	--	480 U	480 U	2,400 U	480 U	480 U	480 U	40,000 U
Aroclor 1221	--	480 U	480 U	20,000 U	480 U	480 U	480 U	95,000 U
Aroclor 1232	--	480 U	480 U	4,800 U	480 U	480 U	480 U	85,000 U
Aroclor 1242	--	480 U	480 U	2,900 U	480 U	480 U	480 U	75,000 U
Aroclor 1248	--	480 U	480 U	2,700 U	480 U	480 U	480 U	28,000 U
Aroclor 1254	--	480 U	480 U	480 U	480 U	480 U	480 U	31,000 U
Aroclor 1260	--	480 U	480 U	480 U	480 U	480 U	480 U	19,000 U
Aroclor 1262	--	480 U	480 U	480 U	480 U	480 U	480 U	480 U
Aroclor 1268	--	480 U	480 U	480 U	480 U	480 U	480 U	480 U
Total PCBs (Aroclor sum)	50,000,000	2,200 U	2,200 U	17,000 U	2,200 U	2,200 U	2,200 U	190,000 U
Dioxin/Furans (pg/L)								
2,3,7,8-TCDD	--	0.44 U	0.58 U	0.51 U	0.52 U	0.44 U	0.37 U	2,700
1,2,3,7,8-PeCDD	--	0.42 U	0.42 U	0.47 U	0.41 U	0.41 U	0.39 U	25 J
1,2,3,4,7,8-HxCDD	--	0.34 U	0.36 U	0.32 U	0.32 U	0.31 U	0.28 U	0.31 U
1,2,3,6,7,8-HxCDD	--	0.47 U	0.52 U	0.45 U	0.43 U	0.46 U	0.4 U	0.48 U
1,2,3,7,8,9-HxCDD	--	0.38 U	0.41 U	0.36 U	0.35 U	0.36 U	0.32 U	0.37 U
1,2,3,4,6,7,8-HpCDD	--	0.37 U	0.49 U	0.4 U	0.44 U	0.41 U	0.35 U	25 J
OCDD	--	1.1 U	0.79 U	0.62 U	0.55 U	3.6 J	7.2 U	390
2,3,7,8-TCDF	--	0.5 U	0.52 U	0.45 U	0.54 U	1.89 J	0.43 U	9,100
1,2,3,7,8-PeCDF	--	0.34 U	0.54 U	0.36 U	0.41 U	0.32 U	0.37 U	270
2,3,4,7,8-PeCDF	--	0.31 U	0.5 U	0.34 U	0.39 U	0.31 U	0.34 U	170
1,2,3,4,7,8-HxCDF	--	0.22 U	0.32 U	0.23 U	0.25 U	0.26 U	0.3 U	520
1,2,3,6,7,8-HxCDF	--	0.22 U	0.31 U	0.23 U	0.25 U	0.26 U	0.3 U	110
1,2,3,7,8,9-HxCDF	--	0.3 U	0.43 U	0.31 U	0.34 U	0.34 U	0.4 U	2.5 U
2,3,4,6,7,8-HxCDF	--	0.23 U	0.33 U	0.25 U	0.26 U	0.27 U	0.31 U	14 J
1,2,3,4,6,7,8-HpCDF	--	0.27 U	0.41 U	0.32 U	0.35 U	0.34 U	0.32 U	120
1,2,3,4,7,8,9-HpCDF	--	0.48 U	0.66 U	0.54 U	0.58 U	0.51 U	0.51 U	50

Table 6
Results of Groundwater Sampling North of I-10

	GWBU	C	C	C	A	A	A	B
	study_loc_id	**SJMWD01**	**SJMWD02**	**SJMWD03**	**SJMWS01**	**SJMWS02**	**SJMWS03**	**SJMWS04**
	sample_date	**1/8/2011**	**1/5/2011**	**1/7/2011**	**1/8/2011**	**1/5/2011**	**1/7/2011**	**12/28/2011**
	x	**3216668.348**	**3217045.488**	**3217179.409**	**3216654.641**	**3217048.206**	**3217163.239**	**3216943.21**
	y	**13857340.83**	**13857702.27**	**13857082.67**	**13857356.47**	**13857716.27**	**13857082.92**	**13857673.38**
	$^{GW}GW_{Class3}$							
OCDF	--	0.55 U	0.69 U	0.67 U	0.68 U	0.57 U	0.7 U	81 J
$TEQ_{DF,M}$	3,000	1.24 U	1.5 U	1.37 U	1.35 U	2.64 J	1.17 U	**3770**

Notes

Bold = Detected concentration is greater than GW_{Class3} screening level. See Section 5.2.2 of the text for a discussion of the determination of site groundwater quality.
Samples SJMWS02-D1 & SJMWS02-D1 are averaged
If values are both ND, the lower detection limit is used.
If one value is ND, that detection limit is used.
$TEQ_{DF,M}$ = Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors (Van den Berg et al. 2006).

-- = no standard
GWBU = groundwater bearing unit
J =estimated value
PCB = polychlorinated biphenyl
TSS = total suspended solids
U = compound analyzed, but not detected above detection limit
UJ = compound analyzed, but not detected above estimated detection limit

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site.
Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 7
Summary Statistics for Dioxin and Furan Concentrations in Surface Sediment & Waste Material Samples

Analyte	Number of Samples[a]	Number of Detected Measurements	Detection Frequency	Minimum (ng/kg dw)	Maximum (ng/kg dw)	Mean (ng/kg dw)
2,3,7,8-TCDD	159	119	75%	0.0403	21,500	625
1,2,3,7,8-PeCDD	159	46	29%	0.016	175	6.83
1,2,3,4,7,8-HxCDD	159	53	33%	0.0221	70	1.12
1,2,3,6,7,8-HxCDD	159	93	58%	0.0233	50	1.55
1,2,3,7,8,9-HxCDD	159	91	57%	0.023	165	2.90
1,2,3,4,6,7,8-HpCDD	159	155	97%	0.921	290	33.1
OCDD	159	157	99%	19.4	4,870	869
2,3,7,8-TCDF	159	153	96%	0.0422	95,000	2,010
1,2,3,7,8-PeCDF	159	86	54%	0.00875	8,880	109
2,3,4,7,8-PeCDF	159	80	50%	0.0114	3,360	58.2
1,2,3,4,7,8-HxCDF	159	111	70%	0.00555	9,650	152
1,2,3,6,7,8-HxCDF	159	86	54%	0.0054	1,790	33.6
1,2,3,7,8,9-HxCDF	159	25	16%	0.00865	290	5.14
2,3,4,6,7,8-HxCDF	159	52	33%	0.00575	478	8.53
1,2,3,4,6,7,8-HpCDF	159	138	87%	0.0165	1,000	36.6
1,2,3,4,7,8,9-HpCDF	159	57	36%	0.0106	364	13.2
OCDF	159	145	91%	0.053	650	47.3
$TEQ_{DF,M}$	159	159	100%	0.129	31,600	875

Notes

For all calculations, concentrations below the detection limit were set to one-half the detection limit.

$TEQ_{DF,M}$ (ND=1/2DL) = Toxicity equivalent for 2,3,7,8-TCDD calculated using dioxins and furans and mammalian toxicity equivalency factors (Van den Berg et al. 2006) with non detects set at one-half the detection limit.

dw = dry weight

USEPA = U.S. Environmental Protection Agency

a - The number of samples used in these calculations may differ from numbers shown in other tables because of the criteria used to select data. For this analysis, "surface sediment" samples were those with an upper depth of 0 inches were used, regardless of the total depth.

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 8
Summary Statistics for Dioxin and Furan Concentrations in Subsurface Sediment & Waste Material Samples

Analyte	Number of Samples	Number of Detected Measurements	Detection Frequency	Minimum (ng/kg dw)	Maximum (ng/kg dw)	Mean (ng/kg dw)
2,3,7,8-TCDD	135	74	55%	0.0183	18,800	883
1,2,3,7,8-PeCDD	135	52	39%	0.0124	134	6.12
1,2,3,4,7,8-HxCDD	135	52	39%	0.014	2.15	0.292
1,2,3,6,7,8-HxCDD	135	88	65%	0.0135	14.3	1.21
1,2,3,7,8,9-HxCDD	135	95	70%	0.0136	5.59	0.972
1,2,3,4,6,7,8-HpCDD	135	134	99%	0.4	252	33.8
OCDD	135	135	100%	13	6,270	895
2,3,7,8-TCDF	135	98	73%	0.0132	72,900	2,670
1,2,3,7,8-PeCDF	135	56	41%	0.0118	1,700	87.4
2,3,4,7,8-PeCDF	135	59	44%	0.0107	1,050	48.8
1,2,3,4,7,8-HxCDF	135	72	53%	0.0052	2,800	142
1,2,3,6,7,8-HxCDF	135	70	52%	0.00515	671	33.1
1,2,3,7,8,9-HxCDF	135	23	17%	0.0091	35.1	1.60
2,3,4,6,7,8-HxCDF	135	40	30%	0.0056	79.9	4.13
1,2,3,4,6,7,8-HpCDF	135	75	56%	0.00995	804	40.2
1,2,3,4,7,8,9-HpCDF	135	51	38%	0.0172	270	13.2
OCDF	135	84	62%	0.018	702	56.4
$TEQ_{DF,M}$	132	132	100%	13.7	103,000	4,940

Notes

For all calculations, concentrations below the detection limit were set to one-half the detection limit. $TEQ_{DF,M}$ (ND=1/2DL) = Toxicity equivalent for 2,3,7,8-TCDD calculated using dioxins and furans and mammalian toxicity equivalency factors (Van den Berg et al. 2006) with non detects set at one-half the detection limit.

dw = dry weight

USEPA = U.S. Environmental Protection Agency

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 9
Summary Statistics for Mercury, Aroclors and Dioxin-Like PCB Concentrations in Surface Sediment & Waste Material Samples

Analyte	Number of Samples	Number of Detected Measurements	Detection Frequency	Minimum	Maximum	Mean
PCB Aroclors (µg/kg dw)						
Aroclor 1016	27	0	0%	9.5	7,000	894
Aroclor 1221	27	0	0%	9.5	15,500	1,520
Aroclor 1232	27	0	0%	9.5	9,000	1,170
Aroclor 1242	27	0	0%	9.5	8,000	1,020
Aroclor 1248	27	0	0%	9.5	3,600	451
Aroclor 1254	27	0	0%	9.5	2,750	276
Aroclor 1260	27	0	0%	9.5	3,100	270
Aroclor 1262	27	0	0%	9.5	1,350	120
Aroclor 1268	27	0	0%	9.5	250	48.6
PCB Congeners (ng/kw dw)						
PCB077	31	19	61%	0.635	2,580	200
PCB081	31	6	19%	0.38	64	7.41
PCB105	31	27	87%	4.37	76,600	5,840
PCB114	31	19	61%	0.374	7,750	440
PCB118	31	26	84%	11.8	197,000	14,800
PCB123	31	19	61%	0.486	4,210	259
PCB126	31	4	13%	0.368	160	15.4
PCB156+157	31	26	84%	2.36	51,400	3,100
PCB167	31	22	71%	0.269	14,900	915
PCB169	31	1	3%	0.28	65	5.53
PCB189	31	14	45%	0.434	1,700	133
$TEQ_{P,M}$	31	30	97%	0.046	27.5	2.49
Metals (mg/kg dw)						
Mercury	124	118	95%	0.001	2.83	0.126

Notes

For all calculations, concentrations below the detection limit were set to one-half the detection limit. $TEQ_{DF,M}$ (ND=1/2DL) = Toxicity equivalent for 2,3,7,8-TCDD calculated using dioxins and furans and mammalian toxicity equivalency factors (Van den Berg et al. 2006) with non detects set at one-half the detection limit.

$TEQ_{P,M}$ = Toxicity equivalent for TCDD calculated for dioxin-like PCBs using mammalian toxicity eqiuvalency factors (Van den Berg et al. 2006).

dw = dry weight

PCB = polychlorinated biphenyl

USEPA = U.S. Environmental Protection Agency

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 10
Summary Statistics for Mercury, Aroclors and Dioxin-Like PCB Congener Concentrations in Subsurface Sediment Samples

Analyte	Number of Samples	Number of Detected Measurements	Detection Frequency	Minimum	Maximum	Mean
PCB Aroclors (µg/kg dw)						
Aroclor 1016	32	0	0%	9.5	15,000	2,710
Aroclor 1221	32	0	0%	9.5	26,500	4,460
Aroclor 1232	32	0	0%	9.5	26,500	4,520
Aroclor 1242	32	0	0%	9.5	17,000	2,940
Aroclor 1248	32	0	0%	9.5	6,500	1,040
Aroclor 1254	32	1	3%	9.5	2,250	321
Aroclor 1260	32	0	0%	9.5	2,650	334
Aroclor 1262	32	0	0%	9.5	650	145
Aroclor 1268	32	0	0%	9.5	650	144
Total PCBs (Aroclor sum) (ng/kg dw)	8	8	100%	1,350	61,200	17,500
PCB Congeners (ng/kw dw)						
PCB077	40	21	53%	0.246	1,400	189
PCB081	40	5	13%	0.244	91.3	12.3
PCB105	40	29	73%	0.695	69,000	6,360
PCB114	40	18	45%	0.29	3,720	347
PCB118	40	26	65%	2.77	158,000	15,100
PCB123	40	17	43%	0.296	1,980	193
PCB126	40	5	13%	0.28	203	19.0
PCB156+157	40	27	68%	0.263	28,600	2,590
PCB167	40	24	60%	0.182	8,310	770
PCB169	40	0	0%	0.206	675	41.4
PCB189	40	15	38%	0.264	1,850	160
$TEQ_{P,M}$	40	32	80%	0.0357	38.1	3.96
Metals (mg/kg dw)						
Mercury	132	128	97%	0.001	2.72	0.157

Notes

For all calculations, concentrations below the detection limit were set to one-half the detection limit. $TEQ_{DF,M}$ (ND=1/2DL) = Toxicity equivalent for 2,3,7,8-TCDD calculated using dioxins and furans and mammalian toxicity equivalency factors (Van den Berg et al. 2006) with non detects set at one-half the detection limit.

$TEQ_{P,M}$ = Toxicity equivalent for TCDD calculated for dioxin-like PCBs using mammalian toxicity eqiuvalency factors (Van den Berg et al. 2006).

dw = dry weight
PCB = polychlorinated biphenyl
USEPA = U.S. Environmental Protection Agency

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 11
Summary Statistics for Dioxins, Furans, PCBs, and Mercury in Edible Blue Crab Tissue from FCAs

	FCA1					FCA2					FCA3					Background				
	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]
Blue Crab - Edible																				
Dioxins and Furans (ng/kg ww)																				
2,3,7,8-TCDD	5/10	0.513	1.43	0.523	0.371	2/10	0.134	0.416	0.126	0.105	0/10	--	--	0.0608	0.0615	1/20	0.0187	0.512	0.0701	0.0437
1,2,3,7,8-PeCDD	0/10	--	--	0.0402	0.0293	0/10	--	--	0.028	0.028	0/10	--	--	0.0333	0.0276	0/20	0.0182	0.0725	0.0404	0.0354
1,2,3,4,7,8-HxCDD	0/10	--	--	0.0248	0.0254	0/10	--	--	0.023	0.023	0/10	--	--	0.025	0.0223	0/20	0.0151	0.0825	0.0327	0.0293
1,2,3,6,7,8-HxCDD	2/10	0.0773	0.184	0.0534	0.0395	0/10	--	--	0.03	0.0305	0/10	--	--	0.0311	0.0278	0/20	0.0202	0.105	0.0413	0.0387
1,2,3,7,8,9-HxCDD	1/10	0.191	0.191	0.0435	0.0279	0/10	--	--	0.0256	0.0259	0/10	--	--	0.027	0.0238	0/20	0.0171	0.0920	0.0358	0.0327
1,2,3,4,6,7,8-HpCDD	7/10	0.102	0.348	0.134	0.117	1/10	0.0962	0.0962	0.0347	0.0254	0/10	--	--	0.0282	0.0257	1/20	0.0177	0.189	0.0485	0.0336
OCDD	5/10	0.443	2.51	0.645	0.407	5/10	0.23	1.27	0.329	0.197	0/10	--	--	0.0962	0.089	3/20	0.0560	0.495	0.207	0.171
2,3,7,8-TCDF	9/10	0.52	3.31	1.39	1.26	8/10	0.359	1.07	0.504	0.464	4/10	0.242	0.787	0.238	0.158	0/20	0.0275	0.823	0.104	0.0477
1,2,3,7,8-PeCDF	0/10	--	--	0.0289	0.0286	0/10	--	--	0.0258	0.0253	0/10	--	--	0.0309	0.03	0/20	0.0150	0.0815	0.0369	0.0327
2,3,4,7,8-PeCDF	0/10	--	--	0.0276	0.0268	0/10	--	--	0.0257	0.0252	0/10	--	--	0.0295	0.0291	0/20	0.0140	0.0740	0.0349	0.0309
1,2,3,4,7,8-HxCDF	1/10	0.199	0.199	0.0376	0.0179	0/10	--	--	0.0185	0.0177	0/10	--	--	0.0208	0.019	0/20	0.0171	0.0835	0.0290	0.0242
1,2,3,6,7,8-HxCDF	3/10	0.0622	0.16	0.0442	0.0213	0/10	--	--	0.0181	0.0172	0/10	--	--	0.0197	0.0179	0/20	0.0164	0.0765	0.0273	0.0230
1,2,3,7,8,9-HxCDF	0/10	--	--	0.0276	0.0191	0/10	--	--	0.0244	0.0225	0/10	--	--	0.0257	0.0235	0/20	0.0179	0.132	0.0380	0.0311
2,3,4,6,7,8-HxCDF	1/10	0.134	0.134	0.0315	0.0181	0/10	--	--	0.0202	0.0189	0/10	--	--	0.0212	0.0193	0/20	0.0173	0.0855	0.0303	0.0248
1,2,3,4,6,7,8-HpCDF	0/10	--	--	0.0319	0.0259	0/10	--	--	0.0195	0.0194	0/10	--	--	0.0265	0.0283	0/20	0.0143	0.0840	0.0307	0.0277
1,2,3,4,7,8,9-HpCDF	0/10	--	--	0.0377	0.0335	0/10	--	--	0.0282	0.0277	0/10	--	--	0.0387	0.0393	0/20	0.0203	0.124	0.0404	0.0380
OCDF	4/10	0.112	0.53	0.15	0.084	0/10	--	--	0.042	0.041	0/10	--	--	0.0577	0.054	1/20	0.0332	0.210	0.0757	0.0660
$TEQ_{DF,M}$	10/10	0.229	1.91	0.739	0.554	8/10	0.139	0.558	0.23	0.199	4/10	0.0921	0.271	0.146	0.151	6/20	0.0726	0.639	0.157	0.119
$TEQ_{DFP,M}$	10/10	0.355	1.99	0.858	0.641	10/10	0.288	0.891	0.472	0.428	10/10	0.233	0.396	0.286	0.273	10/10	0.111	0.28	0.2	0.190
$TEQ_{P,M}$	10/10	0.0654	0.234	0.119	0.107	10/10	0.115	0.547	0.242	0.212	10/10	0.0688	0.303	0.14	0.147	10/10	0.0382	0.169	0.0907	0.0910
Polychlorinated Biphenyls (µg/kg ww)																				
Total PCBs[b]	10/10	0.554	5.86	1.97	1.35	10/10	4.6	13.5	7.44	6.58	10/10	2.94	9.06	5.04	4.22	10/10	0.547	2.13	1.29	1.39
Metals (mg/kg ww)																				
Mercury	10/10	0.0419	0.0652	0.0527	0.0531	10/10	0.0171	0.0498	0.0292	0.0245	10/10	0.0276	0.0522	0.0386	0.0354	10/10	0.0149	0.0364	0.0205	0.0189

Notes

FCA = fish collection area
PCB = polychlorinated biphenyl
$TEQ_{DF,M}$ = Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors (van den Berg et al. 2006) with nondetects set at one-half the detection limit.
$TEQ_{DFP,M}$ = Toxicity equivalent for dioxins, furans and polychlorinated biphenyls calculated using mammalian toxicity equivalency factors (Van den Berg et al. 2006) with nondetects set at one-half the detection limit.
$TEQ_{P,M}$ - Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors with nondetects set at one-half the detection limit. Data for individual congeners are presented in Appendix B.
USEPA = U.S. Environmental Protection Agency
ww = wet weight
-- = Not applicable, no detected values

a - Mean and median calculations include detected and nondetected values. Nondetected values were set at one-half the detection limit.
b - Total PCBs were calculated using all 209 PCB congeners with non-detects set at one-half the detection limit.

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site.
Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 12

Summary Statistics for Dioxins, Furans, PCBs, and Mercury in Hardhead Catfish Fillet Tissue from FCAs

	FCA1					FCA2					FCA3					Background				
	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]
Catfish - Fillet																				
Dioxins and Furans (ng/kg ww)																				
2,3,7,8-TCDD	10/10	0.755	5.03	2.77	2.71	10/10	2.38	5.35	3.6	3.47	10/10	1.5	4.63	2.97	2.85	10/20	0.0965	3.60	0.622	0.241
1,2,3,7,8-PeCDD	2/10	0.163	0.174	0.063	0.0289	4/10	0.108	0.216	0.0978	0.066	4/10	0.183	0.334	0.130	0.0528	5/20	0.0151	0.625	0.118	0.0593
1,2,3,4,7,8-HxCDD	2/10	0.0431	0.0642	0.0242	0.0178	3/10	0.0705	0.103	0.0395	0.0251	3/10	0.0657	0.266	0.0696	0.0299	11/20	0.0130	0.794	0.127	0.0535
1,2,3,6,7,8-HxCDD	6/10	0.134	0.608	0.2	0.153	6/10	0.188	0.704	0.256	0.193	5/10	0.222	1.69	0.476	0.183	11/20	0.0257	2.55	0.376	0.170
1,2,3,7,8,9-HxCDD	4/10	0.0444	0.2	0.0554	0.0413	0/10	--	--	0.0409	0.0278	4/10	0.0558	0.604	0.145	0.0438	7/20	0.0156	0.721	0.141	0.0495
1,2,3,4,6,7,8-HpCDD	1/10	0.845	0.845	0.222	0.167	0/10	--	--	0.239	0.208	2/10	2.44	3.40	0.801	0.247	8/20	0.0895	4.26	0.801	0.277
OCDD	0/10	--	--	0.436	0.455	0/10	--	--	0.558	0.543	0/10	--	--	1.02	0.67	0/20	0.202	10.3	1.99	0.665
2,3,7,8-TCDF	6/10	0.279	1.03	0.319	0.283	9/10	0.404	1.46	0.779	0.687	8/10	0.396	1.27	0.579	0.582	3/20	0.0164	1.10	0.158	0.0615
1,2,3,7,8-PeCDF	0/10	--	--	0.0229	0.0234	1/10	0.0904	0.0904	0.0291	0.021	0/10	--	--	0.0269	0.0276	1/20	0.00940	0.170	0.0320	0.0224
2,3,4,7,8-PeCDF	3/10	0.198	0.335	0.111	0.0658	5/10	0.123	0.300	0.157	0.146	3/10	0.163	0.402	0.158	0.13	5/20	0.0143	0.590	0.0983	0.0313
1,2,3,4,7,8-HxCDF	0/10	--	--	0.0146	0.0146	1/10	0.0504	0.0504	0.0219	0.0193	1/10	0.0794	0.0794	0.0236	0.0182	1/20	0.00895	0.0920	0.0227	0.0158
1,2,3,6,7,8-HxCDF	0/10	--	--	0.0139	0.0138	0/10	--	--	0.0173	0.0171	0/10	--	--	0.0166	0.0171	2/20	0.00850	0.125	0.0261	0.0136
1,2,3,7,8,9-HxCDF	0/10	--	--	0.0185	0.0184	0/10	--	--	0.0216	0.0215	0/10	--	--	0.0199	0.0189	0/20	0.0108	0.107	0.0256	0.0184
2,3,4,6,7,8-HxCDF	0/10	--	--	0.0154	0.0153	0/10	--	--	0.0201	0.0199	0/10	--	--	0.0181	0.0182	0/20	0.00945	0.101	0.0224	0.0149
1,2,3,4,6,7,8-HpCDF	0/10	--	--	0.0182	0.017	0/10	--	--	0.0191	0.0186	0/10	--	--	0.0197	0.0199	1/20	0.0104	0.0671	0.0266	0.0228
1,2,3,4,7,8,9-HpCDF	0/10	--	--	0.0272	0.0255	0/10	--	--	0.0265	0.0264	0/10	--	--	0.0259	0.0242	0/20	0.0141	0.0645	0.0291	0.0299
OCDF	0/10	--	--	0.0494	0.0415	0/10	--	--	0.0357	0.0343	0/10	--	--	0.0573	0.0316	3/20	0.0197	0.943	0.108	0.0490
TEQ$_{DF,M}$	10/10	0.801	5.45	2.94	2.81	10/10	2.58	5.85	3.87	3.66	10/10	1.60	5.32	3.29	3.02	18/20	0.142	4.97	0.865	0.373
TEQ$_{DFP,M}$	10/10	1.26	6.71	4.21	4.06	10/10	3.33	7.14	5.15	5.33	10/10	1.91	8.12	4.66	4.25	10/10	0.504	1.19	0.719	0.649
TEQ$_{P,M}$	10/10	0.457	2.27	1.28	1.15	10/10	0.573	2.03	1.28	1.29	10/10	0.282	2.79	1.36	1.29	10/10	0.223	0.804	0.48	0.571
Polychlorinated Biphenyls (µg/kg ww)																				
Total PCBs[b]	10/10	22.2	159	97.7	91.9	10/10	64.6	158	99.7	97.2	10/10	29.8	152	107	119	10/10	25.4	88.4	46.5	37.4
Metals (mg/kg ww)																				
Mercury	10/10	0.104	0.266	0.159	0.137	10/10	0.069	0.264	0.114	0.0942	10/10	0.0408	0.188	0.0856	0.075	10/10	0.0801	0.197	0.126	0.117

Notes

FCA = fish collection area

PCB = polychlorinated biphenyl

TEQ$_{DF,M}$ = Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors (Van den Berg et al. 2006) with nondetects set at one-half the detection limit.

TEQ$_{DFP,M}$ = Toxicity equivalent for dioxins, furans and polychlorinated biphenyls calculated using mammalian toxicity equivalency factors (Van den Berg et al. 2006) with nondetects set at one-half the detection limit.

TEQ$_{P,M}$ - Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors (Van den Berg et al. 2006) with nondetects set at one-half the detection limit. Data for individual congeners are presented in Appendix B.

USEPA = U.S. Environmental Protection Agency

ww = wet weight

-- = Not applicable, no detected values

a - Mean and median calculations include detected and nondetected values. Nondetected values were set at one-half the detection limit.

b - Total PCBs were calculated using all 209 PCB congeners with non-detects set at one-half the detection limit.

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site.
Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 13
Summary Statistics for Dioxins, Furans, PCBs, and Mercury in Edible Common Rangia (Clam) Tissue from FCAs

	FCA1					FCA2					FCA3					Upstream Background				
	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]
Clam - Edible																				
Dioxins and Furans (ng/kg ww)																				
2,3,7,8-TCDD	4/5	1.31	1.50	1.19	1.37	13/15	0.519	17.6	5	1.98	3/5	0.647	0.784	0.479	0.647	1/10	0.454	0.454	0.152	0.097
1,2,3,7,8-PeCDD	0/5	--	--	0.0303	0.0295	0/15	--	--	0.03	0.0261	0/5	--	--	0.0532	0.054	0/10	--	--	0.045	0.0424
1,2,3,4,7,8-HxCDD	0/5	--	--	0.0255	0.0234	0/15	--	--	0.0388	0.0377	0/5	--	--	0.0517	0.0565	0/10	--	--	0.0368	0.035
1,2,3,6,7,8-HxCDD	0/5	--	--	0.0317	0.0292	1/15	0.727	0.727	0.0912	0.0465	0/5	--	--	0.0669	0.073	0/10	--	--	0.0488	0.0461
1,2,3,7,8,9-HxCDD	0/5	--	--	0.0278	0.0255	1/15	0.468	0.468	0.0691	0.041	0/5	--	--	0.055	0.06	0/10	--	--	0.0403	0.0382
1,2,3,4,6,7,8-HpCDD	3/5	0.882	1.17	0.734	0.882	8/15	0.22	26.1	2.01	0.271	3/5	0.247	0.469	0.314	0.263	6/10	0.406	0.554	0.37	0.408
OCDD	5/5	3.02	8.38	6.51	7.14	13/15	1.31	182	15.3	3.67	5/5	2.01	5.30	3.70	4.24	10/10	3.85	6.22	4.84	4.85
2,3,7,8-TCDF	4/5	2.98	6.03	4.31	4.61	15/15	2.72	89.6	27	10.8	5/5	1.38	3.70	2.47	2.80	9/10	0.498	2.31	1.22	1.28
1,2,3,7,8-PeCDF	0/5	--	--	0.0287	0.0314	2/15	0.358	0.692	0.16	0.0468	0/5	--	--	0.0459	0.047	0/10	--	--	0.0387	0.0365
2,3,4,7,8-PeCDF	0/5	--	--	0.0347	0.0315	3/15	0.591	0.884	0.193	0.0456	0/5	--	--	0.0436	0.044	0/10	--	--	0.0386	0.0371
1,2,3,4,7,8-HxCDF	0/5	--	--	0.0315	0.0313	2/15	0.686	1.36	0.191	0.0334	0/5	--	--	0.0528	0.0505	0/10	--	--	0.0311	0.0305
1,2,3,6,7,8-HxCDF	0/5	--	--	0.0303	0.0302	2/15	0.201	0.691	0.0808	0.0242	0/5	--	--	0.0495	0.0494	0/10	--	--	0.0295	0.029
1,2,3,7,8,9-HxCDF	0/5	--	--	0.0494	0.0483	0/15	--	--	0.042	0.0369	0/5	--	--	0.0686	0.069	0/10	--	--	0.0411	0.0419
2,3,4,6,7,8-HxCDF	0/5	--	--	0.0359	0.0342	1/15	0.611	0.611	0.0643	0.0275	0/5	--	--	0.0567	0.0555	0/10	--	--	0.0345	0.0334
1,2,3,4,6,7,8-HpCDF	0/5	--	--	0.0356	0.0317	1/15	10.2	10.2	0.712	0.0321	0/5	--	--	0.0443	0.0451	0/10	--	--	0.0353	0.0359
1,2,3,4,7,8,9-HpCDF	0/5	--	--	0.0497	0.0452	1/15	1.10	1.10	0.118	0.045	0/5	--	--	0.0588	0.0605	0/10	--	--	0.05	0.0518
OCDF	0/5	--	--	0.069	0.0525	1/15	45.4	45.4	3.08	0.0474	0/5	--	--	0.115	0.114	0/10	--	--	0.0732	0.0715
$TEQ_{DF,M}$	5/5	0.718	2.19	1.7	1.9	15/15	0.854	27.0	7.89	3.61	5/5	0.371	1.29	0.838	1.05	10/10	0.173	0.702	0.364	0.341
$TEQ_{DFP,M}$	5/5	0.940	2.42	1.92	2.06	15/15	1.26	27.6	8.39	3.86	5/5	0.666	1.64	1.2	1.49	10/10	0.296	0.902	0.545	0.479
$TEQ_{P,M}$	5/5	0.156	0.271	0.22	0.225	15/15	0.202	1.90	0.502	0.376	5/5	0.279	0.436	0.366	0.367	10/10	0.118	0.283	0.181	0.175
Polychlorinated Biphenyls (µg/kg ww)																				
Total PCBs[b]	5/5	20.4	25.6	23.6	23.7	15/15	20.2	95.4	46.1	30.8	5/5	30.4	40.8	34.1	34	10/10	9.54	17.8	12.9	11.7
Metals (mg/kg ww)																				
Mercury	5/5	0.0066	0.0124	0.00942	0.0092	13/15	0.0042	0.0154	0.0096	0.0104	5/5	0.0106	0.0178	0.0127	0.012	10/10	0.0046	0.008	0.0062	0.00615

Notes

FCA = fish collection area
PCB = polychlorinated biphenyl
$TEQ_{DF,M}$ = Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors (Van den Berg et al. 2006) with nondetects set at one-half the detection limit.
$TEQ_{DFP,M}$ = Toxicity equivalent for dioxins, furans and polychlorinated biphenyls calculated using mammalian toxicity equivalency factors (Van den Berg et al. 2006) with nondetects set at one-half the detection limit.
$TEQ_{P,M}$ - Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors (Van den Berg et al. 2006) with nondetects set at one-half the detection limit. Data for individual congeners are presented in Appendix B.
USEPA = U.S. Environmental Protection Agency
ww = wet weight
-- = Not applicable, no detected value

a - Mean and median calculations include detected and nondetected values. Nondetected values were set at one-half the detection limit.
b - Total PCBs were calculated using all 209 PCB congeners with non-detects set at one-half the detection limit.

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Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 14
Summary Statistics for Dioxins, Furans, PCBs, and Mercury in Whole Gulf Killifish Tissue from FCAs

	FCA1					FCA2					FCA3					Upstream Background				
	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]	Detection Frequency	Minimum Detected Value	Maximum Detected Value	Mean [a]	Median [a]
Gulf Killifish - Whole																				
Dioxins and Furans (ng/kg ww)																				
2,3,7,8-TCDD	0/2	--	--	0.0761	0.0761	3/6	0.808	9.53	2.48	0.504	0/2	--	--	0.217	0.217	0/8	--	--	0.0685	0.0544
1,2,3,7,8-PeCDD	0/2	--	--	0.0101	0.0101	0/6	--	--	0.0132	0.0138	0/2	--	--	0.0703	0.0703	0/8	--	--	0.0247	0.0169
1,2,3,4,7,8-HxCDD	0/2	--	--	0.012	0.0119	0/6	--	--	0.0138	0.0121	0/2	--	--	0.0324	0.0324	0/8	--	--	0.0205	0.0182
1,2,3,6,7,8-HxCDD	0/2	--	--	0.0134	0.0133	0/6	--	--	0.0155	0.0137	0/2	--	--	0.0431	0.0431	0/8	--	--	0.0254	0.0209
1,2,3,7,8,9-HxCDD	0/2	--	--	0.0123	0.0123	0/6	--	--	0.0142	0.0125	0/2	--	--	0.0351	0.0351	0/8	--	--	0.0218	0.0191
1,2,3,4,6,7,8-HpCDD	0/2	--	--	0.0218	0.0218	4/6	0.0868	0.147	0.0964	0.0916	2/2	0.429	0.663	0.546	0.546	6/8	0.114	0.381	0.200	0.220
OCDD	0/2	--	--	0.195	0.195	1/6	1.43	1.43	0.569	0.431	2/2	4.15	4.30	4.23	4.23	4/8	1.53	4.55	2.22	1.50
2,3,7,8-TCDF	0/2	--	--	0.0369	0.0369	4/6	0.618	4.46	1.69	1.19	2/2	0.505	0.850	0.678	0.678	2/8	0.304	0.444	0.132	0.0873
1,2,3,7,8-PeCDF	0/2	--	--	0.0154	0.0154	0/6	--	--	0.0156	0.0115	0/2	--	--	0.0454	0.0454	0/8	--	--	0.0205	0.0184
2,3,4,7,8-PeCDF	0/2	--	--	0.0152	0.0152	1/6	0.188	0.188	0.0787	0.0131	0/2	--	--	0.0461	0.0461	0/8	--	--	0.0201	0.018
1,2,3,4,7,8-HxCDF	0/2	--	--	0.0079	0.00793	1/6	0.266	0.266	0.057	0.0101	0/2	--	--	0.036	0.036	0/8	--	--	0.0162	0.0115
1,2,3,6,7,8-HxCDF	0/2	--	--	0.0074	0.0074	1/6	0.0695	0.0695	0.0191	0.0095	0/2	--	--	0.0346	0.0346	0/8	--	--	0.0157	0.0109
1,2,3,7,8,9-HxCDF	0/2	--	--	0.0085	0.0085	0/6	--	--	0.0097	0.00955	0/2	--	--	0.0492	0.0492	0/8	--	--	0.0203	0.0124
2,3,4,6,7,8-HxCDF	0/2	--	--	0.0078	0.00783	0/6	--	--	0.009	0.00858	0/2	--	--	0.0394	0.0394	0/8	--	--	0.0172	0.0114
1,2,3,4,6,7,8-HpCDF	0/2	--	--	0.0126	0.0126	0/6	--	--	0.015	0.0139	0/2	--	--	0.0423	0.0423	1/8	0.0621	0.0621	0.0282	0.0207
1,2,3,4,7,8,9-HpCDF	0/2	--	--	0.0153	0.0153	0/6	--	--	0.0184	0.0165	0/2	--	--	0.054	0.054	0/8	--	--	0.0285	0.025
OCDF	0/2	--	--	0.014	0.014	0/6	--	--	0.0153	0.0163	0/2	--	--	0.0765	0.0768	1/8	0.341	0.341	0.0763	0.0314
$TEQ_{DF,M}$	0/2	--	--	0.102	0.102	5/6	0.034	10.1	2.70	0.647	2/2	0.379	0.430	0.404	0.404	7/8	0.0373	0.307	0.13	0.105
$TEQ_{DFP,M}$	2/2	0.390	0.865	0.627	0.627	6/6	0.264	13.0	3.96	1.40	2/2	0.725	1.10	0.914	0.914	8/8	0.165	0.918	0.424	0.323
$TEQ_{P,M}$	2/2	0.318	0.732	0.525	0.525	6/6	0.230	2.92	1.26	0.755	2/2	0.346	0.674	0.510	0.510	8/8	0.103	0.653	0.295	0.201
Polychlorinated Biphenyls (µg/kg ww)																				
Total PCBs[b]	2/2	32.7	39.7	36.2	36.2	6/6	18.6	191	82.6	38.1	2/2	28.4	51.9	40.2	40.2	8/8	10.2	14.6	12	11.9
Metals (mg/kg ww)																				
Mercury	2/2	0.0231	0.0328	0.028	0.028	6/6	0.0221	0.09	0.0501	0.0384	2/2	0.0568	0.0762	0.0665	0.0665	8/8	0.0225	0.0694	0.0393	0.0314

Notes

-- = Not applicable, no detected values

FCA = fish collection area

PCB = polychlorinated biphenyl

$TEQ_{DF,M}$ = Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors (Van den Berg et al. 2006) with nondetects set at one-half the detection limit.

$TEQ_{DFP,M}$ = Toxicity equivalent for dioxins, furans and polychlorinated biphenyls calculated using mammalian toxicity equivalency factors (Van den Berg et al. 2006) with nondetects set at one-half the detection limit.

$TEQ_{P,M}$ - Toxicity equivalent for polychlorinated biphenyls calculated using mammalian toxicity equivalency factors (Van den Berg et al. 2006) with nondetects set at one-half the detection limit. Data for individual congeners are presented in Appendix B.

USEPA = U.S. Environmental Protection Agency

ww = wet weight

a - Mean and median calculations include detected and nondetected values. Nondetected values were set at one-half the detection limit.

b - Total PCBs were calculated using all 209 PCB congeners with non-detects set at one-half the detection limit.

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 15
Summary Statistics for Dioxin and Furan Concentrations in Soil Investigation Area 4 (Southern Impoundment) and Adjacent Surface Soil Samples

Analyte	Number of Samples	Number of Detected Measurements	Detection Frequency	Concentration (ng/kg dw)		
				Minimum	Maximum	Mean
2,3,7,8-TCDD	ng/kg	24	83%	0.544	24.3	4.84
1,2,3,7,8-PeCDD	ng/kg	23	79%	0.216	3.30	0.766
1,2,3,4,7,8-HxCDD	ng/kg	25	86%	0.186	4.71	1.25
1,2,3,6,7,8-HxCDD	ng/kg	27	93%	0.720	12.6	3.88
1,2,3,7,8,9-HxCDD	ng/kg	29	100%	0.627	12.2	3.59
1,2,3,4,6,7,8-HpCDD	ng/kg	29	100%	19.6	438	149
OCDD	ng/kg	29	100%	376	64,900	9200
2,3,7,8-TCDF	ng/kg	25	86%	0.237	78.7	15.7
1,2,3,7,8-PeCDF	ng/kg	21	72%	0.229	3.72	1.03
2,3,4,7,8-PeCDF	ng/kg	24	83%	0.180	3.48	1.01
1,2,3,4,7,8-HxCDF	ng/kg	29	100%	0.160	8.26	2.64
1,2,3,6,7,8-HxCDF	ng/kg	21	72%	0.229	2.94	0.999
1,2,3,7,8,9-HxCDF	ng/kg	6	21%	0.0696	0.353	0.103
2,3,4,6,7,8-HxCDF	ng/kg	20	69%	0.258	3.60	0.998
1,2,3,4,6,7,8-HpCDF	ng/kg	29	100%	0.870	60.8	14.4
1,2,3,4,7,8,9-HpCDF	ng/kg	22	76%	0.204	4.82	1.20
OCDF	ng/kg	29	100%	3.00	249	66.4
$TEQ_{DF,M}$	ng/kg	29	100%	1.35	36.9	13.3

Notes

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

$TEQ_{DF,M}$ (ND=1/2DL) = Toxicity equivalent for 2,3,7,8-tetrachlorinated dibenzo-p-dioxin (TCDD) calculated using dioxins and furans and mammalian toxicity equivalency factors (Van den Berg et al. 2006) with nondetects set at one-half the detection limit.

dw = dry weight

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Table 16
Summary Statistics for Dioxin and Furan Concentrations in Soil Investigation Area 4 (Southern Impoundment) and Adjacent Subsurface Soils Samples

Analyte	Number of Samples	Number of Detected Measurements	Detection Frequency	Concentration (ng/kg dw)		
				Minimum	Maximum	Mean
2,3,7,8-TCDD	ng/kg	176	80%	0.157	33800	398
1,2,3,7,8-PeCDD	ng/kg	145	66%	0.0449	375	4.97
1,2,3,4,7,8-HxCDD	ng/kg	145	66%	0.0226	17.5	1.41
1,2,3,6,7,8-HxCDD	ng/kg	180	81%	0.109	89.6	6.76
1,2,3,7,8,9-HxCDD	ng/kg	184	83%	0.0476	52	4.28
1,2,3,4,6,7,8-HpCDD	ng/kg	217	98%	0.995	2390	211
OCDD	ng/kg	221	100%	5.86	106000	6620
2,3,7,8-TCDF	ng/kg	203	92%	0.347	129000	1470
1,2,3,7,8-PeCDF	ng/kg	166	75%	0.0975	8300	67.7
2,3,4,7,8-PeCDF	ng/kg	165	75%	0.0905	3690	37.2
1,2,3,4,7,8-HxCDF	ng/kg	190	86%	0.109	11300	92.6
1,2,3,6,7,8-HxCDF	ng/kg	154	70%	0.069	3750	30.8
1,2,3,7,8,9-HxCDF	ng/kg	62	28%	0.039	242	1.82
2,3,4,6,7,8-HxCDF	ng/kg	134	61%	0.0763	646	6.70
1,2,3,4,6,7,8-HpCDF	ng/kg	200	90%	0.091	4240	67.8
1,2,3,4,7,8,9-HpCDF	ng/kg	144	65%	0.101	1620	14.8
OCDF	ng/kg	201	91%	0.266	11300	616
$TEQ_{DF,M}$	ng/kg	221	100%	0.0917	50100	582

Notes

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

$TEQ_{DF,M}$ (ND=1/2DL) = Toxicity equivalent for 2,3,7,8-tetrachlorinated dibenzo-p-dioxin (TCDD) calculated using dioxins and furans and mammalian toxicity equivalency factors (Van den Berg et al. 2006) with nondetects set at one-half the detection limit.

dw = dry weight

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 17

Summary Statistics for Dioxin and Furan Concentrations in Soil Investigation Area 4 (Southern Impoundment) and Adjacent Core Soil Samples

Analyte	Number of Samples	Detected Measurements	Detection Frequency	Concentration (ng/kg dw)		
				Minimum	Maximum	Mean
2,3,7,8-TCDD	172	140	81%	0.0314	33,800	509
1,2,3,7,8-PeCDD	172	109	63%	0.00935	375	6.21
1,2,3,4,7,8-HxCDD	172	107	62%	0.00875	17.5	1.52
1,2,3,6,7,8-HxCDD	172	137	80%	0.00865	89.6	7.59
1,2,3,7,8,9-HxCDD	172	138	80%	0.0184	52	4.65
1,2,3,4,6,7,8-HpCDD	172	168	98%	0.135	2,390	233
OCDD	172	172	100%	5.86	106,000	6,690
2,3,7,8-TCDF	172	159	92%	0.049	129,000	1,880
1,2,3,7,8-PeCDF	172	127	74%	0.00505	8,300	86.6
2,3,4,7,8-PeCDF	172	127	74%	0.00575	3,690	47.4
1,2,3,4,7,8-HxCDF	172	144	84%	0.0078	11,300	118
1,2,3,6,7,8-HxCDF	172	120	70%	0.00815	3,750	39.2
1,2,3,7,8,9-HxCDF	172	51	30%	0.0112	242	2.31
2,3,4,6,7,8-HxCDF	172	103	60%	0.0093	646	8.31
1,2,3,4,6,7,8-HpCDF	172	152	88%	0.011	4,240	82.3
1,2,3,4,7,8,9-HpCDF	172	111	65%	0.0148	1,620	18.6
OCDF	172	153	89%	0.0221	11,300	768
$TEQ_{DF,M}$	172	172	100%	0.0917	50,100	743

Notes

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

$TEQ_{DF,M}$ (ND=1/2DL) = Toxicity equivalent for 2,3,7,8-tetrachlorinated dibenzo-p-dioxin (TCDD) calculated using dioxins and furans and mammalian toxicity equivalency factors (Van den Berg et al. 2006) with nondetects set at one-half the detection limit.

dw = dry weight

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Table 18

Summary Statistics for Total PCB[a] Concentrations in Soil Investigation Area 4 Surface, Subsurface, and Core Soil Samples

Analyte	Number of Samples	Number of Detected Measurements	Detection Frequency	Concentration (µg/kg dw)		
				Minimum	Maximum	Mean
Surface Soils (0 to 6 inches)						
Total PCBs (Congeners)	11	11	100%	9.1	468	162
Total PCBs (Aroclors)	10	8	80%	1.05	112	26.9
Combined Total PCBS	21	19	90%	1.05	468	97.7
Subsurface Soils (6 to 24 inches)						
Total PCBs (Congeners)	22	22	100%	0.967	838	147
Total PCBs (Aroclors)	17	13	76%	1.05	420	50.2
Combined Total PCBS	39	35	90%	0.967	838	105
Soil Cores (2 feet deep and deeper)						
Total PCBs (Congeners)	42	42	100%	0.251	6,590	619
Total PCBs (Aroclors)	45	21	47%	1.05	630	93.8
Combined Total PCBS	87	63	72%	0.251	6,590	348

Notes

Mean calculations include detected and nondetected values. Nondetected values were set to one-half the detection limit.

a - PCBs were analyzed as Aroclors in samples collected in 2011 (Stations SJSB001 through SJSB010 and SJTS032 through SJTS034), and as 209 congeners in samples collected in 2012. For soils analyzed for Aroclors, total PCBs was calculated as the sum of detected Aroclors. If all Aroclors were nondetected, then total PCBs was estimated as one-half the highest Aroclor detection limit in the sample. For samples analyzed for all 209 congeners, the sum of all congeners was used, with nondetects estimated at one-half the detection limit.

dw = dry weight

Table 19
Summary Statistics for Chemical Concentrations in Waste Material Groundwater Samples Collected from Soil Investigation Area 4 (Southern Impoundment)

Analyte	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
				Minimum	Maximum	Mean
Dioxin and Furans (pg/L)						
2,3,7,8-Tetrachlorodibenzo-p-dioxin	3	2	67%	8.92	32.4	20.7
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	3	0	0%			
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	3	0	0%			
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	3	1	33%	3.16	3.16	3.16
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	3	0	0%			
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	3	2	67%	22.1	56.2	39.1
2,3,7,8-Tetrachlorodibenzofuran	3	3	100%	29.3	110	66
1,2,3,7,8-Pentachlorodibenzofuran	3	2	67%	2.4	2.73	2.56
2,3,4,7,8-Pentachlorodibenzofuran	3	1	33%	2.02	2.02	2.02
1,2,3,4,7,8-Hexachlorodibenzofuran	3	3	100%	1.62	5.69	3.46
1,2,3,6,7,8-Hexachlorodibenzofuran	3	1	33%	0.61	0.61	0.61
1,2,3,7,8,9-Hexachlorodibenzofuran	3	0	0%			
2,3,4,6,7,8-Hexachlorodibenzofuran	3	0	0%			
1,2,3,4,6,7,8-Heptachlorodibenzofuran	3	1	33%	26.5	26.5	26.5
1,2,3,4,7,8,9-Heptachlorodibenzofuran	3	1	33%	3.47	3.47	3.47
$TEQ_{DF,M}$ (ND=DL)	3	3	100%	14.4	48	30
$TEQ_{DF,M}$ (ND=1/2DL)	3	3	100%	13.6	47.3	26
$TEQ_{DF,M}$ (ND=0)	3	3	100%	6.42	46.7	22
Total Metals (mg/L)						
Aluminum	3	3	100%	0.0245	1.22	0.48
Arsenic	3	2	67%	0.00305	0.0105	0.0068
Barium	3	3	100%	0.245	0.256	0.25
Cadmium	3	0	0%			
Chromium	3	3	100%	0.0015	0.00298	0.00226
Cobalt	3	3	100%	0.00152	0.00465	0.00308
Copper	3	2	67%	0.00355	0.0087	0.00613
Lead	3	2	67%	0.00315	0.00933	0.00624
Magnesium	3	3	100%	41.4	184	134
Manganese	3	3	100%	2.04	2.29	2.18
Mercury	3	1	33%	4.00×10^{-5}	4.00×10^{-5}	4.00×10^{-5}
Nickel	3	1	33%	0.00135	0.00135	0.00135
Thallium	3	3	100%	5.40×10^{-5}	6.60×10^{-5}	5.85×10^{-5}
Vanadium	3	3	100%	0.00583	0.0071	0.00668
Zinc	3	3	100%	0.0016	0.0153	0.0098

Table 19
Summary Statistics for Chemical Concentrations in Groundwater Samples Collected from Soil Investigation Area 4 (Southern Impoundment)

Analyte	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
				Minimum	Maximum	Mean
Dissolved Metals (mg/L)						
Aluminum	3	3	100%	0.011	0.609	0.214
Arsenic	3	1	33%	0.0094	0.0094	0.0094
Barium	3	3	100%	0.243	0.782	0.6
Cadmium	3	0	0%			
Chromium	3	1	33%	0.0007	0.0007	0.0007
Cobalt	3	3	100%	0.00156	0.005	0.00315
Copper	3	1	33%	0.0011	0.0011	0.0011
Lead	3	1	33%	0.0068	0.0068	0.0068
Magnesium	3	3	100%	42	85.3	70
Manganese	3	3	100%	2.07	2.26	2.19
Mercury	3	0	0%			
Nickel	3	3	100%	0.001	0.0035	0.00247
Thallium	3	1	33%	$5.20x10^{-5}$	$5.20x10^{-5}$	$5.20x10^{-5}$
Vanadium	3	3	100%	0.00385	0.0094	0.00722
Zinc	3	3	100%	0.0029	0.0075	0.00467
Polycyclic Aromatic Hydrocarbons (µg/L)						
2-Methylnaphthalene	3	1	33%	0.1	0.1	0.1
2-Nitroaniline	3	0	0%			
3-Nitroaniline	3	0	0%			
4-Nitroaniline	3	0	0%			
Acenaphthene	3	2	67%	0.089	0.35	0.22
Acenaphthylene	3	2	67%	0.0175	0.021	0.0192
Anthracene	3	3	100%	0.16	0.255	0.202
Benzo[a]anthracene	3	0	0%			
Benzo[a]pyrene	3	0	0%			
Benzo[b]fluoranthene	3	0	0%			
Benzo[g,h,i]perylene	3	0	0%			
Benzo[k]fluoranthene	3	0	0%			
Chrysene	3	1	33%	0.0235	0.0235	0.0235
Dibenzofuran	3	0	0%			
Dibenzo[a,h]anthracene	3	0	0%			
Fluoranthene	3	2	67%	0.028	0.11	0.069
Fluorene	3	2	67%	0.042	0.074	0.058
Indeno[1,2,3-cd]pyrene	3	0	0%			

Table 19
Summary Statistics for Chemical Concentrations in Groundwater Samples Collected from Soil Investigation Area 4 (Southern Impoundment)

Analyte	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
				Minimum	Maximum	Mean
Naphthalene	3	0	0%			
Phenanthrene	3	3	100%	0.0252	0.069	0.0418
Pyrene	3	2	67%	0.0325	0.12	0.076
Polychlorinated Biphenyls (µg/L)						
Aroclor 1016	3	0	0%			
Aroclor 1221	3	0	0%			
Aroclor 1232	3	0	0%			
Aroclor 1242	3	0	0%			
Aroclor 1248	3	0	0%			
Aroclor 1254	3	1	33%	0.086	0.086	0.086
Aroclor 1260	3	2	67%	0.00545	0.037	0.0212
Aroclor 1262	3	0	0%			
Aroclor 1268	3	0	0%			
Pesticides (µg/L)						
Carbazole	3	2	67%	0.0242	0.059	0.0416
Phenols (µg/L)						
2,4,5-Trichlorophenol	3	0	0%			
2,4,6-Trichlorophenol	3	0	0%			
2,4-Dichlorophenol	3	0	0%			
2-Chlorophenol	3	0	0%			
Pentachlorophenol	3	0	0%			
Conventional Chemistry (mg/L)						
Total Dissolved Solids	3	3	100%	1,520	5,040	3,100
Total Suspended Solids	3	3	100%	22	77.5	54.2
Semivolatile Organic Compounds (µg/L)						
1,2,4-Trichlorobenzene	3	0	0%			
1,2-Dichlorobenzene	3	0	0%			
1,3-Dichlorobenzene	3	1	33%	0.86	0.86	0.86
1,4-Dichlorobenzene	3	0	0%			
2,2'-oxybis(1-Chloropropane)	3	0	0%			
2,4-Dimethylphenol	3	0	0%			
2,4-Dinitrophenol	3	0	0%			
2,4-Dinitrotoluene	3	0	0%			
2,6-Dinitrotoluene	3	0	0%			
2-Chloronaphthalene	3	0	0%			
2-Methylphenol	3	0	0%			
2-Nitrophenol	3	0	0%			

Table 19

Summary Statistics for Chemical Concentrations in Groundwater Samples Collected from Soil Investigation Area 4

Analyte	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
				Minimum	Maximum	Mean
3,3'-Dichlorobenzidine	3	0	0%			
4,6-Dinitro-2-methylphenol	3	0	0%			
4-Bromophenyl-phenylether	3	0	0%			
4-Chloro-3-methylphenol	3	0	0%			
4-Chloroaniline	3	0	0%			
4-Chlorophenyl-phenyl ether	3	0	0%			
4-Methylphenol	3	1	33%	1.3	1.3	1.3
4-Nitrophenol	3	0	0%			
Benzoic acid	3	3	100%	2.65	7	4.65
Benzyl alcohol	3	2	67%	0.0587	0.37	0.214
Bis(2-chloroethyl)ether	3	0	0%			
bis(2-Chloroethoxy)methane	3	0	0%			
bis(2-Ethylhexyl)phthalate	3	1	33%	0.2	0.2	0.2
Benzyl n-butyl phthalate	3	0	0%			
Diethyl phthalate	3	0	0%			
Dimethyl phthalate	3	1	33%	0.019	0.019	0.019
Di-n-butyl phthalate	3	0	0%			
Di-n-octylphthalate	3	0	0%			
Hexachloroethane	3	0	0%			
Hexachlorobenzene	3	0	0%			
Hexachlorobutadiene	3	0	0%			
Hexachlorocyclopentadiene	3	0	0%			
Isophorone	3	0	0%			
Nitrobenzene	3	0	0%			
N-Nitrosodi-n-propylamine	3	0	0%			
N-Nitrosodiphenylamine	3	2	67%	0.14	0.43	0.285
Phenol	3	3	100%	0.08	0.24	0.145
Volatile Organic Compounds (µg/L)						
1,1,1,2-Tetrachloroethane	3	0	0%			
1,1,1-Trichloroethane	3	0	0%			
1,1,2,2-Tetrachloroethane	3	1	33%	0.51	0.51	0.51
1,1,2-Trichloroethane	3	0	0%			
1,1-Dichloroethane	3	0	0%			
1,1-Dichloroethene	3	0	0%			
1,1-Dichloropropene	3	0	0%			
1,2,3-Trichlorobenzene	3	0	0%			
1,2,3-Trichloropropane	3	0	0%			

Table 19
Summary Statistics for Chemical Concentrations in Groundwater Samples Collected from Soil Investigation Area 4 (Southern Impoundment)

Analyte	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
				Minimum	Maximum	Mean
1,2,4-Trimethylbenzene	3	2	67%	0.11	0.33	0.22
1,2-Dibromo-3-chloropropane	3	0	0%			
1,2-Dibromoethane	3	0	0%			
1,2-Dichloroethane	3	0	0%			
1,2-Dichloropropane	3	0	0%			
1,3,5-Trimethylbenzene	3	1	33%	0.12	0.12	0.12
1,3-Dichloropropane	3	0	0%			
2,2-Dichloropropane	3	0	0%			
2-Chlorotoluene	3	0	0%			
2-Hexanone	3	0	0%			
4-Chlorotoluene	3	0	0%			
4-Isopropyl toluene	3	1	33%	0.26	0.26	0.26
4-Methyl-2-pentanone	3	0	0%			
Acetone	3	2	67%	3.8	17	10.4
Benzene	3	3	100%	0.07	5	1.73
Bromobenzene	3	0	0%			
Bromochloromethane	3	1	33%	0.23	0.23	0.23
Bromodichloromethane	3	3	100%	0.1	0.85	0.4
Bromomethane	3	0	0%			
Bromoform	3	2	67%	0.32	1	0.66
Sum of benzene, toluene, ethylbenzene, and xylenes (ND = 0)	3	3	100%	0.12	17.3	5.9
Carbon disulfide	3	3	100%	0.0522	0.53	0.274
Carbon Tetrachloride	3	0	0%			
Chloroform	3	3	100%	0.09	0.52	0.252
cis-1,2-Dichloroethene	3	0	0%			
cis-1,3-Dichloropropene	3	0	0%			
Chlorobenzene	3	1	33%	0.23	0.23	0.23
Chloroethane	3	0	0%			
Chloromethane	3	0	0%			
Dibromochloromethane	3	2	67%	0.38	1.5	0.94
Dibromomethane	3	1	33%	0.2	0.2	0.2
Dichlorodifluoromethane	3	0	0%			
Ethylbenzene	3	1	33%	2.3	2.3	2.3
Isopropylbenzene	3	2	67%	0.09	0.1	0.09
2-Butanone	3	1	33%	3.1	3.1	3.1
m,p-Xylene	3	2	67%	0.13	6.6	3.36
Methylene Chloride	3	0	0%			

Table 19
Summary Statistics for Chemical Concentrations in Groundwater Samples Collected from Soil Investigation Area 4 (Southern Impoundment)

Analyte	Number of Samples	Number of Detected Measurements	Detection Frequency	Detected Data		All Data
				Minimum	Maximum	Mean
n-Butylbenzene	3	2	67%	0.0535	0.13	0.092
n-Propylbenzene	3	2	67%	0.07	0.3	0.185
o-Xylene	3	1	33%	3.4	3.4	3.4
sec-Butylbenzene	3	0	0%			
Styrene	3	0	0%			
tert-Butylbenzene	3	0	0%			
Tetrachloroethene	3	0	0%			
Toluene	3	0	0%			
Sum of chlorinated Volatile Organic Compounds (ND = 0)	3	3	100%	0.35	4.85	2.2
Trichloroethene	3	3	100%	0.15	0.645	0.318
trans-1,2-Dichloroethene	3	0	0%			
trans-1,3-Dichloropropene	3	0	0%			
Trichlorofluoromethane	3	0	0%			
Vinyl Chloride	3	0	0%			

Notes

DL = detection limit

ND = nondetect

TEF = toxicity equvalence factor

$TEQ_{DF,M}$ = Toxicity equivalent for dioxins and furans calculated using mammalian toxicity equivalency factors (Van den Berg et al. 2006).

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 20

Baseline Human Health Risk Assessment Exposure Parameters for Deterministic Evaluation for the Area North of I-10 and Aquatic Envrionment

			Hypothetical Recreational Fisher				Hypothetical Subsistence Fisher			Hypothetical Recreational Visitor			
			RME			CTE	RME			RME			CTE
	Abbreviation	Units	Adult	Older Child	Young Child	Adult	Adult	Older Child	Young Child	Adult	Older Child	Young Child	Adult
All Pathways													
Body weight	BW	kg	80	50	19	80	80	50	19	80	50	19	80
Exposure duration	ED	years	16	11	6	12	16	11	6	16	11	6	12
Averaging time - non-carcinogens	ATn	days	5,840	4,015	2,190	4,380	5,840	4,015	2,190	5,840	4,015	2,190	4,380
Averaging time - carcinogens	ATc	days	28,470	28,470	28,470	28,470	28,470	28,470	28,470	28,470	28,470	28,470	28,470
Ingestion of Fish and Shellfish													
Exposure frequency, fish, shellfish	$EF_{fish\text{-}shellfish}$	days/year	365	365	365	365	365	365	365	--	--	--	--
Ingestion rate, fish	IR_{fish}	g/day	24	18	14	21	58	45	30	--	--	--	--
Ingestion rate, shellfish	$IR_{shellfish}$	g/day	1.4	1.0	0.6	1.0	3.8	4.5	2.0	--	--	--	--
Fraction of total fish or shellfish intake that is site-related	$FI_{fish\text{-}shellfish}$	% as fraction	0.25	0.25	0.25	0.10	1	1	1	--	--	--	--
Ingestion of Soil and Sediment													
Exposure frequency; soil, sediment	$EF_{soil\text{-}sed}$	days/year	39	39	39	13	104	104	104	104	104	104	52
Ingestion rate, soil	IR_{soil}	mg/day	20	50	125	20	20	50	125	20	50	125	20
Ingestion rate, sediment	IR_{sed}	mg/day	20	50	125	20	20	50	125	20	50	125	20
Fraction of total ingestion that is soil	F_{soil}	% as fraction	0	0	0	0	0	0	0	0.5	0.5	0.5	0.5
Fraction of total ingestion that is sediment	F_{sed}	% as fraction	1	1	1	1	1	1	1	0.5	0.5	0.5	0.5
Fraction of total daily soil/sediment intake that is site-related	$FI_{soil\text{-}sed}$	% as fraction	1	1	1	0.5	1	1	1	1	1	1	0.5
Dermal Contact with Soil and Sediment													
Exposure frequency; soil, sediment	$EF_{soil\text{-}sed}$	days/year	39	39	39	13	104	104	104	104	104	104	52
Skin surface area	SA	cm^2	6,080	4,270	3,280	6,080	6,080	4,270	3,280	6,080	4,270	3,280	6,080
Adherence factor, soil	AF_{soil}	mg/cm^2	0.07	0.07	0.09	0.07	0.07	0.07	0.09	0.07	0.07	0.09	0.07
Adherence factor, sediment	AF_{sed}	mg/cm^2	4.9	5.1	3.6	4.9	4.9	5.1	3.6	4.9	5.1	3.6	4.9
Fraction of pathway exposure that is soil	F_{soil}	% as fraction	0	0	0	0	0	0	0	0.5	0.5	0.5	0.5
Fraction of pathway exposure that is sediment	F_{sed}	% as fraction	1	1	1	1	1	1	1	0.5	0.5	0.5	0.5
Fraction of total daily soil/sediment intake that is site-related	$FI_{soil\text{-}sed}$	% as fraction	1	1	1	0.5	1	1	1	1	1	1	0.5
Event frequency	EV	1/day	1	1	1	1	1	1	1	1	1	1	1

Notes

-- = Not applicable; pathway is not evaluated for receptor.
CTE = central tendency exposure
RME = reasonable maximum exposure

ABSd = dermal absorption factor for soil and sediment
COPCH = chemical of potential concern for human health
LOSS = chemical reduction due to preparation and cooking
RBAtissue = relative bioavailability adjustment for tissue
RBAss = relative bioavailability adjustment for soil and sediment

$COPC_H$	ABS_d (% as fraction)	RBA_{ss} (% as fraction)	RBA_{tissue} (% as fraction)	LOSS (% as fraction)
Dioxins and Furans				
Dioxins and Furans	0.03[a]	0.5[b]	1[c]	0[c]

a - Value is from USEPA (2004)
b - Multiple sources were used to derive this value
c - Conservative default assumption
d - Value is from CalEPA (2011)

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Baseline Human Health Risk Assessment, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 21
Baseline Human Health Risk Assessment Exposure Scenarios for the Area North of I-10 and Aquatic Environment

Scenario		Exposure Unit			
		Sediment EU(s)	Soil EU(s)	Finfish EU(s)	Shellfish EU(s)
Northern Impoundments and Aquatic Environment					
Hypothetical Fisher (Recreational and Subsistence)					
Scenario 1A		Beach Area A	--	Hardhead Catfish: FCA 2/3	--
Scenario 1B		Beach Area A	--	--	Clam: FCA 1/3
Scenario 1C		Beach Area A	--	--	Crab: FCA 2/3
Scenario 2A		Beach Area B/C	--	Hardhead Catfish: FCA 2/3	--
Scenario 2B		Beach Area B/C	--	--	Clam: 2
Scenario 2C		Beach Area B/C	--	--	Crab: FCA 2/3
Scenario 3A		Beach Area E	--	Hardhead Catfish: FCA 2/3	--
Scenario 3B		Beach Area E	--	--	Clam: 2
Scenario 3C		Beach Area E	--	--	Crab: FCA 2/3
Scenario 4A		Beach Area D	--	Hardhead Catfish: FCA 1	
Scenario 4B		Beach Area D	--	--	Clam: FCA 1/3
Scenario 4C		Beach Area D	--	--	Crab: FCA 1
Hypothetical Recreational Visitor					
Scenario 1		Beach Area A	Soils North of I-10	--	--
Scenario 2		Beach Area B/C	Soils North of I-10	--	--
Scenario 3		Beach Area E	Soils North of I-10	--	--
Scenario 4		Beach Area D	Soils North of I-10	--	--
Area of Investigation on the Peninsula South of I-10					
Hypothetical Trespasser					
Scenario 1		--	Area of Investigation on the Peninsula South of I-10	--	--
Hypothetical Commercial Worker					
Scenario 1		--	Area of Investigation on the Peninsula South of I-10	--	--
Hypothetical Construction Worker					
Scenario DS-1		--	DS-1	--	--
Scenario DS-2		--	DS-2	--	--
Scenario DS-3		--	DS-3	--	--
Scenario DS-4		--	DS-4	--	--
Scenario DS-5		--	DS-5	--	--

Notes

-- = Not applicable, see CSM and refined conceptualization of potential exposure pathways presented in Section 4 of the text.
BHHRA = baseline human health risk assessment
CSM = conceptual site model
DS = deep soil
EU = exposure unit
FCA = fish collection area

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Baseline Human Health Risk Assessment, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 22

Baseline Human Health Risk Assessment Exposure Parameters for Deterministic Evaluation for the Area South of I-10

		Units	Hypothetical Trespasser RME	Hypothetical Trespasser CTE	Hypothetical Commercial Worker RME	Hypothetical Commercial Worker CTE	Hypothetical Construction Worker RME	Hypothetical Construction Worker CTE
All Pathways								
Body weight	BW	kg	74	74	80	80	80	80
Exposure duration	ED	years	7	4	25	12	1	1
Fraction of total daily soil intake that is site-related	FI_{soil}	% as fraction	0.5	0.25	1	1	1	1
Exposure frequency, soil	EF_{soil}	days/year	24	12	225	225	250	125
Averaging time - non-carcinogens	ATn	days	2,555	1,460	9,125	4,380	365	365
Averaging time - carcinogens	ATc	days	28,470	28,470	28,470	28,470	28,470	28,470
Ingestion of Soil								
Ingestion rate, soil	IR_{soil}	mg/day	41	41	100	50	330	100
Dermal Contact with Soil								
Skin surface area	SA	cm^2	5,550	5,550	3,470	3,470	2,630	2,630
Adherence factor, soil	AF_{soil}	mg/cm^2	0.07	0.07	0.2	0.2	0.2	0.2
Event frequency	EV	1/day	1	1	1	1	1	1

Notes

CTE = central tendency exposure
RME = reasonable maximum exposure

ABSd = dermal absorption factor for soil and sediment
COPCH = chemical of potential concern for human health
LOSS = chemical reduction due to preparation and cooking
RBAtissue = relative bioavailability adjustment for tissue
RBAss = relative bioavailability adjustment for soil and sediment

$COPC_H$	ABS_d (% as fraction)	RBA_{ss} (% as fraction)	RBA_{tissue} (% as fraction)	LOSS (% as fraction)
Dioxins and Furans				
Dioxins and Furans	0.03[a]	0.5[b]	1[c]	0[c]

a - Value is from USEPA (2004)
b - Multiple sources were used to derive this value
c - Conservative default assumption
d - Value is from CalEPA (2011)

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Baseline Human Health Risk Assessment, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 23
Chemicals of Potential Ecological Concern Screening for Benthic Macroinvertebrate Community, North of I-10

Chemical	NOEC [a]	Highest Site Concentration (TCEQ and USEPA 2006) [b]	Frequency of Detection of Site Samples	Does Maximum Site Sample Exceed NOEC?	Maintain as COPC for Benthic Invertebrates?	Reason for COPC Decision
Metals (mg/kg)						
Aluminum	NV	22,100	7/7	NSLV	Yes	No SLV, detected at least once in Site sediments
Antimony	NV	7.2 *U*	1/7	NSLV	No	No SLV; however, there is only a single detection in Site data and this is not a chemical expected to be associated with pulp mill waste
Arsenic	8.2	3	4/7	No	No	Maximum site concentration does not exceed SLV
Barium	NV	244	7/7	NSLV	Yes	No SLV, detected at least once in Site sediments
Cadmium	1.2	0.7 *U*	4/7	No	No	Maximum site concentration does not exceed SLV
Chromium	81	22.1	7/7	No	No	Maximum site concentration does not exceed SLV
Cobalt	NV	6.8 *J*	7/7	NSLV	Yes	No SLV, detected at least once in Site sediments
Copper	34	62.5	7/7	Yes	Yes	Maximum site concentration exceeds SLV
Lead	46.7	59.3	7/7	No	Yes	Maximum site concentration exceeds SLV
Magnesium	NV	4,790	7/7	NSLV	Yes	No screening value, detected at least once in Site sediments
Manganese	NV	790	7/7	NSLV	Yes	No screening value, detected at least once in Site sediments
Mercury	0.15	1.7	7/7	Yes	Yes	Maximum site concentration exceeds SLV
Nickel	20.9	14	7/7	No	No	Maximum site concentration does not exceed SLV

Modified from: Integral Consulting Inc. 2013. Baseline Ecological Risk Assessment, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 23
Chemicals of Potential Ecological Concern Screening for Benthic Macroinvertebrate Community, North of I-10

Chemical	NOEC [a]	Highest Site Concentration (TCEQ and USEPA 2006) [b]	Frequency of Detection of Site Samples	Does Maximum Site Sample Exceed NOEC?	Maintain as COPC for Benthic Invertebrates?	Reason for COPC Decision
Silver	1	1.4 *U*	2/7	Yes	No	Highest concentration is close to SLV. High percentage of non-detects. Highest detected concentration is 0.29, below SLV
Thallium	NV	3.5 *U*	0/7	NSLV	Yes (secondary)	No SLV, no detected concentrations in Site sediments
Vanadium	NV	34.4	7/7	NSLV	Yes	No SLV, detected at least once in Site sediments
Zinc	150	244	7/7	Yes	Yes	Maximum site concentration exceeds SLV
Dioxins/Furans (ng/kg)						
2,3,7,8-TCDD	25,000 [c]	18,500	7/7	No	No [d]	Maximum site value does not exceed SLV
Polychlorinated Biphenyls (PCBs) (µg/kg)						
Total PCBs	1,200 [e]	90 *U* [f]	0/7	N/A	No	Highest detection limit does not exceed screening value
Semivolatile Organic Compounds (µg/kg)						
Acenaphthene	16	455 *U*	0/7	Yes	Yes (secondary)	No SLV, no detected concentrations in Site sediments
Fluorene	19	455 *U*	0/7	Yes	Yes (secondary)	No SLV, no detected concentrations in Site sediments
Naphthalene	160	455 *U*	0/7	Yes	Yes (secondary)	No SLV, no detected concentrations in Site sediments
Phenanthrene	240	455 *U*	0/7	Yes	Yes (secondary)	No SLV, no detected concentrations in Site sediments

Modified from: Integral Consulting Inc. 2013. Baseline Ecological Risk Assessment, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 23
Chemicals of Potential Ecological Concern Screening for Benthic Macroinvertebrate Community, North of I-10

Chemical	NOEC [a]	Highest Site Concentration (TCEQ and USEPA 2006) [b]	Frequency of Detection of Site Samples	Does Maximum Site Sample Exceed NOEC?	Maintain as COPC for Benthic Invertebrates?	Reason for COPC Decision
2,4,6-Trichlorophenol	NV	455 *U*	0/7	NSLV	Yes (secondary)	No SLV, no detected concentrations in Site sediments
2,4-Dichlorophenol	NV	455 *U*	0/7	NSLV	Yes (secondary)	No SLV, no detected concentrations in Site sediments
Pentachlorophenol	NV	1,150 *U*	0/7	NSLV	Yes (secondary)	No SLV, no detected concentrations in Site sediments
Phenol	NV	455 *U*	0/7	NSLV	Yes (secondary)	No SLV, no detected concentrations in Site sediments
Hexachlorobenzene	NV	455 *U*	0/7	NSLV	Yes (secondary)	No SLV, no detected concentrations in Site sediments
2,3,4,6-Tetrachlorophenol	NV	NV	NV	NA	Yes (secondary)	No information available on which to base evaluation
Carbazole	NV	455 *U*	0/7	NSLV	Yes (secondary)	No SLV, no detected concentrations
2,4,5-Trichlorophenol	NV	1,150 *U*	0/7	NSLV	Yes (secondary)	No SLV, no detected concentrations
Bis(2-ethylhexyl)phthalate	182	1800	3/7	Yes	Yes	Maximum site concentration exceeds SLV
Volatile Organic Compounds (µg/kg)						
Chloroform	4300 [g]	NV	NV	NA	Yes (secondary)	No information available on which to base evaluation
1,2,4-Trichlorobenzene	390	NV	NV	NA	Yes (secondary)	No information available on which to base evaluation
1,2-Dichlorobenzene	740	NV	NV	NA	Yes (secondary)	No information available on which to base evaluation

Modified from: Integral Consulting Inc. 2013. Baseline Ecological Risk Assessment, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 23
Chemicals of Potential Ecological Concern Screening for Benthic Macroinvertebrate Community, North of I-10

Chemical	NOEC [a]	Highest Site Concentration (TCEQ and USEPA 2006) [b]	Frequency of Detection of Site Samples	Does Maximum Site Sample Exceed NOEC?	Maintain as COPC for Benthic Invertebrates?	Reason for COPC Decision
1,3-Dichlorobenzene	320	NV	NV	NA	Yes (secondary)	No information available on which to base evaluation
1,4-Dichlorobenzene	700	NV	NV	NA	Yes (secondary)	No information available on which to base evaluation
1,2,3-Trichlorobenzene	NV	NV	NV	NA	Yes (secondary)	No information available on which to base evaluation

Notes

DL = detection limit
EqP = equilibrium partitioning
OC = organic carbon
NA = not applicable
NOEC = no effect concentration
NV = no value
NSLV = no screening level value available
SLV = screening level value
J = estimated
U = analyte not detected

a - NOEC (no effect concentration) is from TCEQ 2006 and is based on Long et al. (1995) unless otherwise indicated. Units of screening value match those of sediment data as given in compound class header (e.g., metals in mg/kg).

b - Nondetects are provided at 1/2 the detection limit.

c - Barber et al. (1998)

d - Although dioxins and furans passed the screening step, on the basis of information provided in Attachment B2, evaluation of risks to benthic invertebrates resulting from exposure to 2,3,7,8-TCDD is appropriate (Table B-6).

e - Fuchsman et al. (2006). Lowest unbounded NOEC (growth) for a PCB mixture of 81 mg/kg OC (*Macoma nasuta*). Using EqP and conservative estimate of organic carbon of 1.5 percent (Louchouarn and Brinkmeyer 2009), the dry weight equivalent of this value is 1.2 mg/kg.

f - As there were no detections of PCBs, this value is the highest reporting limit in the data set for any of the Aroclors evaluated.

g - Table 3-3 in TCEQ (2006)

Table 24
Chemicals of Potential Ecological Concern Screening for Fish and Wildlife, North of I-10

Chemical	Highest Site Concentration (TCEQ and USEPA 2006)[a]	Frequency of Detection of Site Samples	Log Kow of Chemical (Organics Only)[b]	Is Chemical Potentially Bioaccumulative from Sediment?[c]	Maintain as COPC for Fish and Wildlife	Reason for COPC Decision
Metals (mg/kg)						
Aluminum	22,100	7/7	NA	No	No	Not potentially bioaccumulative
Antimony	7.2 *U*	1/7	NA	No	No	Not potentially bioaccumulative
Arsenic	3	7/7	NA	No	No	Not potentially bioaccumulative
Barium	244	7/7	NA	No	No	Not potentially bioaccumulative
Cadmium	0.7 *U*	4/7	NA	Yes	Yes	Potentially bioaccumulative,
Chromium	22.1	7/7	NA	No	No	Not potentially bioaccumulative
Cobalt	6.8 *J*	7/7	NA	No	No	Not potentially bioaccumulative
Copper	62.5	7/7	NA	Yes	Yes	Potentially bioaccumulative, detected at least once in Site sediments
Lead	59.3	7/7	NA	No	No	Not potentially bioaccumulative
Magnesium	4,790	7/7	NA	No	No	Not potentially bioaccumulative
Manganese	790	7/7	NA	No	No	Not potentially bioaccumulative
Mercury	1.7	7/7	NA	Yes	Yes	Potentially bioaccumulative, detected at least once in Site sediments
Nickel	14	7/7	NA	Yes	Yes	Potentially bioaccumulative, detected at least once in Site sediments

Table 24
Chemicals of Potential Ecological Concern Screening for Fish and Wildlife, North of I-10

Chemical	Highest Site Concentration (TCEQ and USEPA 2006)[a]	Frequency of Detection of Site Samples	Log Kow of Chemical (Organics Only)[b]	Is Chemical Potentially Bioaccumulative from Sediment?[c]	Maintain as COPC for Fish and Wildlife	Reason for COPC Decision
Silver	1.4 *U*	2/7	NA	No	No	Not potentially bioaccumulative
Thallium	3.5 *U*	0/7	NA	No	No	Not potentially bioaccumulative
Vanadium	34.4	7/7	NA	No	No	Not potentially bioaccumulative
Zinc	244	7/7	NA	Yes	Yes	Potentially bioaccumulative, detected at least once in Site sediments
Dioxins/Furans (ng/kg)						
TEQ birds at ND=1/2DL	62,200	N/A	>5	Yes	Yes	Potentially bioaccumulative, detected at least once in Site sediments
TEQ fish at ND=1/2DL	22,300	N/A	>5	Yes	Yes	Potentially bioaccumulative, detected at least once in Site sediments
TEQ mammals at ND=1/2 DL	24,000	N/A	>5	Yes	Yes	Potentially bioaccumulative, detected at least once in Site sediments
Polychlorinated Biphenyls (µg/kg)						
Total PCBs	90 U[d]	0/7	>5	Yes	Yes (secondary)	Potentially bioaccumulative, no detected concentrations in Site sediments
Semivolatile Organic Compounds (µg/kg)						
Acenaphthene	455 *U*	0/7	3.92	No[e]	No	Not potentially bioaccumulative

Modified from: Integral Consulting Inc. 2013. Baseline Ecological Risk Assessment, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Table 24
Chemicals of Potential Ecological Concern Screening for Fish and Wildlife, North of I-10

Chemical	Highest Site Concentration (TCEQ and USEPA 2006)[a]	Frequency of Detection of Site Samples	Log Kow of Chemical (Organics Only)[b]	Is Chemical Potentially Bioaccumulative from Sediment?[c]	Maintain as COPC for Fish and Wildlife	Reason for COPC Decision
Fluorene	455 *U*	0/7	4.18	No[e]	No	Not potentially bioaccumulative
Naphthalene	455 *U*	0/7	3.3	No[e]	No	Not potentially bioaccumulative
Phenanthrene	455 *U*	0/7	4.57	No[e]	No	Not potentially bioaccumulative
2,4,6-Trichlorophenol	455 *U*	0/7	3.72	No[e]	No	Not potentially bioaccumulative
2,4-Dichlorophenol	455 *U*	0/7	3.06	No[e]	No	Not potentially bioaccumulative
Pentachlorophenol	1,150 *U*	0/7	5.12	Yes	Yes (secondary)	Potentially bioaccumulative, no detected concentrations in Site sediments
Phenol	455 *U*	0/7	1.46	No[f]	No	Not potentially bioaccumulative
Hexachlorobenzene	455 *U*	0/7	5.73	Yes	Yes (secondary)	Potentially bioaccumulative, no detected concentrations in Site sediments
2,3,4,6-Tetrachlorophenol	NV	NV	4.45	No[e]	No	Not potentially bioaccumulative
Carbazole	455 *U*	0/7	3.72	No[e]	No	Not potentially bioaccumulative
2,4,5-Trichlorophenol	1,150 *U*	0/7	3.69	No[e]	No	Not potentially bioaccumulative
Bis(2-ethylhexyl)phthalate	1800	3/7	7.6	Yes	Yes	Potentially bioaccumulative, detected in Site sediments

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Table 24
Chemicals of Potential Ecological Concern Screening for Fish and Wildlife, North of I-10

Chemical	Highest Site Concentration (TCEQ and USEPA 2006)[a]	Frequency of Detection of Site Samples	Log Kow of Chemical (Organics Only)[b]	Is Chemical Potentially Bioaccumulative from Sediment?[c]	Maintain as COPC for Fish and Wildlife	Reason for COPC Decision
Volatile Organic Compounds (µg/kg)						
Chloroform	NV	NV	1.97	No[e]	No	Not potentially bioaccumulative
1,2,4-Trichlorobenzene	NV	NV	4.02	No[e]	No	Not potentially bioaccumulative
1,2-Dichlorobenzene	NV	NV	3.43	No[e]	No	Not potentially bioaccumulative
1,3-Dichlorobenzene	NV	NV	3.53	No[e]	No	Not potentially bioaccumulative
1,4-Dichlorobenzene	NV	NV	3.44	No[e]	No	Not potentially bioaccumulative
1,2,3-Trichlorobenzene	NV	NV	4.05	No[e]	No	Not potentially bioaccumulative

Notes

COPC = chemical of potential concern
NA = not applicable
NV = no value
TCEQ = Texas Commission on Environmental Quality
TEQ = toxicity equivalent
J = estimated
U = analyte not detected
a - Undetected values are set to 1/2 the detection limit.
b - Log Kow: Octanol-water partition coefficient, the ratio of the concentration of a chemical in octanol and water at equilibrium and at a specified temperature. Octanol is an organic solvent that is used as a surrogate for natural organic matter (e.g.,
c - Determination of bioaccumulative potential is based on TCEQ guidance (TCEQ 2006) or, if chemical is not addressed in guidance, log Kow information is used to determine bioaccumulative potential (as indicated in footnote e), with those chemicals having
d - As there were no detections of PCBs, this value is the highest reporting limit in the dataset for PCBs+A66
e - Not provided in TCEQ guidance; log Kow used to determine potential for bioaccumulation as described in footnote d.

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Table 25
Summary of Ecological Receptor Surrogates for the Area North of I-10 and Aquatic Environment

Receptor Group	Receptor Surrogate	Feeding Guild	Potentially Present	Representative of One or More Feeding Guilds	High Site Fidelity/Residential	Sensitive or Potentially Highly Exposed	Life History Information Is Readily Available	Additional Considerations
Benthic macroinvertebrates								
	Benthic macroinvertebrate community	All	X	X	X	X	X	Close association with sediment; much of the toxicological literature addresses community level endpoints.
	Molluscs	Filter feeders	X	X	X	X[a]	X	Close association with sediment
Fish								
	Gulf killifish	Omnivore	X	X	X		X	Common prey for other fish and bird species
	Black drum	Benthic invertivore	X	X	X		X	Popular sport fish; limited range, limited interbay movement
	Southern flounder	Benthic piscivore	X	X	X[b]	X	X	Supports commercial and recreational fisheries
Reptiles								
	Alligator snapping turtle	Omnivore	X	X	X	X	X	Sensitive species (rare in estuaries)
Birds								
	Neotropic cormorant	Piscivore (diving)	X	X			X	
	Great blue heron	Piscivore (wading)	X	X			X	
	Spotted sandpiper	Invertivore (probing)	X	X		X	X	As a sediment-probing invertivore, expected to be closely associated with sediment exposure pathway
	Killdeer	Invertivore (terrestrial)	X	X	X		X	Feeds on invertebrate fauna closely associated with soils
Mammals								
	Marsh Rice Rat	Omnivore	X	X	X		X	Semi-aquatic, diet consists of aquatic and emergent plants, and invertebrates
	Raccoon	Omnivore	X	X			X	Representative of both aquatic and terrestrial omnivorous feeding guilds

Notes
a - Sensitive reproductive endpoint
b - Site fidelity is probably high except in winter, when this species moves into more saline waters to spawn.

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Table 26
Summary of Ecological Receptor Surrogates for the Area South of I-10

Receptor Group	Receptor Surrogate	Feeding Guild	Potentially Present	Representative of One or More Feeding Guilds	High Site Fidelity/Residential	Sensitive or Potentially Highly Exposed	Life History Information Is Readily Available	Additional Considerations
Reptiles								
	Common garter snake	Carnivore	X	X	X	X	X	
Birds								
	Killdeer	Invertivore (terrestrial)	X	X	X		X	Feeds on invertebrate fauna closely associated with soils
Mammals								
	Pocket gopher	Herbivore	X	X	X	X	X	Burrowing mammal, used to evaluate both ingestion and inhalation pathways
	Virginia oppossum	Omnivore	X	X	X		X	

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Table 27
Summary of Lines of Evidence for Ecological Receptors and Assessment Endpoints for the Area North of I-10 and Aquatic Environment

Receptor	Assessment Endpoint	Lines of Evidence	Measure of Exposure	Measure of Effect	Comments/Rationale
Benthic Macroinvertebrates	Abundance and diversity of benthic macroinvertebrate communities	Comparison of $COPC_E$ concentrations in sediment to literature-based effects levels	$COPC_E$ Concentrations in sediment (mg/kg dw)	Toxicity reference values for sediment (mg/kg dw)	
		Comparisons of $COPC_E$ concentrations in sediment porewater to literature-based effects levels	$COPC_E$ concentrations in porewater (µg/L)	Toxicity reference values for estuarine and marine waters (µg/L)	Porewater concentrations are modeled using sediment concentrations and Kd or Koc values from the literature (Table 4-5)
Bivalve Molluscs	Stable or increasing populations of bivalves within the site	Comparisons of $COPC_E$ concentrations in clam tissue to literature-based reproductive effect values for molluscs	$COPC_E$ concentrations in clam tissue	Toxicity reference values for invertebrate tissue (ng/kg ww)	
Fish	Stable or increasing populations of fish in the following guilds: benthic omnivore, benthic invertivore, benthic piscivore	Comparison of $COPC_E$ concentrations in surface water to literature-based effects levels	$COPC_E$ concentrations in water (µg/L)	Toxicity reference values for estuarine and marine surface waters ((µg/L)	Surface water concentrations of nickel and BEHP are modeled using sediment concentrations and Kd or Koc values from the literature (Table 4-5)
		Comparison of $COPC_E$ concentrations (metals) in the diet of fish to literature-based effects levels associated with concentrations in the diet of fish	$COPC_E$ concentrations (metals) in food items of fish (mg/kg dw)	Toxicity reference values for concentrations of $COPC_E$s (metals) in food items of fish (mg/kg dw)	
		Comparisons of $COPC_E$ concentrations (PCBs, dioxins, and furans) in fish tissue to literature-based effects levels	$COPC_E$ concentrations (PCBs, dioxins, and furans) in fish tissue (µg/kg lw or ww)	Toxicity reference values for concentrations of $COPC_E$s (PCBs, dioxins, and furans) in fish tissue (ug/kg lw or ww)	
Reptiles	Stable or increasing populations of omnivorous reptiles	Comparison of estimated ingested $COPC_E$ dose to literature-based effects levels expressed on a dose basis	$COPC_E$ doses that account for all ingested media (mg/kg bw-day)	Toxicity reference values for concentrations of COPCEs as ingested doses (mg/kg bw-day)	
Birds	Stable or increasing populations of birds that may be exposed to $COPC_E$s from the site in the following feeding guilds: invertivore (aquatic and terrestrial), omnivorous wading bird, piscivorous diving bird	Comparison of estimated ingested $COPC_E$ dose to literature-based effects levels expressed on a dose basis	$COPC_E$ doses that account for all ingested media (mg/kg bw-day)	Toxicity reference values for concentrations of COPCEs as ingested doses (mg/kg bw-day)	
		Comparison of estimated concentrations of $COPC_E$s (dioxins and furans) in bird eggs to literature-based effects levels for associated with reproductive effects in birds	$COPC_E$ (dioxins and furans) concentration in bird eggs (ng/g ww)	Toxicity reference values for $COPC_E$s (dioxins and furans) in bird eggs (ng/g ww)	Exposure concentrations are estimated using data for concentrations of $COPC_E$s in ingested media (prey and sediment)
Mammals	Stable or increasing populations of omnivorous mammals	Comparison of estimated ingested $COPC_E$ dose to literature-based effects levels expressed on a dose basis	$COPC_E$ doses that account for all ingested media (mg/kg bw-day)	Toxicity reference values for concentrations of COPCEs as ingested doses (mg/kg bw-day)	

Notes
bw = body weight
$COPC_E$ = chemical of potential ecological concern
dw = dry weight

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Table 28
Summary of Lines of Evidence for Ecological Receptors and Assessment Endpoints for the Area South of I-10

Receptor	Assessment Endpoint	Lines of Evidence	Measure of Exposure	Measure of Effect	Comments/Rationale
Reptiles	Stable or increasing populations of reptiles	Comparison of estimated ingested $COPC_E$ dose to literature-based effects levels expressed on a dose basis	$COPC_E$ doses that account for all ingested media (mg/kg bw-day)	Toxicity reference values for concentrations of $COPC_E$s as ingested doses (mg/kg bw-day)	Evaluated in the uncertainty assessment because dosimetric data for reptiles is lacking. Bird receptor is used as surrogate.
Birds	Stable or increasing populations of invertivorous birds	Comparison of estimated ingested $COPC_E$ dose to literature-based effects levels expressed on a dose basis	$COPC_E$ doses that account for all ingested media (mg/kg bw-day)	Toxicity reference values for concentrations of $COPC_E$s as ingested doses (mg/kg bw-day)	
Mammals	Stable or increasing populations of omnivorous mammals	Comparison of estimated ingested $COPC_E$ dose to literature-based effects levels expressed on a dose basis	$COPC_E$ doses that account for all ingested media (mg/kg bw-day)	Toxicity reference values for concentrations of $COPC_E$s as ingested doses (mg/kg bw-day)	
	Stable or increasing populations of herbivorous mammals	Comparison of estimated ingested $COPC_E$ dose to literature-based effects levels expressed on a dose basis	$COPC_E$ doses that account for all ingested media (mg/kg bw-day)	Toxicity reference values for concentrations of $COPC_E$s as ingested doses (mg/kg bw-day)	

Notes
bw = body weight
$COPC_E$ = chemical of potential ecological concern

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Table 29 Applicable or Relevant and Appropriate Requirements		
Citation	**ARAR or TBC**	**Summary Description**
Federal		
Clean Water Act (CWA): Criteria and standards for imposing technology-based treatment requirements under § 402; 33 U.S.C. § 1342; 40 CFR Part 125 Subpart A)	Relevant and appropriate	Both on-site and off-site discharges from CERCLA sites to surface waters are required to meet the substantive CWA (National Pollutant Discharge Elimination System) NPDES requirements (USEPA 1988). On-site discharges must comply with the substantive technical requirements of the CWA but do not require a permit (USEPA 1988). Off-site discharges would be regulated under the conditions of a NPDES permit (USEPA 1988). Standards of control for direct discharges must meet technology-based requirements. Best conventional pollution control technology (BCT) is applicable to conventional pollutants. Best available technology economically achievable (BAT) applies to toxic and non-conventional pollutants. For CERCLA sites, BCT/BAT requirements are determined on a case-by-case basis using best professional judgment. This is likely to be a potential requirement only if treated water or excess dredge water is discharged during implementation.
CWA Sections 303 and 304: Federal Water Quality Criteria 33 U.S.C. §§1313 and 1314 (304(a) list at date of ROD)	Relevant and appropriate	Under §303 (33 U.S.C. §1313), individual states have established water quality standards to protect existing and attainable uses (USEPA 1988). CWA §301(b)(1)(C) requires that pollutants contained in direct discharges be controlled beyond BCT/BAT equivalents (USEPA 1988). Best management practices (BMPs) would be established for remedial actions and applied during construction. Water quality would also be monitored during construction and additional BMPs may be implemented if necessary to protect water quality. CERCLA §121(d)(2)(B)(i) establishes conditions under which water quality criteria, which were developed by USEPA as guidance for states to establish location-specific water quality standards, are to be considered relevant and appropriate. Two kinds of water quality criteria have been developed under CWA §304 (33 U.S.C. §1314): one for protection of human health, and another for protection of aquatic life. These requirements include establishment of total maximum daily loads (TMDL). Where state water quality standards contain numerical criteria for toxic pollutants, appropriate numerical discharge limitations may be derived for the discharge and considered (USEPA 1988).
CWA Section 401: Water Quality Certification 33 U.S.C. §1341	Applicable	Requires applicants for federal permits for projects that involve a discharge into navigable waters of the U.S. to obtain certification from state or regional regulatory agencies that the proposed discharge will comply with CWA Sections 301, 302, 303, 306, and 307. On-site activities would not require a federal permit, but compliance with substantive requirements. For on-site or off-site actions, certification should occur as part of the state identification of substantive state ARARs (USEPA 1988).

[1] ARARs are applicable or relevant and appropriate requirements of federal or state environmental laws or facility siting laws. CERCLA section 121(d) requires that remedial actions generally comply with ARARs. The USEPA has stated a policy of attaining ARARs to the greatest extent practicable on remedial or removal actions (USEPA 1988). USEPA also stated that certain nonpromulgated federal and state advisories or guidelines would be considered in selecting remedial or removal actions; these guidelines are referred to as TBCs, or "to be considered."

Citation	ARAR or TBC	Summary Description
CWA Section 404 and 404(b)(1): Dredge and Fill; 33 U.S.C. §1344 (b)(1); 33 CFR 320 and 330; 40 CFR 230)	Applicable	Discharges of dredged and fill material into waters of the U.S. must comply with the CWA §404 (33 U.S.C. 1344) guidelines and demonstrate the public interest is served (USEPA 1988). The San Jacinto site is a water of the U.S. (USEPA 2007). Dredge and fill permits are applicable to dredging, in-water disposal, capping, construction of berms or levees, stream channelization, excavation and/or dewatering within waters of the U.S. (USEPA 1988). Permits are not required for on-site CERCLA actions. Under the 404(b)(1) guidelines, efforts should be made to avoid, minimize, and mitigate adverse effects on the waters of the U.S. and, where possible, select a practicable (engineering feasible) alternative with the least adverse effects. The substantive requirements of Section 404 will apply in the development, evaluation, and implementation of remedial action to minimize adverse impacts to waters of the U.S.
Resource Conservation And Recovery Act (RCRA): Hazardous Waste Management 42 U.S.C. §§6921 et seq.; 40 CFR Parts 260 – 268	Applicable for hazardous waste; relevant and appropriate for materials managed as non-hazardous waste	RCRA is intended to protect human health and the environment from the hazards posed by waste management (both hazardous and nonhazardous). RCRA also contains provisions to encourage waste reduction. RCRA Subtitle C and its implementing regulations contain the federal requirements for the management of hazardous wastes. This requirement would apply to certain activities if the waste materials or affected sediments contain RCRA listed hazardous waste or exhibit a hazardous waste characteristic.
Toxic Substances Control Act (TSCA) - 15 USC §2601 et. seq.; 40 CFR 761.61 (c)	Applicable	40 CFR 761.61 provides TSCA cleanup and disposal options for PCB remediation waste, which includes PCB-contaminated soil, sediment, sewage or industrial sludge, and building material. 761.61(c) is the risk- based option for PCB remediation waste. A proposed site cleanup plan was developed, under the TSCA risk-based option, developing a remedial plan to reach risk-based cleanup levels that are protective of human health and the environment.
RCRA: General Requirements for Solid Waste Management - 42 U.S.C. §§6941 et seq.; 40 CFR 258)	Relevant and appropriate	Requirements for construction for municipal solid waste landfills that receive RCRA Subtitle D wastes, including industrial solid waste. Requirements for run- on/run-off control systems, groundwater monitoring systems, surface water requirements, etc. This requirement would be relevant if a landfill is constructed for the disposal of non-hazardous solid waste. There are no specific federal requirements for non-hazardous waste management; state regulations provide specific applicable requirements for siting, design, permitting, and operation of landfills.
Clean Air Act (CAA) - 42 U.S.C. §§7401 et seq.	Potentially applicable	Would apply if dredging and/or excavation activities generate air emissions sufficient to require a permit, greater than 10 tons of any pollutant per year under the CAA operational permit (USEPA 2009). None of the remedial alternatives is expected to trigger an operational permit.
Rivers And Harbors Act of 1899: Obstruction of navigable waters (generally, wharves; piers, etc.); excavation and fill - 33 U.S.C. §401	Applicable	Controls the alteration of navigable waters (i.e., waters subject to ebb and flow of the tide shoreward to the mean high water mark). Activities controlled include construction of structures such as piers, berms, and installation of pilings as well as excavation and fill. Section 10 may be applicable for any action that may obstruct or alter a navigable waterway. No permit is required for on-site activities. However, substantive requirements might limit in-water construction activities.

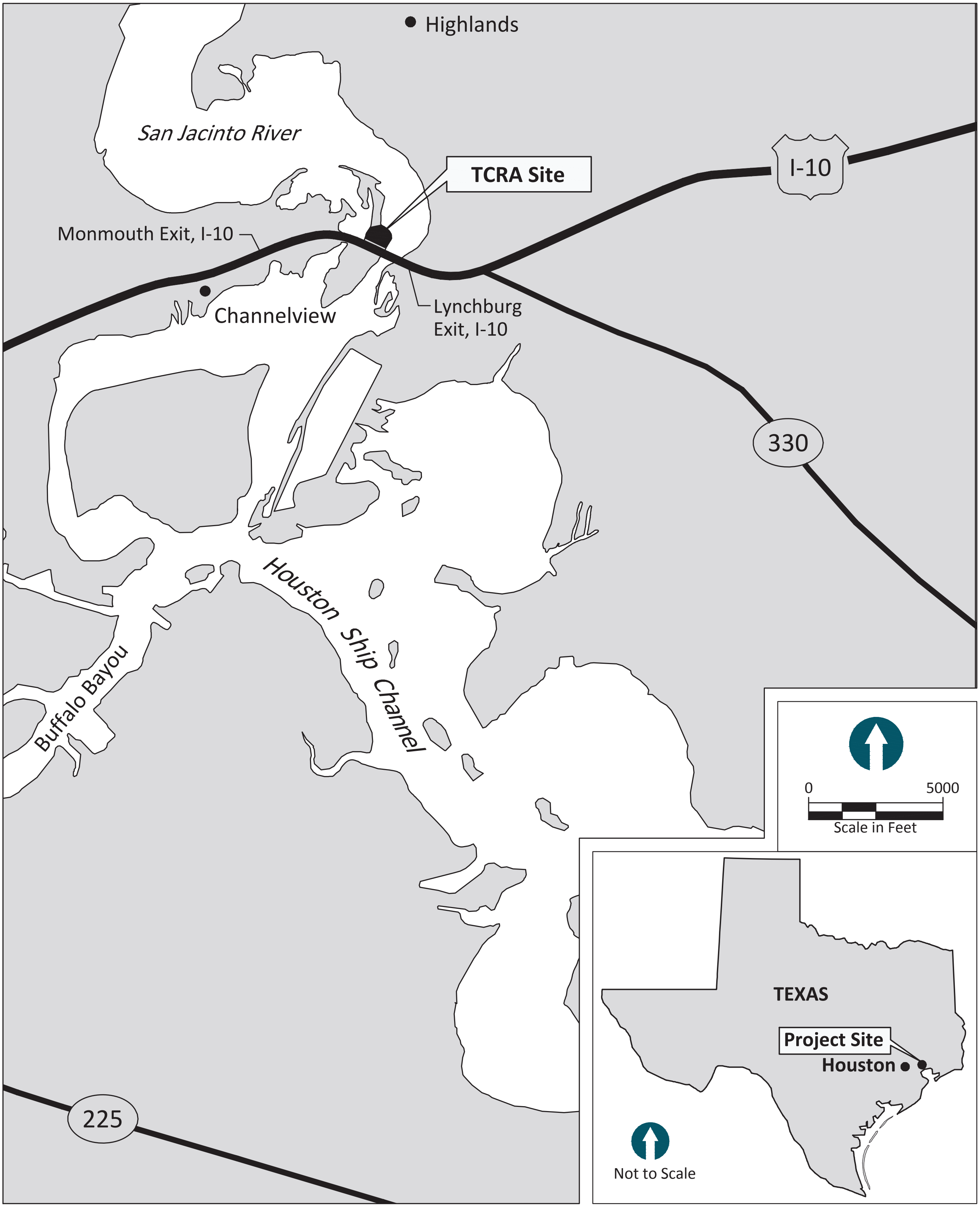
Citation	ARAR or TBC	Summary Description
Endangered Species Act - 16 U.S.C. §§ 1531 et seq.	Potentially applicable based on consultation	Federal agencies must ensure that actions they authorize, fund, or carry out are not likely to adversely modify or destroy critical habitat of endangered or threatened species. Actions authorized, funded, or carried out by federal agencies may not jeopardize the continued existence of endangered or threatened species as well as adversely modify or destroy their critical habitats. Based on a 2010 evaluation, as well as a desktop review of site photos and USFWS and NMFS species and habitat maps, no federally listed threatened or endangered (T&E) species or their critical habitat are present on the site or utilize areas in the vicinity of the site. NMFS includes endangered sea turtles in Trust resources impacted by contaminated surface water and sediments that may have been transported from the site. USEPA will consult with the resource agencies to determine whether the proposed remedial alternative will have an effect on listed species.
Fish and Wildlife Coordination Act - 16 U.S.C. §§661 et seq., 16 U.S.C. §742a, 16 U.S.C. § 2901	Applicable	Requires adequate provision for protection of fish and wildlife resources. This title has been expanded to include requests for consultation with USFWS for water resources development projects (Mueller 1980). Any modifications to rivers and channels require consultation with the USFWS, Department of Interior, and state wildlife resources agency. Project-related losses (including discharge of pollutants to water bodies) may require mitigation or compensation.
Bald and Golden Eagle Protection Act	Potentially applicable	Makes it unlawful to take, import, export, possess, buy, sell, purchase, or barter any bald or golden eagle, nest, or egg. “Take” is defined as pursuing, hunting, shooting, poisoning, wounding, killing, capturing, trapping and collecting, molesting, or disturbing. This requirement is potentially relevant to CERCLA activities. No readily available information suggests bald or golden eagles frequent the project area; however, a qualified biologist would perform a site visit prior to a potential remedial action to confirm that bald and golden eagles do not frequent the project area.
Migratory Bird Treaty Act - 16 U.S.C. §§703-712; 50 CFR §10.12	Potentially Applicable	Makes it unlawful to take, import, export, possess, buy, sell, purchase, or barter any migratory bird. “Take” is defined as pursuing, hunting, shooting, poisoning, wounding, killing, capturing, and trapping and collecting. This requirement is potentially relevant to CERCLA activities. No readily available information suggests migratory birds frequent the project area, and aerial photography of the site suggests no suitable nesting or stopover habitat is present; however, a qualified biologist would perform a site visit prior to a potential remedial action to confirm that migratory birds do not frequent the project area.
Coastal Zone Management Act - 16 USC §§1451 et seq.; 15 CFR 930	Applicable	Federal activities must be consistent with, to the maximum extent practicable, state coastal zone management programs. Federal agencies must supply the state with a consistency determination (USEPA 1989). This requirement is potentially relevant to CERCLA activities. The San Jacinto River lies within the Coastal Zone Boundary according to the Texas Coastal Management Plan (TCMP) prepared by the General Land Office (GLO). The FS considers whether the remedial alternatives would affect (adversely or not) the coastal zone, and the lead agency is required to determine whether the activity will be consistent with the state’s CZMP (USEPA 1989). More information regarding the state requirements is provided under Texas Coastal Coordination Council (TCCC) Policies for Development in Critical Areas.

Citation	ARAR or TBC	Summary Description
FEMA (Federal Emergency Management Agency), Department of Homeland Security (Operating Regulations) - 42 U.S.C. 4001 et seq.; 44 CFR Chapter 1)	Applicable	Prohibits alterations to river or floodplains that may increase potential for flooding. This requirement is relevant to CERCLA activities in floodplains and in the river because the project area is within a designated flood zone. The FS includes a brief review of the potential impacts of remedial alternatives on the floodplain, and there will be a full evaluation of the selected alternative as part of the remedial design process.
National Flood Insurance Program (NFIP) Regulations - 42 U.S.C. subchapter III, §§4101 et seq.	TBC	Provides federal flood insurance to local authorities and requires that the local authorities not allow fill in the river that would cause an increase in water levels associated with floods. The FS includes a brief review of the potential impacts of remedial alternatives on the floodplain, and there will be a full evaluation of the selected alternative as part of the remedial design process.
Floodplain Management and Wetlands Protection - Executive Orders (EO) 11988 and 11990	TBC	Requires federal agencies to conduct their activities to avoid, if possible, adverse impacts associated with the destruction or modification of wetlands and occupation or modification of floodplains. Executive Orders 11988 and 11990 require federal projects to avoid adverse effects and minimize potential harm to wetlands and within flood plains. The EO 11990 requires federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative (USEPA 1994). Potentially relevant to disposal or treatment activities in the upland as well as any in-water facilities that might displace floodwaters. The waste pits are located within the floodway and Zone AE, or the 1% probability floodplain. The FS includes a brief review of the potential impacts of remedial alternatives on the floodplain, and there will be a full evaluation of the selected alternative as part of the remedial design process.
National Historic Preservation Act - 16 U.S.C. §§ 470 et seq.; 36 CFR 800	Applicable	Section 106 of this statute requires federal agencies to consider effects of their undertakings on historic properties. Historic properties may include any district, site, building, structure, or object included in or eligible for the National Register of Historic Places (NRHP), including artifacts, records, and material remains related to such a property. According to the San Jacinto River Waste Pits Remedial Investigation/Feasibility Study (RI/FS) cultural resources assessment, "no NRHP-eligible properties are documented in the area of concern. Because of the extensive disturbance to the site and minimal ground disturbance that will likely occur for the project, it is not likely that NRHP-eligible historic properties will be affected by RI/FS or eventual site remediation activities" (Anchor QEA 2009).
Noise Control Act 42 U.S.C. §§ 4901 et seq.; 40 CFR Subchapter G §201 et seq.	TBC	Noise Control Act remains in effect but unfunded (USEPA 2010). Noise is regulated by the state.
Hazardous Materials Transportation Act - 49 U.S.C. §§1801 et seq.; 49 CFR Subchapter C	Applicable	Establishes standards for packaging, documenting, and transporting hazardous materials. This requirement would apply to remedial alternatives that involve transporting hazardous materials off-site for treatment or disposal.

Citation	ARAR or TBC	Summary Description
30 Texas Administrative Code (TAC) Part 1: Industrial Solid Waste and Municipal Hazardous Waste General Terms 30 TAC §§335.1 – 335.15	Applicable	Substantive requirements for the transportation of industrial solid and hazardous wastes; requirements for the location, design, construction, operation, and closure of solid waste management facilities. Guidelines to promote the proper collection, handling, storage, processing, and disposal of industrial solid waste or municipal hazardous waste in a manner consistent with the purposes of Texas Health and Safety Code, Chapter 361. Solid nonhazardous waste provisions are applicable if material is transported to an upland disposal facility.
30 TAC Part 1: Industrial Solid Waste and Municipal Hazardous Waste: Notification - 30 TAC Chapter 335 Subchapter P	TBC	Requires placement of warning signs in contaminated and hazardous areas if a determination is made by the executive director of the Texas Water Commission a potential hazard to public health and safety exists which will be eliminated or reduced by placing a warning sign on the contaminated property. Warning signs and fencing were placed around the site as part of the Time Critical Removal Action. The FS includes additional institutional controls for all alternatives, including additional warning signs and fencing.
30 TAC Part 1: Industrial Solid Waste and Municipal Hazardous Waste: Generators = 30 TAC Chapter 335,	Applicable to hazardous waste.	Standards for hazardous waste generators either disposing of waste on-site or shipping off-site with the exception of conditionally exempt small quantity generators. The definition of hazardous involves state and federal standards.
Texas Surface Water Quality Standards - 30 TAC §307.4-7, 10	Site-specific criteria for San Jacinto basin - Applicable	San Jacinto Basin surface water quality standards are potentially relevant to the determination of risks, but should not override any site-specific toxicity values or risks determined through the risk assessment process. They are also relevant to the identification of potential sources and the short-term and long-term effectiveness of removal alternatives. However, the surface water quality criterion for TEQ is generally not being met throughout the Houston Ship Channel, San Jacinto Bay and Galveston Bay areas. In more than 90 percent of edible fish tissue samples and in more than 85 percent of edible crab tissue outside of USEPA's Preliminary Site Perimeter from 2002 through 2011, TEQ concentrations exceeded this tissue-based standard.
Texas Water Quality: Pollutant Discharge Elimination System (TPDES) - 30 TAC §279.10	Applicable	These state regulations require stormwater discharge permits for either industrial discharge or construction-related discharge. The State of Texas was authorized by USEPA to administer the NPDES program in Texas on September 14, 1998 (Texas Commission on Environmental Quality 2009). No permit is required for on-site activities.
Texas Water Quality: Water Quality Certification - 30 TAC §279.10	Applicable	These state regulations establish procedures and criteria for applying for, processing, and reviewing state certifications under CWA, §401. It is the purpose of this chapter, consistent with the Texas Water Code and the federal CWA, to maintain the chemical, physical, and biological integrity of the state's waters.
Natural Resources Code, Antiquities Code of Texas - Texas Parks and Wildlife Commission Regulations 191.092-171	Potentially applicable depending upon outcome of consultation.	Requires that the Texas Historical Commission staff review any action that has the potential to disturb historic and archeological sites on public land. Actions that need review include any construction program that takes place on land owned or controlled by a state agency or a state political subdivision, such as a city or a county. Without local control, this requirement does not apply. Assessment of historical resources during the TCRA produced no known eligible properties and determined that disturbance of any archaeological or historic resources is unlikely within the TCRA Site.

Citation	ARAR or TBC	Summary Description
Practice and Procedure, Administrative Code of Texas - 13 TAC Part 2, Chapter 26	Potentially applicable depending upon outcome of consultation.	Regulations implementing the Antiquities Code of Texas. Describes criteria for evaluating archaeological sites and permit requirements for archaeological excavation. This requirement is only applicable if an archaeological site is found; based on evaluations conducted as part of the RI/FS and TCRA processes, it is unlikely that archaeological resources would be found on the site.
State of Texas Threatened and Endangered (T&E) Species Regulations - 31 TAC 65.171 - 65.176	Potentially applicable	No person may take, possess, propagate, transport, export, sell or offer for sale, or ship any species of fish or wildlife listed as threatened or endangered. The presence or absence of state T&E species was evaluated in 2010, and concluded that no state T&E species were likely to occur on the site or in the vicinity.
Texas Coastal Coordination Council Policies for Development in Critical Areas - 31 TAC §501.23	Potentially applicable depending upon outcome of consultation.	Dredging in critical areas is prohibited if activities have adverse effects or degradation on shellfish and/or jeopardize the continued existence of endangered species or results in an adverse effect on a coastal natural resource area (CNRA)[5]; prohibit the location of facilities in coastal natural resource areas unless adverse effects are prevented and/or no practicable alternative. Actions should not be conducted during spawning or nesting seasons or during seasonal migration periods. Specifies compensatory mitigation.
Texas Coastal Management Plan (CMP) Consistency - 31 TAC, §506.12	Potentially applicable	Specifies federal actions within the CMP boundary that may adversely affect CNRAs; specifically selection of remedial actions. The San Jacinto River lies within the Coastal Zone Boundary (GLO TCMP). The FS evaluated whether remedial alternatives may affect (adversely or not) the coastal zone and provides a technical basis for the lead agency to determine whether the activity will be consistent with the state's CMP.
Texas State Code – obstructions to navigation - Natural Resources Code § 51.302 Prohibition and Penalty	Relevant and appropriate	Prohibits construction or maintenance of any structure or facility on land owned by the state without an easement, lease, permit, or other instrument from the state. The FS evaluated whether the remedial alternatives include construction on state-owned land.
Noise Regulations Texas Penal Code Chapter 42, Section 42.01	Applicable	The Texas Penal Code regulates any noise that exceeds 85 decibels after the noise is identified as a public nuisance. Noise abatement may be required if actions are identified as a public nuisance. Due to the isolation of the site, its location adjacent to a freeway with high volumes of traffic during normal working hours, and the industrial nature of the nearest properties, noise from construction activity associated with a potential remedial action is unlikely to constitute a public nuisance. Noise associated with truck traffic to and from the site should be considered for alternatives that involve transportation of materials off site.
Regulations of Harris County Texas for Flood Plain Management	TBC	Presents construction requirements along the segment of the San Jacinto River at or near the site.

FIGURES



Modified from: Anchor QEA, LLC. 2014. Draft Final Interim Feasibility Study Report, San Jacinto Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. March.

Figure 1
Site Location
San Jacinto River Waste Pits Site

USEPA's Preliminary Site Perimeter
Original 1966 Perimeter of the Impoundments North of I-10
Approximate TCRA Footprint
Soil Investigation Area 4

FEATURE SOURCES:
Aerial Imagery: 0.5-meter. Photo Date: 01/14/2009
Texas Strategic Mapping Program (StratMap), TNRIS

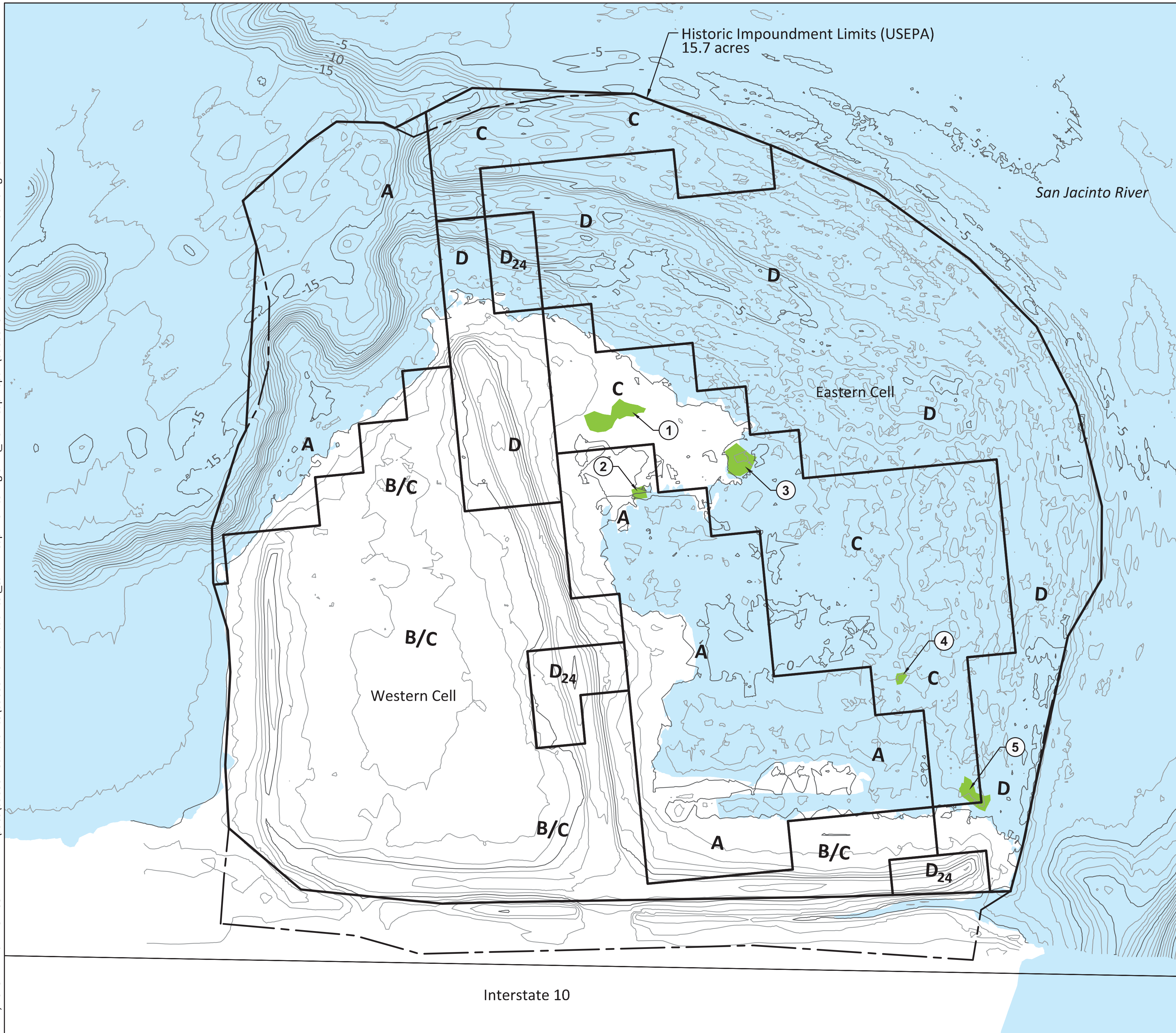
0 800
Scale in Feet

Figure 2
Site Overview
San Jacinto River Waste Pits Site

[a] Designation of the sand separation area is intended to be a general reference to areas in which such activities are believed to have taken place based on visual observations of aerial photography from 1998 through 2002.

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

K:\Jobs\090557-San Jacinto\090557-01 - San Jacinto_SJRWP Cap Monitoring SAP_TCRA Cap Repair\09055701-TCRA CAP REPAIR-004.dwg FIG 1
Jan 22, 2013 11:17am heriksen



LEGEND:

Post-Construction Contour, 10/2012 (1-foot interval)

Historic Impoundment Limit (USEPA)

Repair Areas

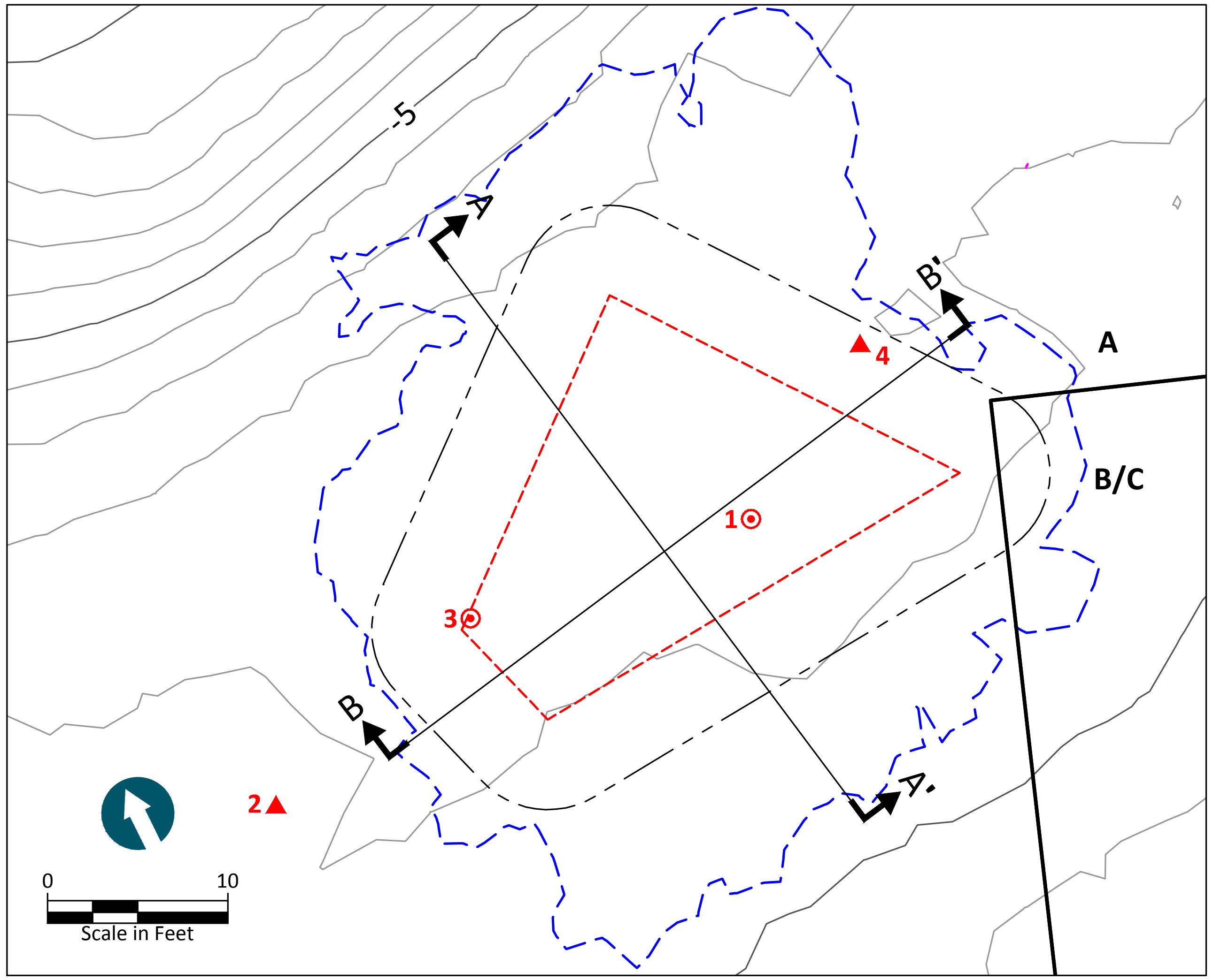
HORIZONTAL DATUM: Texas South Central, NAD83. US Survey Feet.
VERTICAL DATUM: NAVD88.

0 120
Scale in Feet

ANCHOR QEA

Modified by EPA

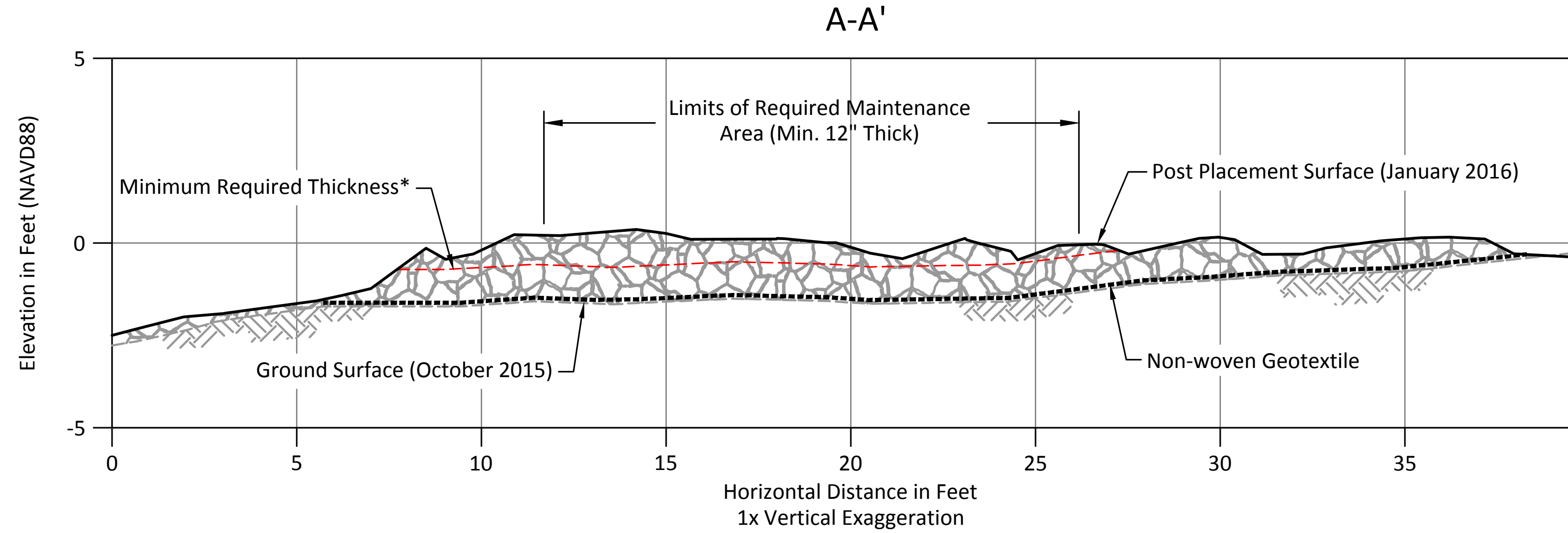
Figure 3
TCRA Site Map
TCRA Cap Repairs
San Jacinto River Waste Pits Superfund Site



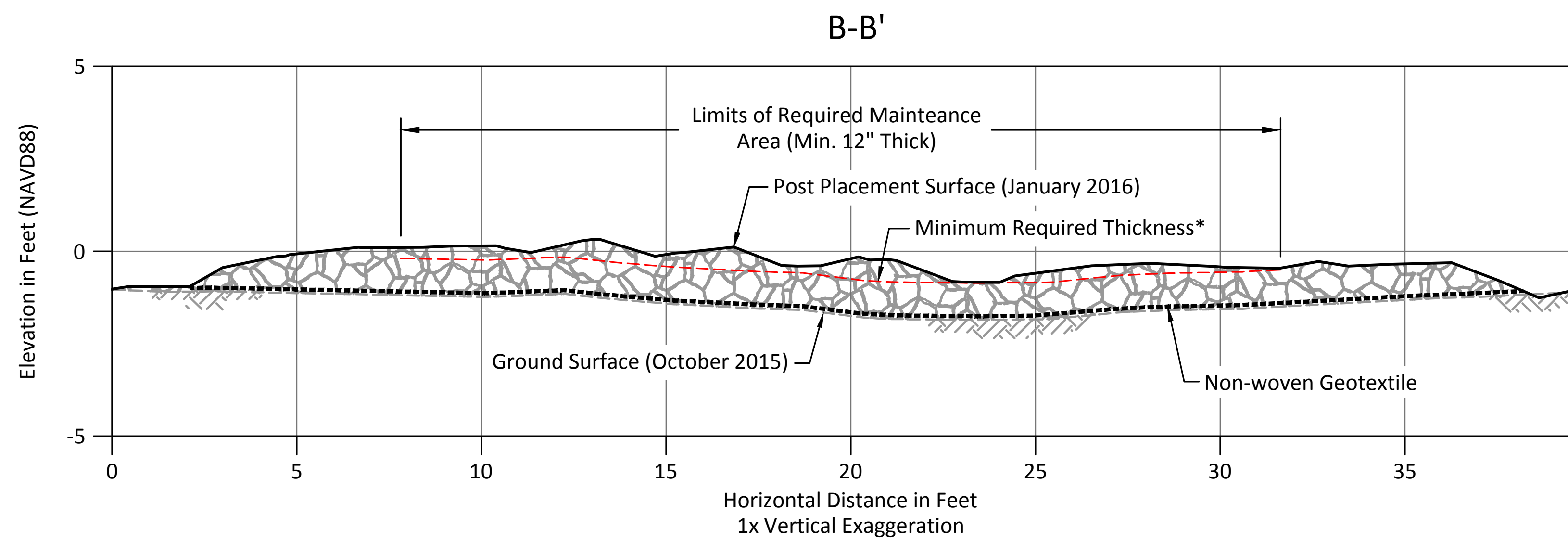
SOURCE: Drawing prepared from surveys provided by Hydrographic Consultants dated July 2015 and October 2015.
HORIZONTAL DATUM: Texas State Plane South Central, NAD83, U.S. Feet.
VERTICAL DATUM: NAVD 88.

LEGEND:

- October 2015 Bathymetric and Topographic Contours (1 Foot Interval)
- Limits of Damaged Area (December 2015)
- Limits of Required Maintenance Area (December 2015)
- Toe of Actual Armor Rock Placement (December 2015)
- 4▲ USEPA Probe Location (December 2015), Rock
- 1⊙ USEPA Probe Location (December 2015), Sediment
- B/C Armored Cap Type and Boundary



* Minimum thickness was field verified by probing.

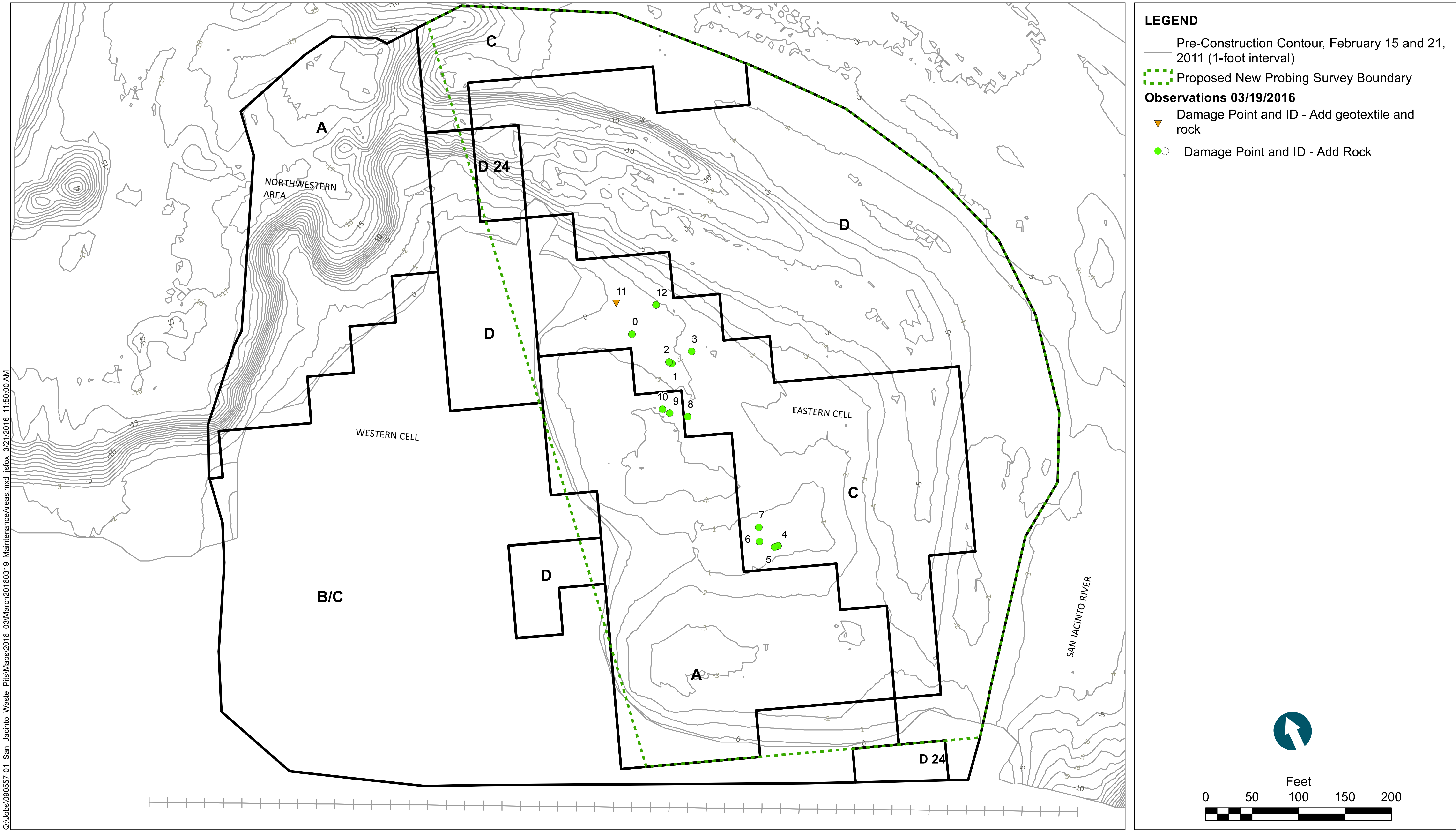


* Minimum thickness was field verified by probing.

ANCHOR QEA

Modified by EPA

Figure 4
2015 Damaged Area Location & Repairs Completed
NW Part of TCRA Cap
San Jacinto River Waste Pits Superfund Site

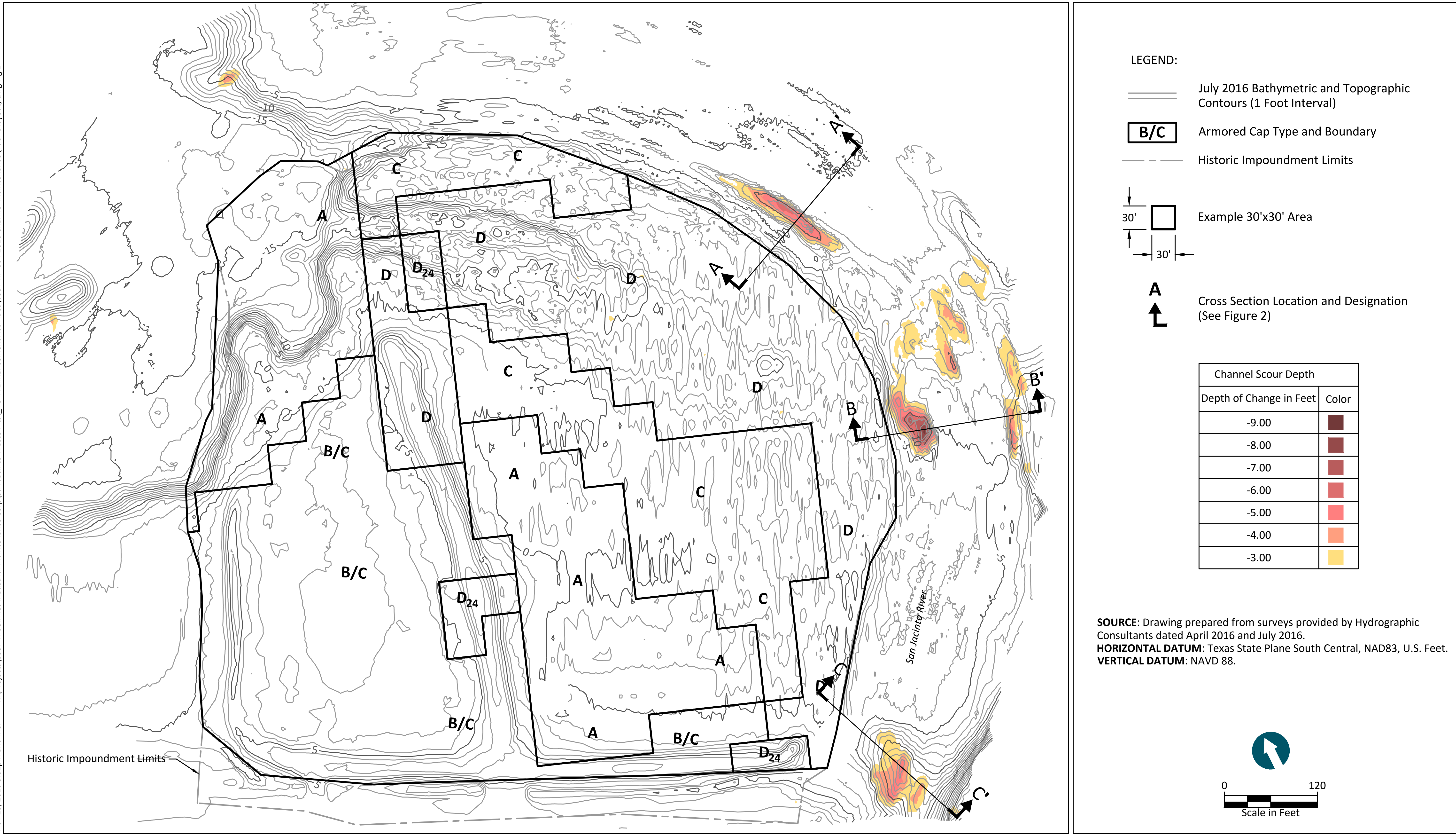


Q:\Jobs\090557-01_San_Jacinto_Waste_Pits\Maps\2016_03\March20160319_MaintenanceAreas.mxd jsfox 3/21/2016 11:50:00 AM

ANCHOR QEA

Modified by EPA

Figure 5
March 2016 Damaged Areas
San Jacinto Waste Pits Superfund Site



Channel Scour Depth	
Depth of Change in Feet	Color
-9.00	
-8.00	
-7.00	
-6.00	
-5.00	
-4.00	
-3.00	

K:\Projects\0557-McGinnes Industrial Maintenance Corp\San Jacinto Waste Pits_TCRA Enhancement Activities\0557-RP-004 2016 Channel Maintenance (Fabric layout).dwg Fig 1

Nov 15, 2016 5:01pm dholmer

ANCHOR QEA

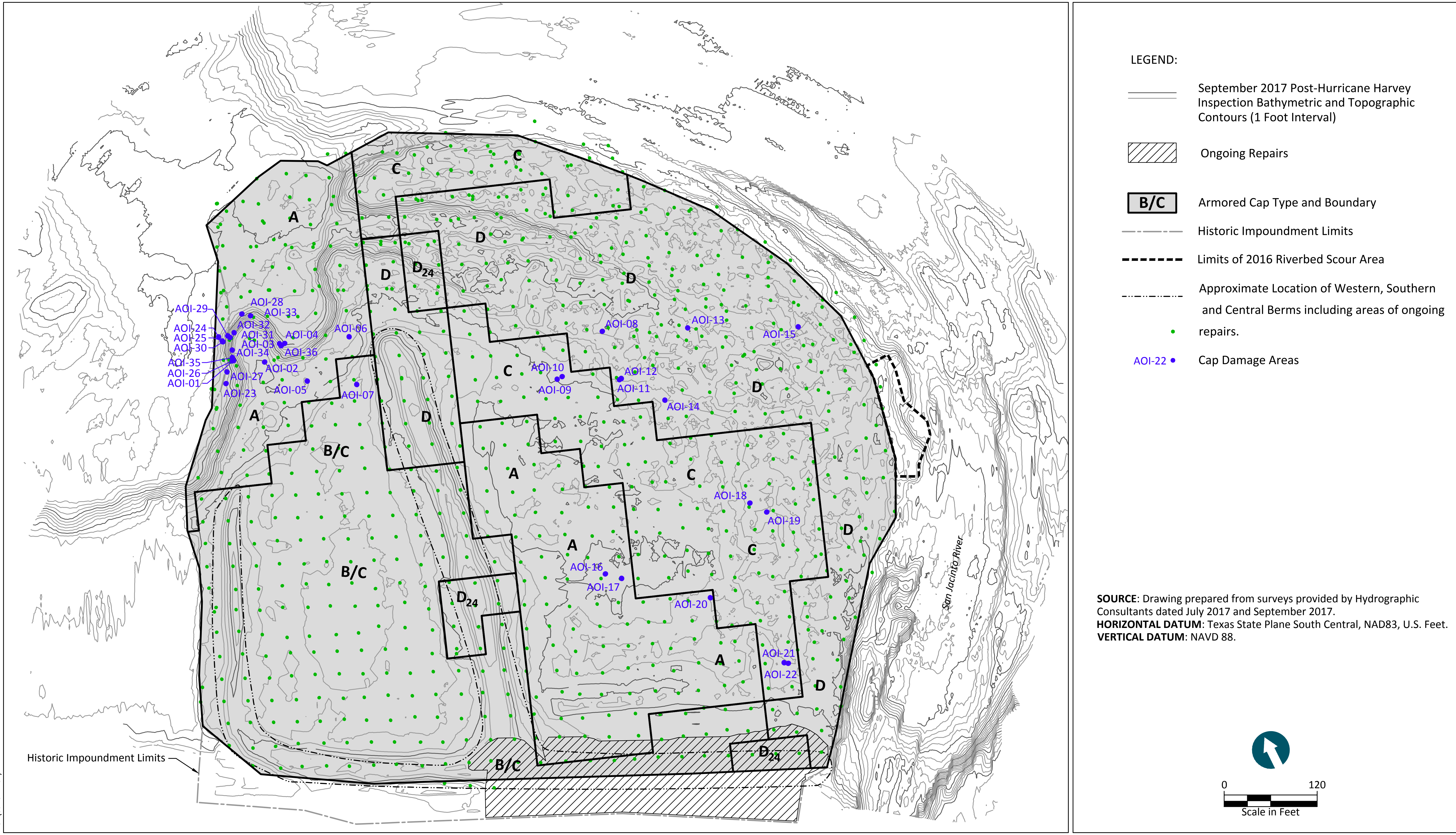
Modified by EPA

Figure 6
San Jacinto River Scour Repair Wor□Plan
April 2016 Survey vs. July 2016 Survey
San Jacinto River Waste Pits Superfund Site

San Jacinto River Waste Pits Superfund Site
View: Northeast Description: West Section of Southern Berm - Washout of cap, geotextile, & portion of berm.

San Jacinto River Waste Pits Superfund Site
View: Southeast Description: East Section of Southern Berm – Cap eroded off berm.

Figure 7
San Jacinto River Waste Pits Superfund Site
Pictures of Cap Following Hurricane Harvey



Sep 15, 2017 4:01pm dholmer K:\Projects\0557-McGinnes Industrial Maintenance Corp\San Jacinto Waste Pits_Quarterly Inspection Reports\2017-07\Post-Hurricane Harvey Inspection\0557-HARVEY-010 (AOI Locations).dwg AOI (sans Prior)

ANCHOR QEA

Modified by EPA

Figure 8
Post-Hurricane Harvey Inspection Plan View
Cap Damage Areas
San Jacinto River Waste Pits Superfund Site

SOURCE: Google Map Pro 2009

NOTE: TCRA = Time Critical Removal Action

LEGEND:

— — — Original 1966 Perimeter of the Impoundments North of I-10

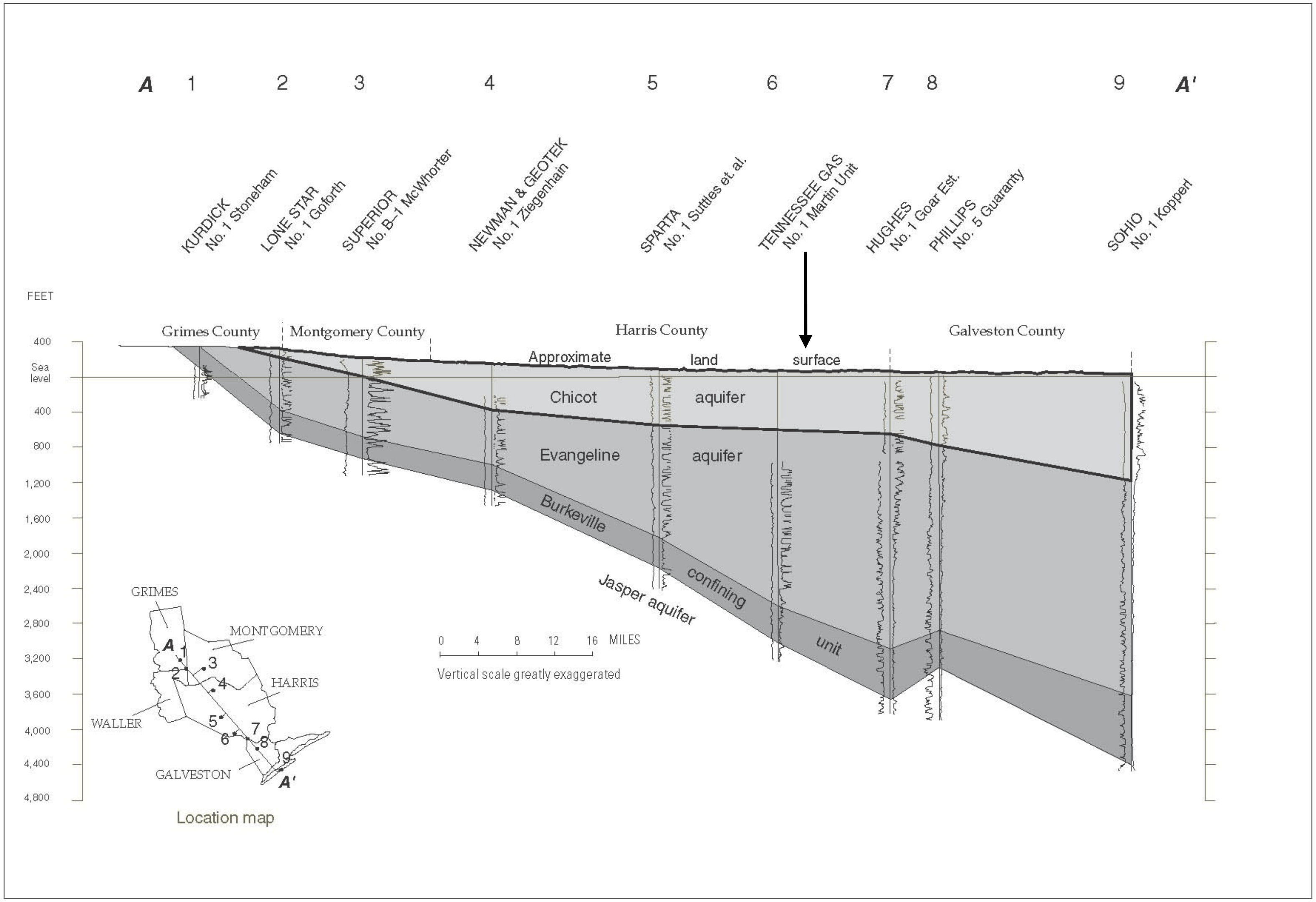
Approximate TRCA Footprint

0 500
Scale in Feet

Modified by EPA

Figure 9

San Jacinto River Waste Pits Site



From USGS, 2002

↓ Indicates Approximate Site Location

\\gfalls1\gfalls\San_Jacinto\documents\Draft_wkpl\Figure-2-8_Cross-section_20100401_MPC.docx

ANCHOR QEA

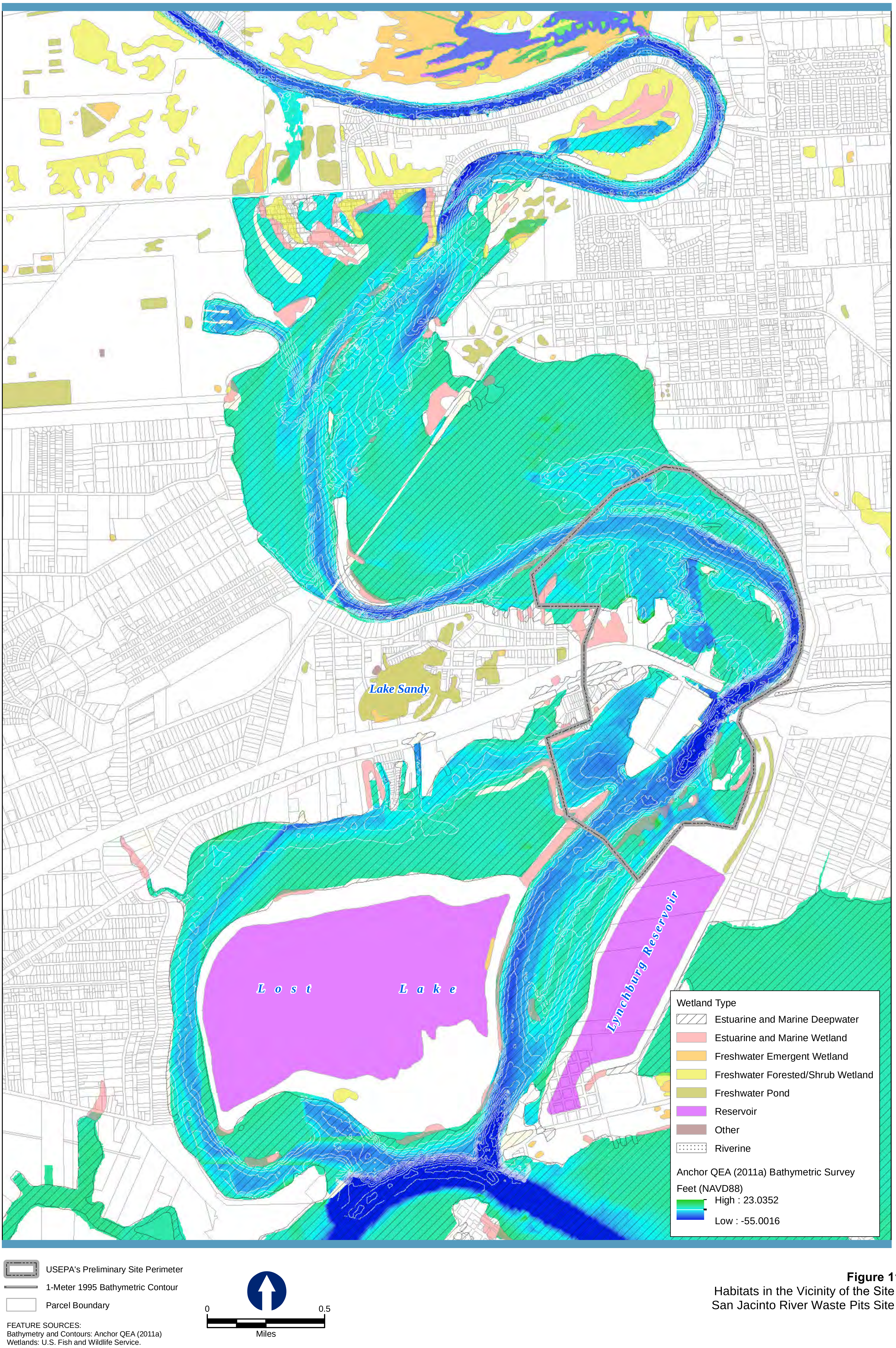
integral consulting inc

Modified by EPA

Figure 10

Generalized Cross-Section Showing Hydrogeologic Units of Interest in Houston, Texas

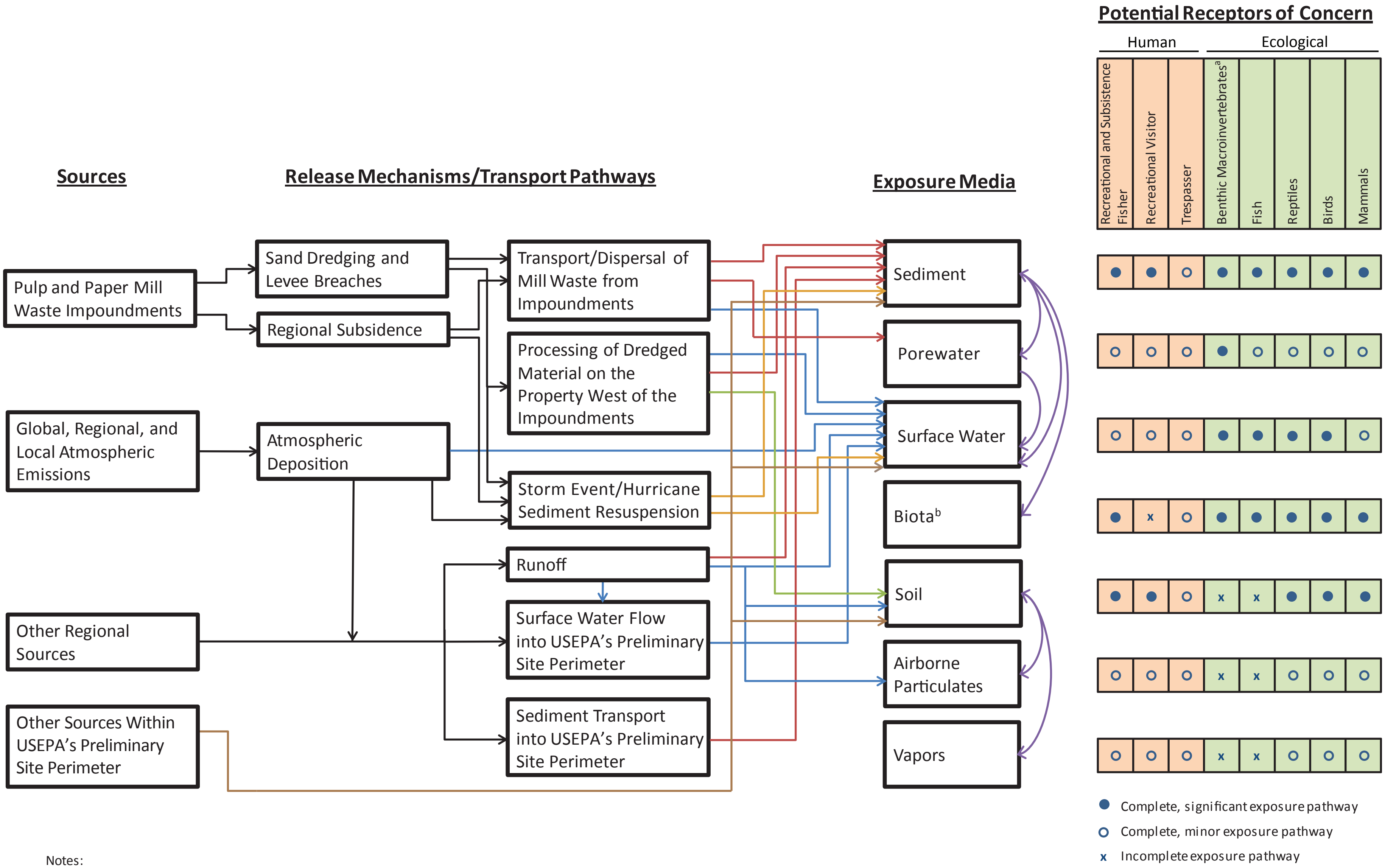
San Jacinto River Waste Pits Superfund Site



FEATURE SOURCES:
Bathymetry and Contours: Anchor QEA (2011a)
Wetlands: U.S. Fish and Wildlife Service.
Parcel Boundaries: Harris County Appraisal District.

Figure 11
Habitats in the Vicinity of the Site
San Jacinto River Waste Pits Site

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.



Notes:

Other regional sources may include industrial effluents, publicly owned treatment works, and stormwater.

Curved lines indicate potential transport pathways for chemicals of potential concern among exposure media.

[a]Benthic macroinvertebrates include crabs and other crustaceans and shellfish consumed by all receptors, as well as polychaetes and other infauna consumed by fish, other marine life, birds and mammals.

[b]Biota consumed by human receptors are expected to be fish and shellfish.

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Baseline Human Health Risk Assessment, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Figure 12

Conceptual Site Model Pathways for the Area North of I-10 and Aquatic Environment
San Jacinto Waste Pits Site

Potential Human Receptors of Concern

Exposure Media	Exposure Route	Recreational and Subsistence Fishers	Recreational Visitor	Trespasser
Sediment	Ingestion	●	●	○
	Dermal Contact	●	●	○
Porewater	Dermal Contact	○	○	○
Surface Water	Ingestion	○	○	○
	Dermal Contact	○	○	○
Fish and Shellfish	Ingestion	●	x	○
Soil	Ingestion	●	●	○
	Dermal Contact	●	●	○
Airborne Particulates	Inhalation	○	○	○
Vapors	Inhalation	○	○	○

● Potentially complete and significant exposure pathway

○ Potentially complete but minor exposure pathway

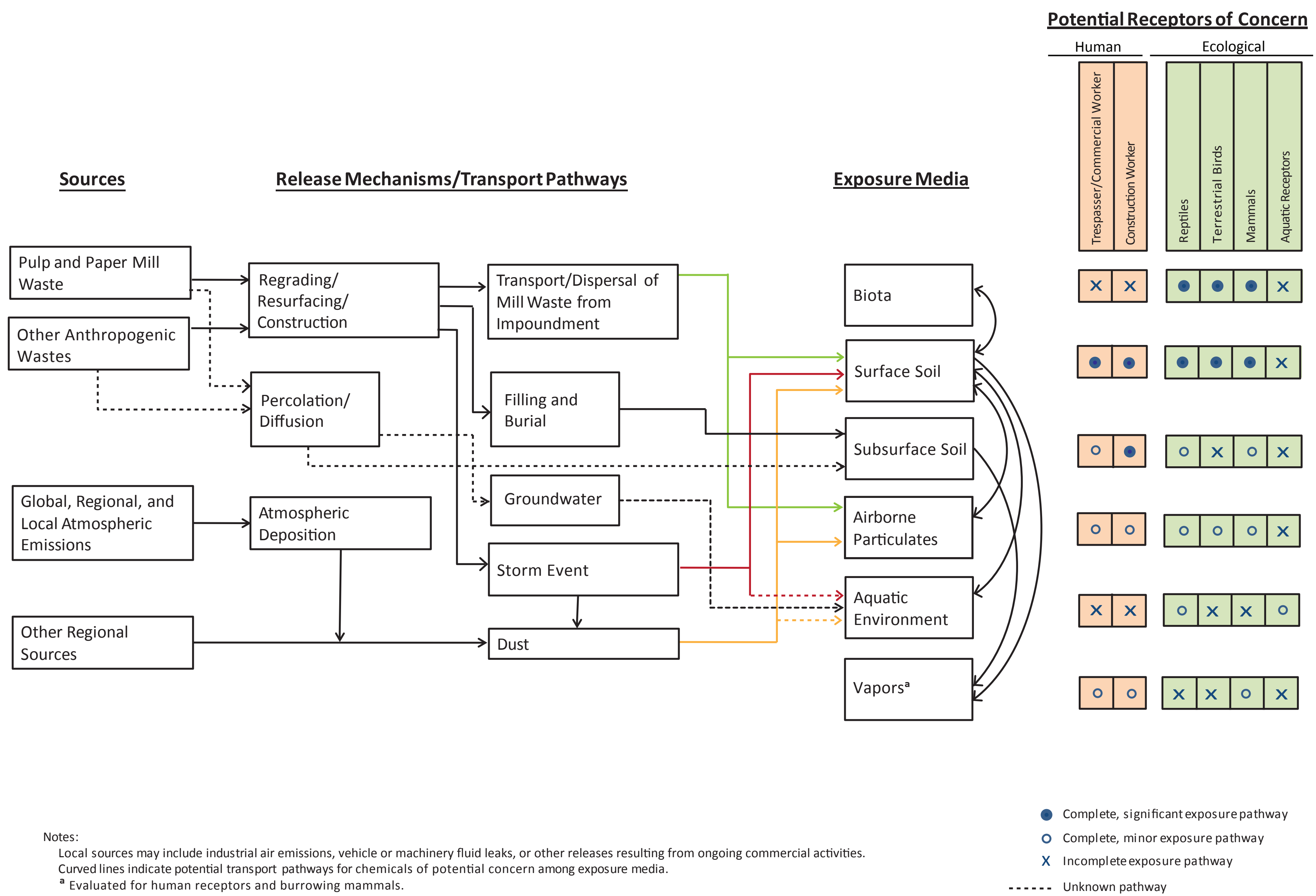
x Incomplete exposure pathway

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Baseline Human Health Risk Assessment, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Figure 13

Human Exposure Pathways for the Area North of I-10 and Aquatic Environment

San Jacinto River Waste Pits Site



Notes:

Local sources may include industrial air emissions, vehicle or machinery fluid leaks, or other releases resulting from ongoing commercial activities.

Curved lines indicate potential transport pathways for chemicals of potential concern among exposure media.

[a] Evaluated for human receptors and burrowing mammals.

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Baseline Human Health Risk Assessment, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Figure 14

Conceptual Site Model Pathways for the Area South of I-10

San Jacinto River Waste Pits Site

Exposure Media	Exposure Route	Potential Human Receptors of Concern: Trespasser/ Commercial Worker	Construction Worker
Soil	Ingestion	●	●
	Dermal contact	●	●
Subsurface Soil	Ingestion	X	●
	Dermal contact	X	●
Airborne Particulates and Vapors	Inhalation	○	○

Notes:

● Potentially complete and significant exposure pathway

○ Potentially complete but minor exposure pathway

X Incomplete exposure pathway

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Baseline Human Health Risk Assessment, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Figure 15

Human Exposure Pathways for the Area South of I-10

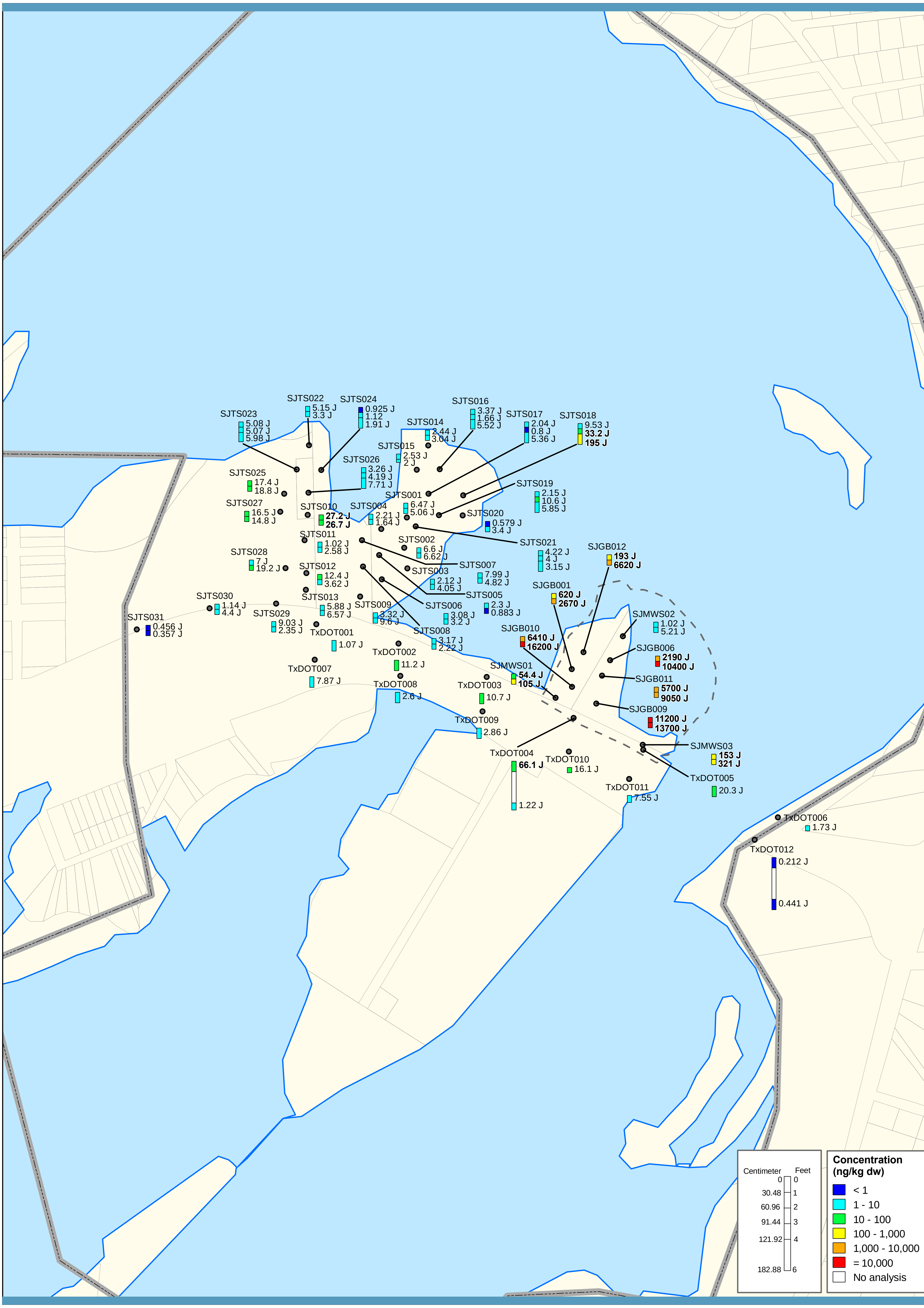
San Jacinto River Waste Pits Site

ANCHOR QEA integral consulting inc.

USEPA's Preliminary Site Perimeter
Original 1966 Perimeter of the Impoundments North of I-10
Surface Water Actual Sampling Location
TMDL Station ID shown in ( )

0 3,000
Feet

Figure 16
Locations of Surface Water Samples Collected in 2016
Data Summary Report: 2016 Studies
SJRWP Superfund/MIMC and IPC



Soil Sampling Location

USEPA's Preliminary Site Perimeter

Original 1966 Perimeter of the Impoundments North of I-10

FEATURE SOURCES:
Parcel Boundaries: Harris County Appraisal District

0 1,000
Feet

Figure 17
Distribution of TEQ_{DF} in Soils of the TxDOT Right-of-Way and North of I-10
San Jacinto River Waste Pits Site

Notes:
$TEQ_{DF,M}$ = toxicity equivalent for dioxins and furans using mammalian TEFs from van den Berg et al. (2006) (nondetect =1/2 detection limit)

J = Estimated. One or more congeners used to calculate the $TEQ_{DF,M}$ was not detected.

Concentrations in bold indicate values above reference envelope value (REV) for surface soil; REV = 24.3 ng/kg dw

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Soil Sampling Locations for $TEQ_{P, M}$ (ND = 1/2 DL)

USEPA's Preliminary Site Perimeter

Original 1966 Perimeter of the Impoundments North of I-10

$TEQ_{P, M}$ (ND = 1/2 DL)(ng/kg dw) Cores

- =1.68
- 0.571 - 1.68
- 0.366 - 0.571
- 0.075 - 0.366
- <0.075
- No analysis

0 1,000 Feet

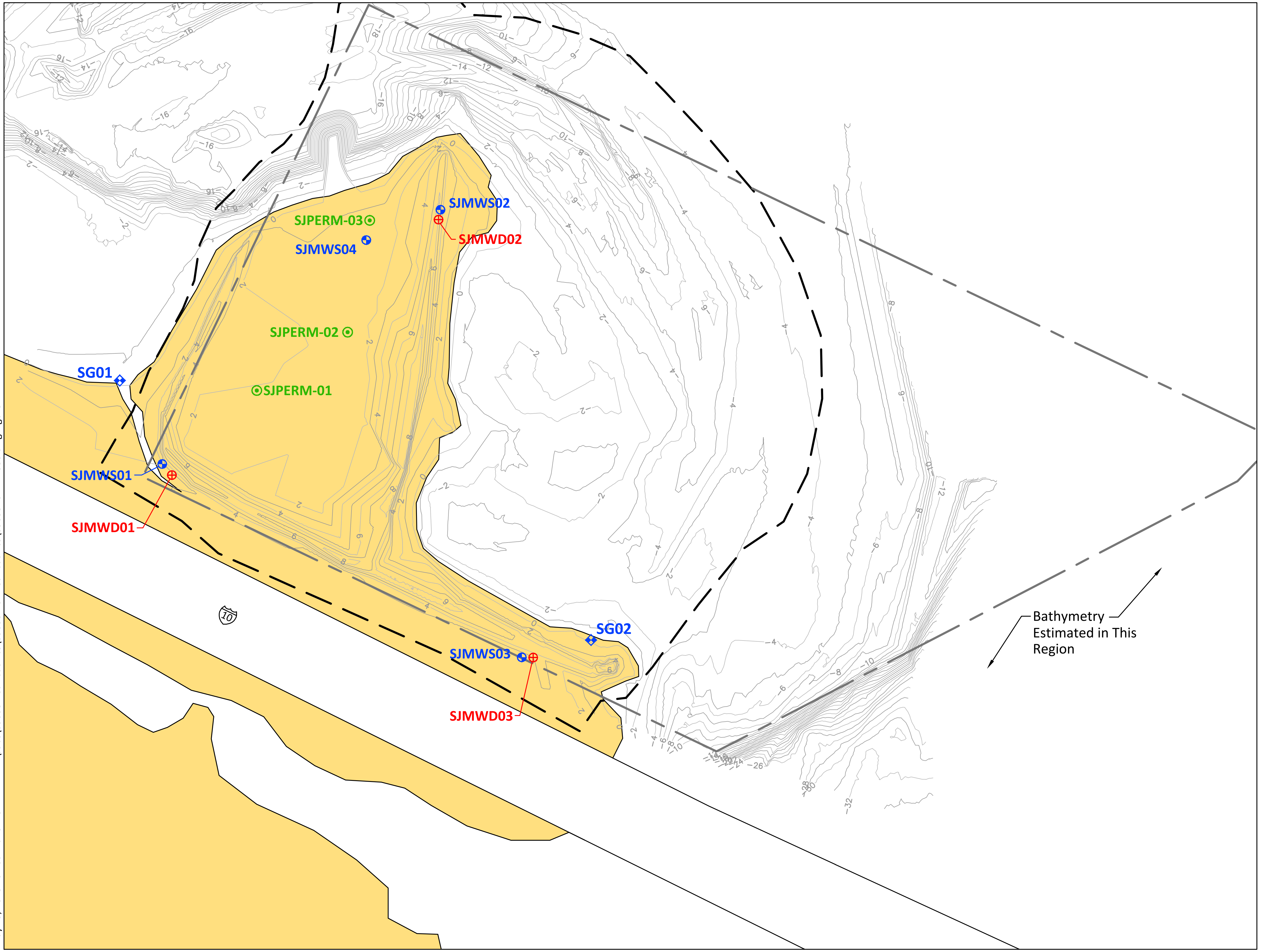
NOTES:
$TEQ_{P, M}$ = Toxicity equivalent for 2,3,7,8-TCDD calculated for dioxin-like PCBs using mammalian TEFs from van den Berg et al.(2006) (nondetect = 1/2 detection limit)

J = Estimated. One or more congeners used to calculate the $TEQ_{P, M}$ was not detected.
U = Undetected at the detection limit shown.

FEATURE SOURCES:
Parcel Boundaries: Harris County Appraisal District

Figure 18
Distribution of $TEQ_{P, M}$ (ND = 1/2 DL) in Soils of the TxDOT Right-of-Way
San Jacinto River Waste Pits Site

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.



Number	Easting	Northing
SJMWS01	3216654.64	13857356.47
SJMWD01	3216668.35	13857340.83
SJMWS02	3217048.21	13857716.27
SJMWD02	3217045.49	13857702.27
SJMWS03	3217163.24	13857082.92
SJMWD03	3217179.41	13857082.67
SJMWS04	3216943.21	13857673.38
SJPERM-01	3216788.39	13857460.49
SJPERM-02	3216916.93	13857543.05
SJPERM-03	3216948.14	13857701.19
SG01	3216594.63	13857474.61
SG02	3217261.16	13857107.46

LEGEND:

Approximate 1966 Berm Alignment Perimeter

Virgil C. McGinnes Trustee Property Line

Approximate Limit of Vegetated Area (Shoreline)

SG02 Staff Gauge

SJMWS03 Shallow Monitoring Well

SJMWD03 Deep Monitoring Well

SJPERM-02 Permeability Core

0 150
Scale in Feet

SOURCE: Drawing prepared from electronic file provided by US Army Corps of Engineers.
HORIZONTAL DATUM: Texas South Central NAD 83, US Survey Feet.
VERTICAL DATUM: NAVD 88.
NOTE: Water level in SJMW04 likely perched. Water level elevation not included in shallow potentiometric surface contours as it is screened in a disparate unit (i.e. clayey waste) relative to other shallow wells (screened in coarse alluvium).

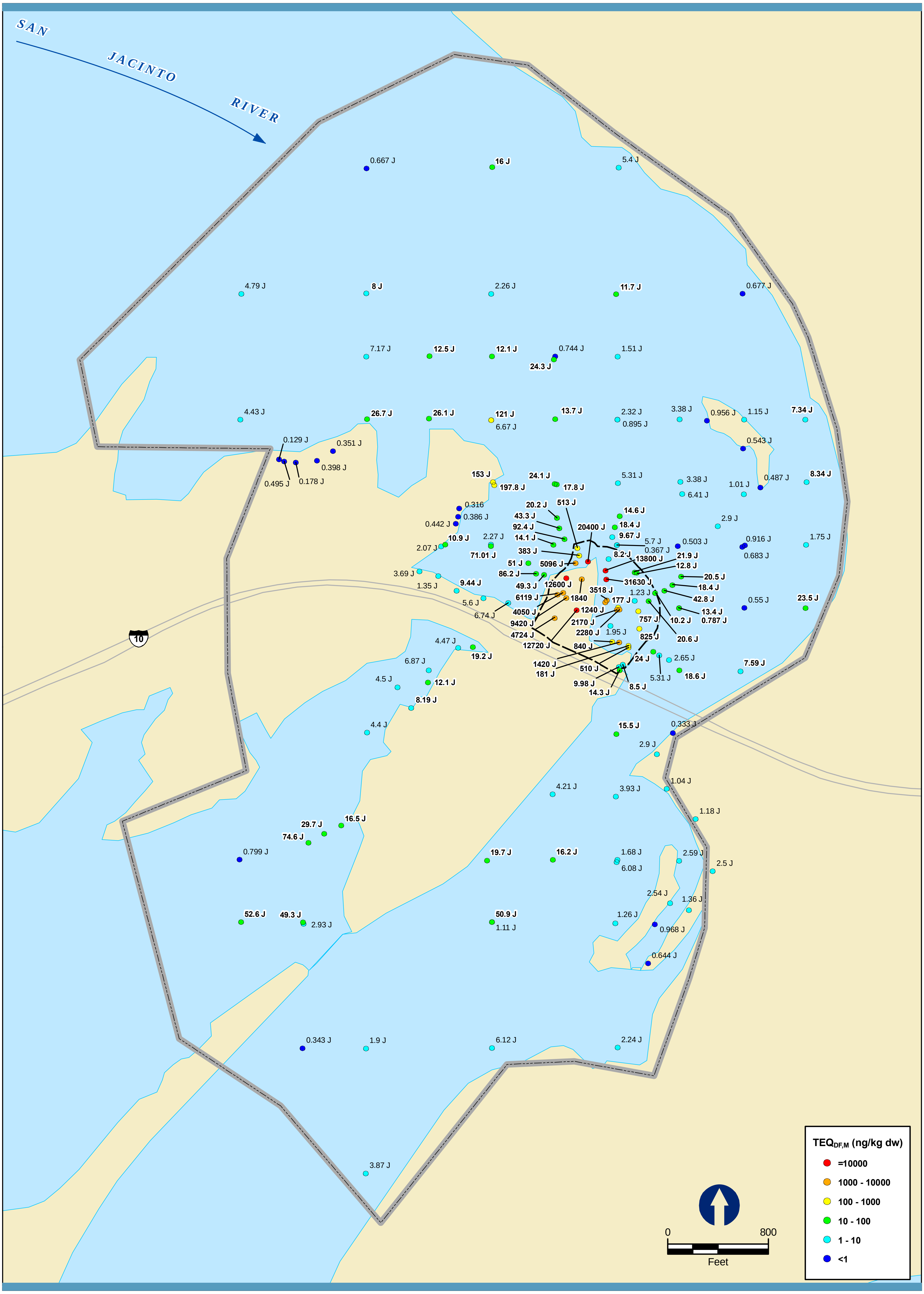
K:\Jobs\090557-San Jacinto\090557-01 - San Jacinto\09055701-RP-086.dwg Figure 2-12

May 15, 2013 10:10am dholmer

Figure 19
Groundwater Sampling Locations - Northern Waste Pits

Remedial Investigation Report
San Jacinto River Waste Pits Superfund Site

ANCHOR QEA
integral consulting inc.



USEPA's Preliminary Site Perimeter

Original 1966 Perimeter of the Impoundments North of I-10

Surface Sediment Sample Location

Notes:

$TEQ_{DF,M}$ = Toxicity equivalent for 2,3,7,8-TCDD calculated for dioxins and furans using mammalian TEFs from van den Berg et al. (2006) (nondetect = 1/2 detection limit)

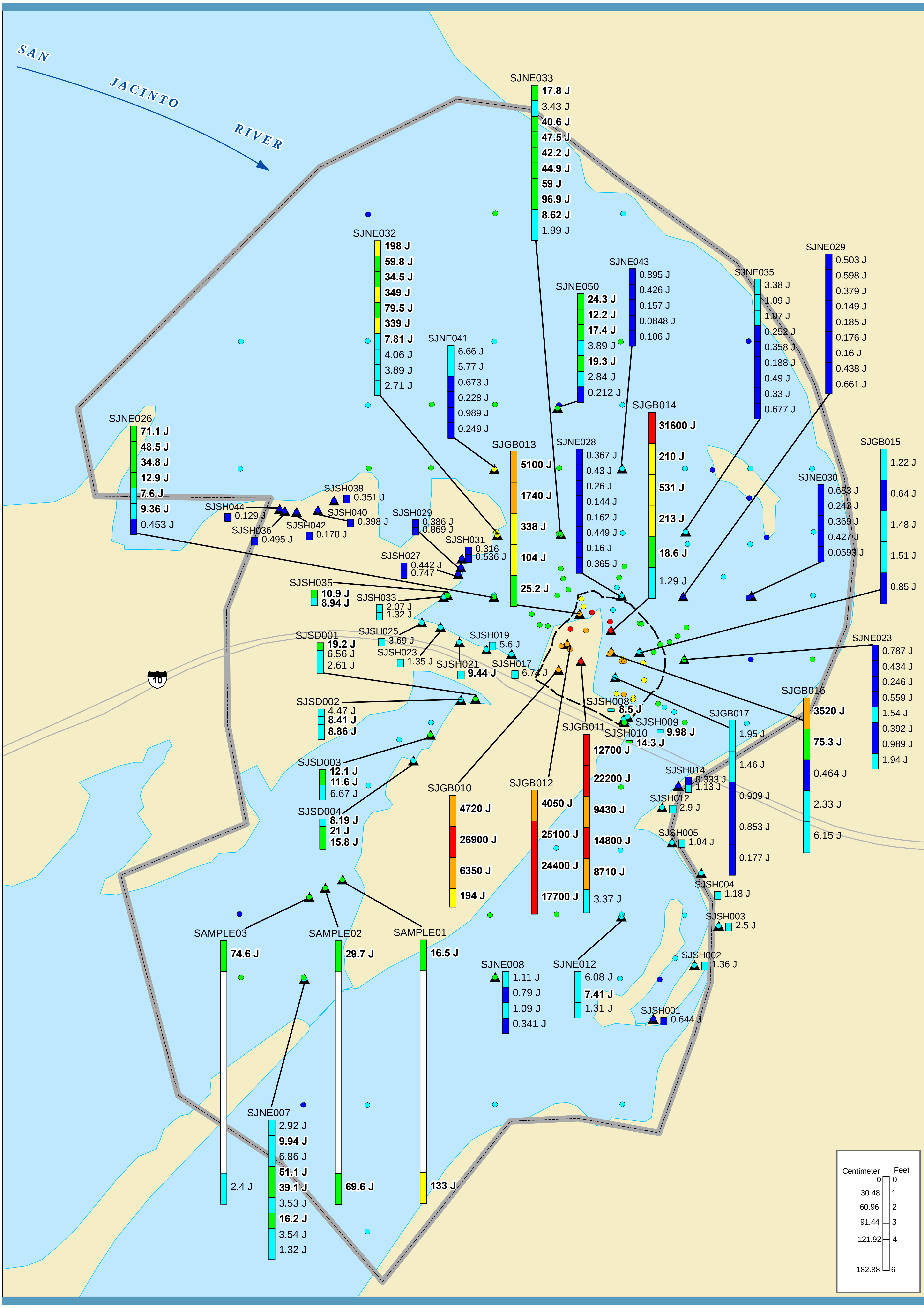
J = Estimated. One or more congeners used to calculate the $TEQ_{DF,M}$ was not detected.

Concentrations in bold indicate values above reference envelope value (REV); REV = 7.2 ng/kg dw

Figure 20

TEQ_{DF} Concentrations in Surface Sediment & Waste
San Jacinto River Waste Pits Site

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.



USEPA's Preliminary Site Perimeter

Original 1966 Perimeter of the Impoundments North of I-10

▲ Core Location

○ Surface Sediment Sample Location

$TEQ_{DF,M}$ (ng/kg dw)

Cores

- =10000
- 1000 - 10000
- 100 - 1000
- 10 - 100
- 1 - 10
- <1
- No analysis

0 800

Scale in Feet

Notes:

$TEQ_{DF,M}$ = Toxicity equivalent for 2,3,7,8-TCDD calculated for dioxins and furans using mammalian TEFs from van den Berg et al. (2006) (nondetect = 1/2 detection limit)

J = Estimated. One or more congeners used to calculate the $TEQ_{DF,M}$ was not detected.

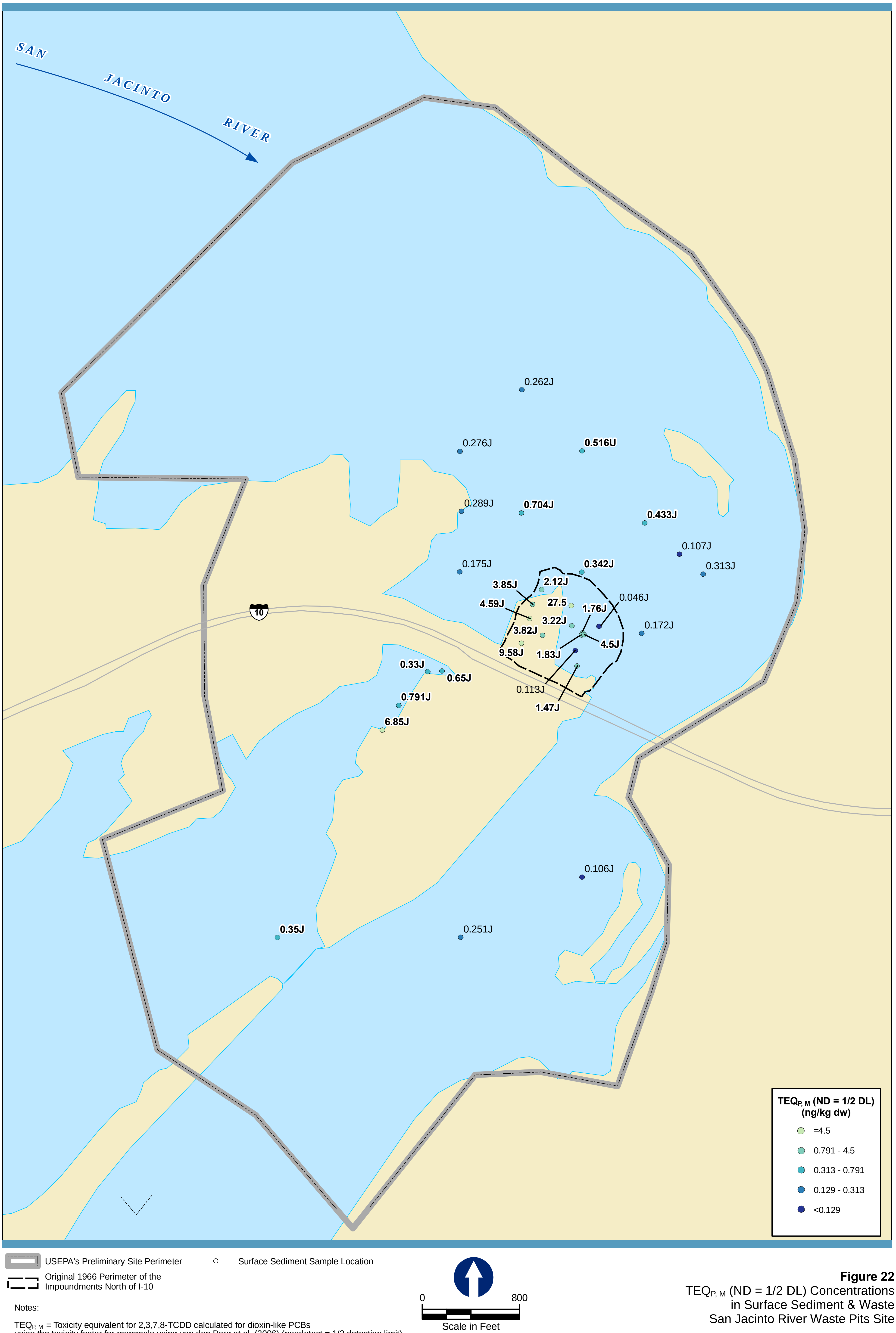
Concentrations in bold indicate values above reference envelope value (REV); REV= 7.2 ng/kg dw

Figure 21

TEQ_{DF} Concentrations in Sediment & Waste Cores

San Jacinto River Waste Pits Site

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.



Notes:

$TEQ_{P,M}$ = Toxicity equivalent for 2,3,7,8-TCDD calculated for dioxin-like PCBs using the toxicity factor for mammals using van den Berg et al. (2006) (nondetect = 1/2 detection limit)

J = Estimated.
U = Undetected at detection limit shown.

Concentrations in bold indicate values above reference envelope value (REV); REV = 0.326 ng/kg dw

Figure 22
$TEQ_{P,M}$ (ND = 1/2 DL) Concentrations in Surface Sediment & Waste
San Jacinto River Waste Pits Site

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site.
Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

USEPA's Preliminary Site Perimeter

Original 1966 Perimeter of the Impoundments North of I-10

Core Location

Surface Sediment Sample Location

TEQ$_{P,M}$ (ND = 1/2 DL) (ng/kg dw)

Cores

- ≥4.5
- 0.791- 4.5
- 0.313 - 0.791
- 0.129 - 0.313
- <0.129

0 800

Scale in Feet

Notes:

TEQ$_{P,M}$ = Toxicity equivalent for 2,3,7,8-TCDD calculated for dioxin-like PCBs using the toxicity factor for mammals using van den Berg et al. (2006) (nondetect = 1/2 detection limit)

J = Estimated.
U = Undetected at detection limit shown.

Concentrations in bold indicate values above reference envelope value (REV); REV = 0.326 ng/kg dw

Figure 23
TEQ$_{P,M}$ (ND = 1/2 DL) Concentrations in Sediment & Waste Cores
San Jacinto River Waste Pits Site

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

USEPA's Preliminary Site Perimeter
Original 1966 Perimeter of the Impoundments North of I-10
Approximate TCRA Footprint

Clams and Small Fish
Small Fish
Clams
Large Fish and Blue Crab Fish Collection Areas

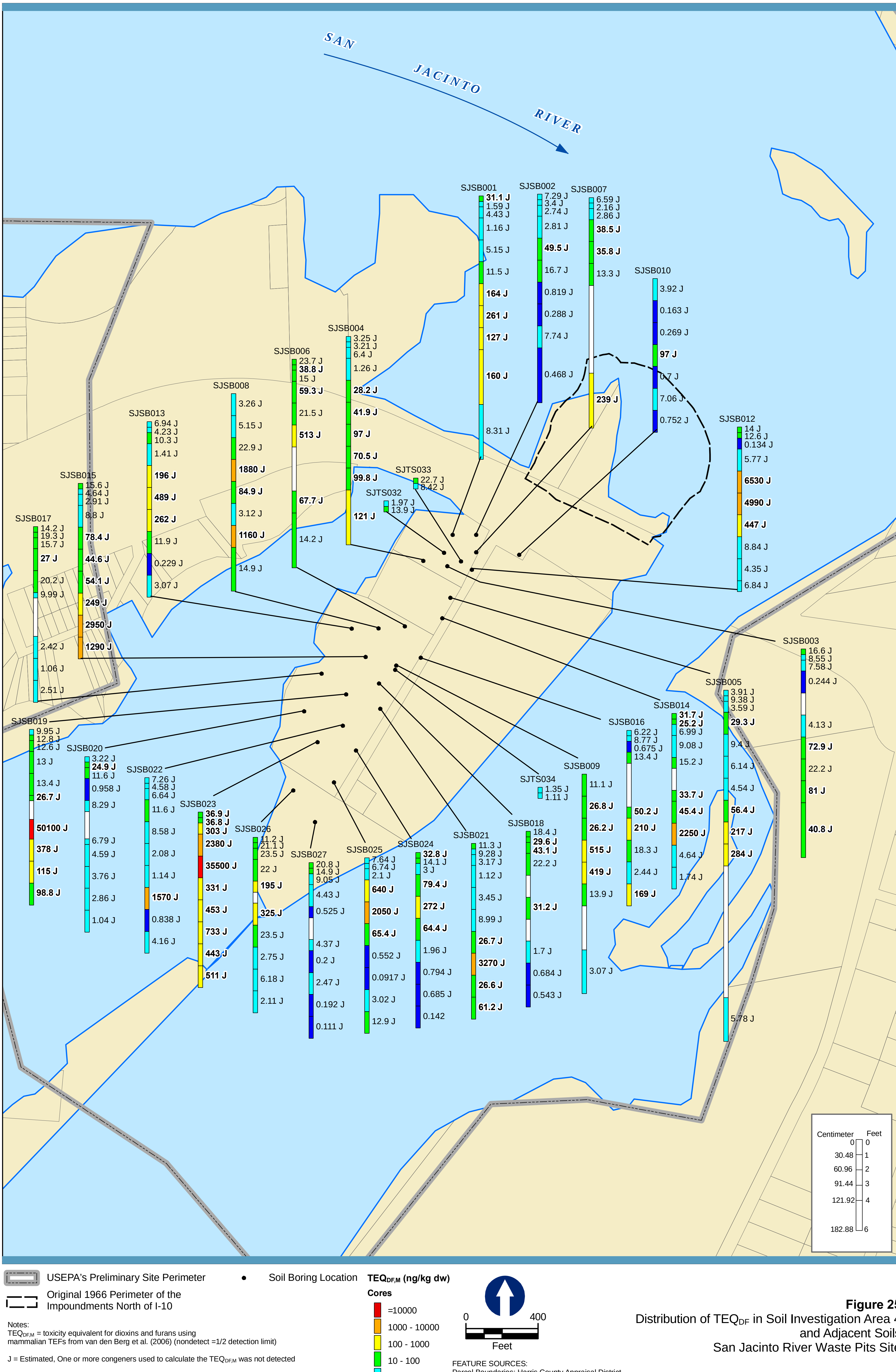
0 800
Scale in Feet

Figure 24
Fish Collection Areas and Tissue Sampling Transects
San Jacinto River Waste Pits Site

[a] Designation of the sand separation area is intended to be a general reference to areas in which such activities are believed to have taken place based on visual observations of aerial photography from 1998 through 2002.

FEATURE SOURCES:
Aerial Imagery: 0.5-meter January 2009 DOQQs - Texas Strategic Mapping Program (StratMap), TNIS

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.



USEPA's Preliminary Site Perimeter

Original 1966 Perimeter of the Impoundments North of I-10

Soil Boring Location

$TEQ_{DF,M}$ (ng/kg dw)

Cores

- =10000
- 1000 - 10000
- 100 - 1000
- 10 - 100
- 1 - 10
- <1
- No analysis

0 400 Feet

Notes:
$TEQ_{DF,M}$ = toxicity equivalent for dioxins and furans using mammalian TEFs from van den Berg et al. (2006) (nondetect =1/2 detection limit)

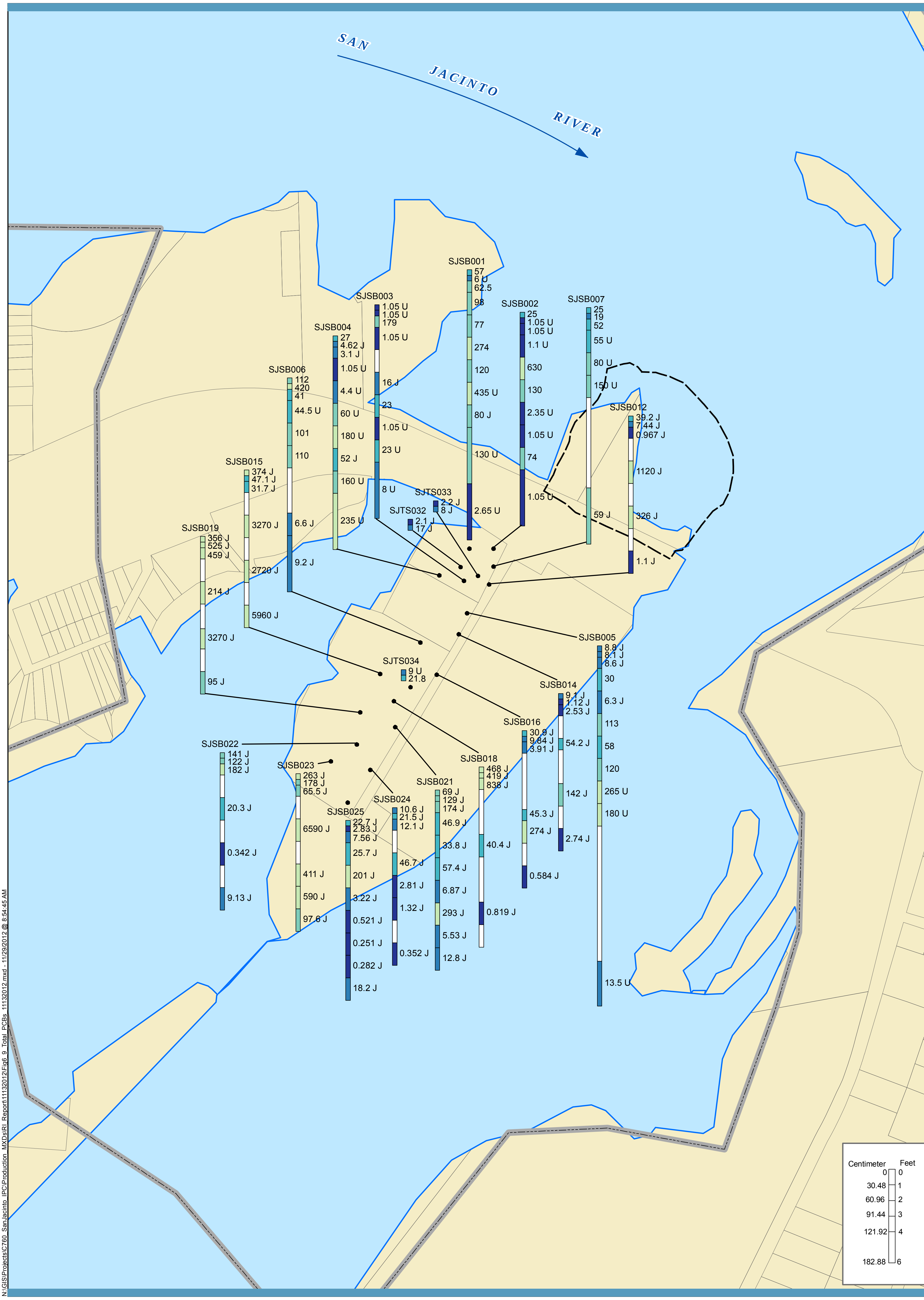
J = Estimated, One or more congeners used to calculate the $TEQ_{DF,M}$ was not detected

Concentrations in bold indicate values above reference envelope value (REV); REV= 24.3 ng/kg dw

FEATURE SOURCES:
Parcel Boundaries: Harris County Appraisal District
Hydrology: Harris County Flood Control District

Figure 25
Distribution of TEQ_{DF} in Soil Investigation Area 4 and Adjacent Soils
San Jacinto River Waste Pits Site

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Remedial Investigation Report, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.



N:\GIS\Projects\C760_SanJacinto_IPC\Production_MXDs\RI_Report\11132012\Fig6_9_Total_PCBs_11132012.mxd - 11/29/2012 @ 8:54:45 AM

ANCHOR QEA integral consulting inc.

- Soil Boring Location
- USEPA's Preliminary Site Perimeter
- Original 1966 Perimeter of the Impoundments North of I-10

Total PCBs (µg/kg dw) *

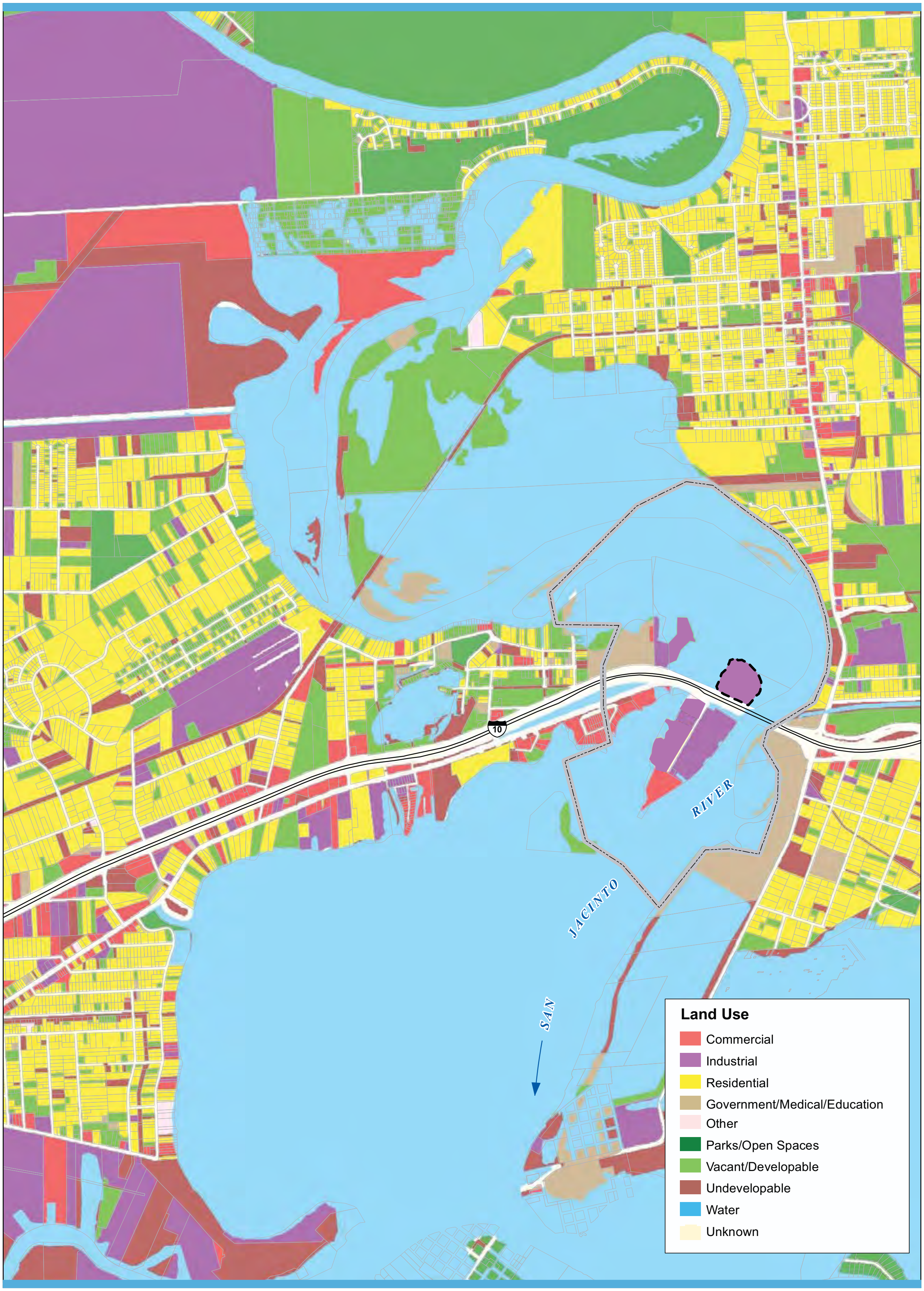
Cores

- =180
- 59 - 180
- 20.3 - 59
- 3.1 - 20.3
- <3.1
- No analysis

NOTES:
J = Estimated
U = None of the chemicals included in this sum were detected
* Stations SJSB001 through SJSB010 and SJTS032 through SJTS034 are only Aroclor data. At all other stations total PCBs was calculated as the sum of all 209 congeners. When Aroclors were not detected, total PCBs is estimated as one half of the highest Aroclor detection limit.

Figure 26
Distribution of Total PCBs in Soil Investigation Area 4 Soils
Remedial Investigation Report
San Jacinto River Waste Pits Superfund Site

FEATURE SOURCES:
Parcel Boundaries: Harris County Appraisal District
Hydrology: Harris County Flood Control District



USEPA's Preliminary Site Perimeter
Limit of TCRA Cap
Tax Parcel Boundary

FEATURE SOURCES:
Land Use: Modified from Houston-Galveston Area Council*
Parcel Boundaries: Harris County Appraisal District

*Modifications to land use within USEPA's Preliminary Site Perimeter to show reasonably anticipated future land use where appropriate.

0 0.5
Scale in Miles

Figure 27
Land Use in the Vicinity of the Site
San Jacinto River Waste Pits Site

Modified from: U.S. Environmental Protection Agency. 2016. Final Interim Feasibility Study Report, San Jacinto River Waste Pits Superfund Site.

Figure 28
Exposure Units for Sediment, Area North of I-10 and Aquatic Environment Baseline
San Jacinto River Waste Pits Site

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Baseline Human Health Risk Assessment, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Figure 29

Exposure Units for Fish and Shellfish Tissue, Area North of I-10 and Aquatic Environment
San Jacinto River Waste Pits Site

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Baseline Human Health Risk Assessment, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Surface Soil Sample Location

USEPA's Preliminary Site Perimeter

0 1,000

Feet

Figure 30
Exposure Unit for Soils, Area North of I-10 and Aquatic Environment, Baseline
San Jacinto River Waste Pits Site

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Baseline Human Health Risk Assessment, San Jacinto River Waste Pits Superfund Site.
Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Note: [a] Tidal conditions under which this contour was measured are unknown.

Figure 31
Exposure Unit for Sediment, Area North of I-10 and Aquatic Environment, Post-TCRA
San Jacinto River Waste Pits Site

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Baseline Human Health Risk Assessment, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

Surface Soil Sample Location
TCRA Fence Line
Coastal Water Authority Fence Line
USEPA's Preliminary Site Perimeter

0
1,000
Feet

Figure 32
Exposure Unit for Soils, Area North of I-10 and Aquatic Environment, Post-TCRA
San Jacinto River Waste Pits Site

Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Baseline Human Health Risk Assessment, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

0 400
Feet

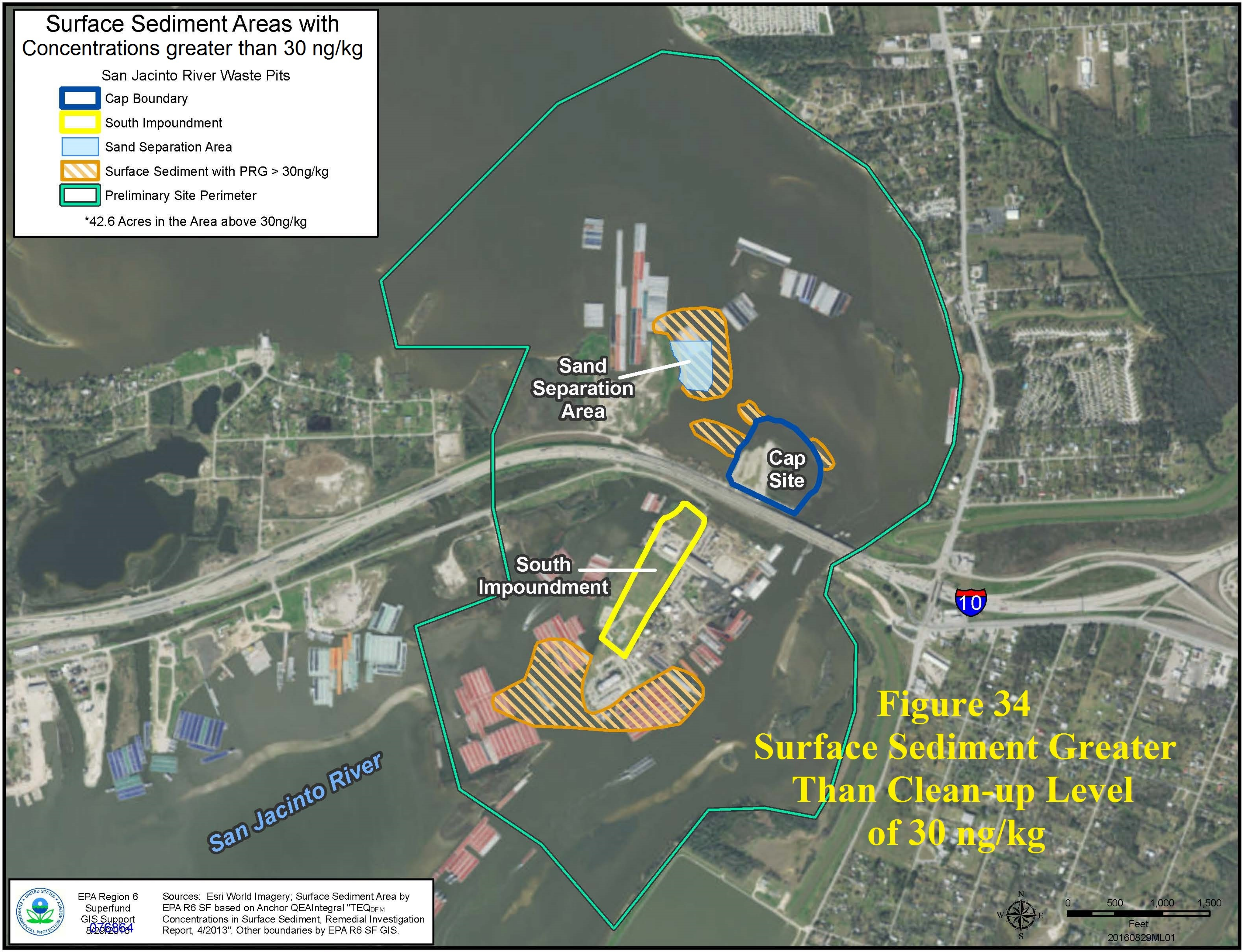
Surface and Subsurface Soil Sample Location
Exposure Unit for Deep Soils, 0-10 feet

FEATURE SOURCES:
Aerial Imagery: 0.5-meter 2008/2009 DOQQs - Texas Strategic Mapping Program (StratMap), TNRIS

Figure 33
Areas Above Southern Impoundment Clean-up Level (>240 ng/kg) on the Peninsula South of I-10, 0-10 feet
San Jacinto River Waste Pits Site

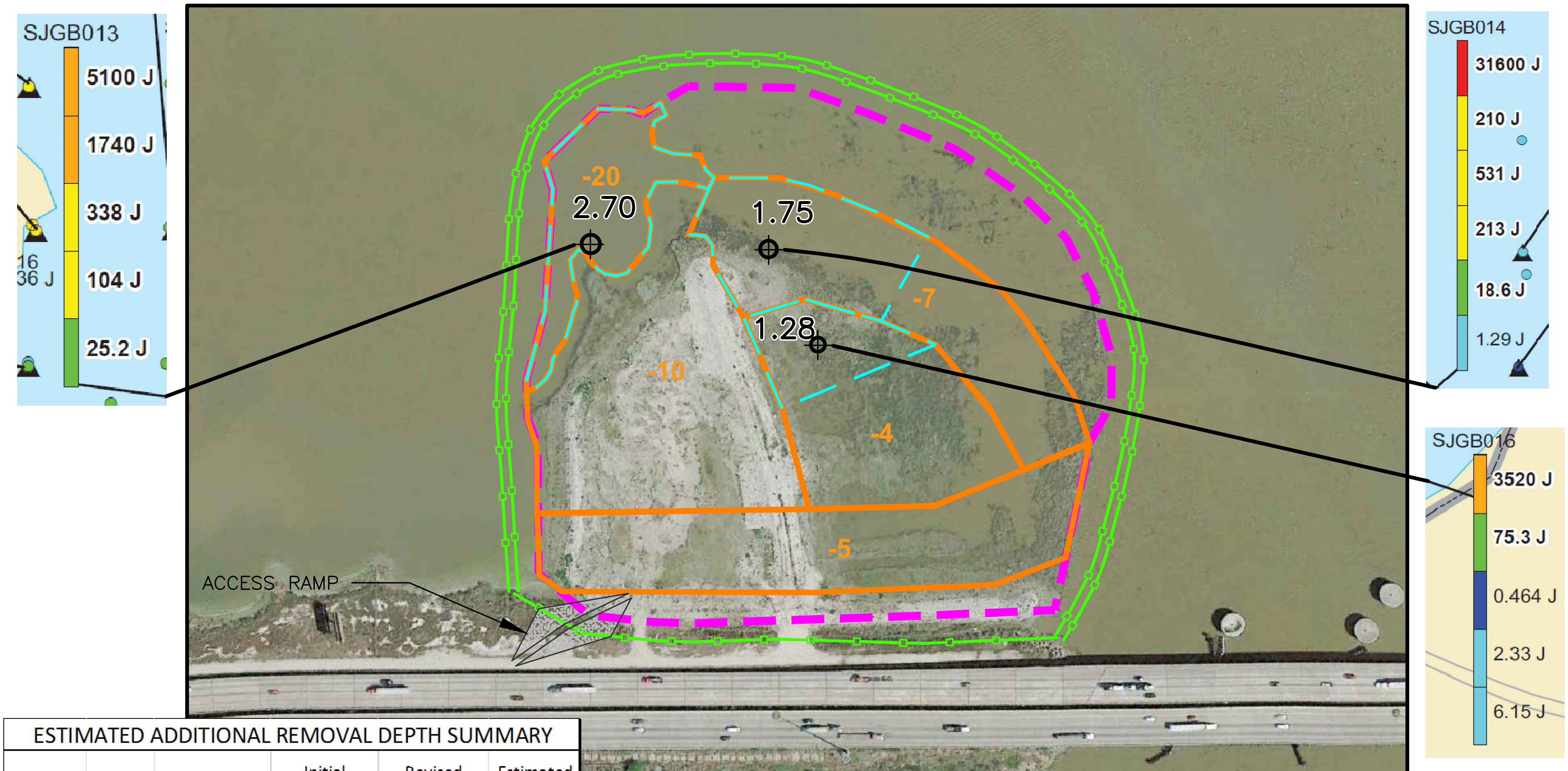
Modified from: Integral Consulting Inc. and Anchor QEA, LLC. 2013. Baseline Human Health Risk Assessment, San Jacinto River Waste Pits Superfund Site. Prepared for: McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. May.

076870



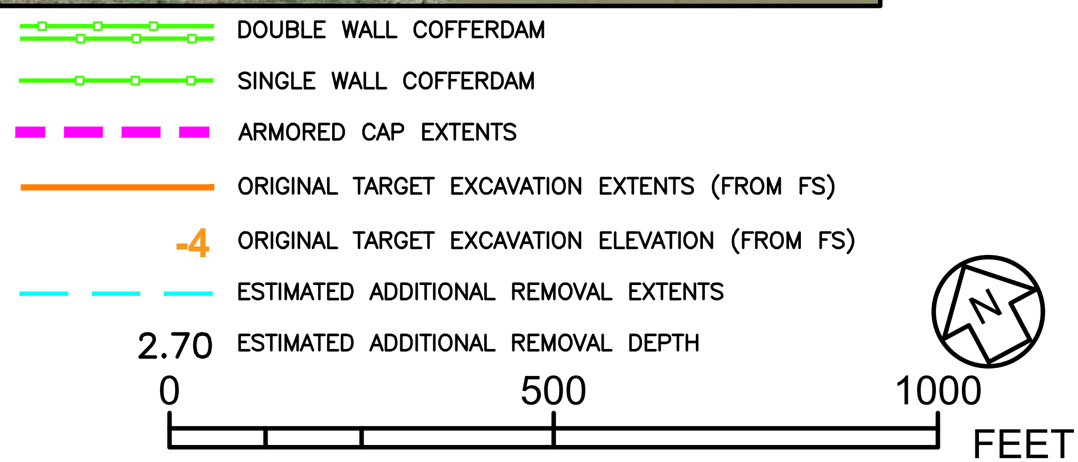
Surface Sediment Areas with Concentrations greater than 30 ng/kg
San Jacinto River Waste Pits
Cap Boundary
South Impoundment
Sand Separation Area
Surface Sediment with PRG > 30ng/kg
Preliminary Site Perimeter
*42.6 Acres in the Area above 30ng/kg
Sand Separation Area
Cap Site
South Impoundment
10
San Jacinto River
Figure 34
Surface Sediment Greater Than Clean-up Level of 30 ng/kg
EPA Region 6
Superfund
GIS Support
8/29/2016
076864
Sources: Esri World Imagery; Surface Sediment Area by EPA R6 SF based on Anchor QEAIntegral "TEQDF,M Concentrations in Surface Sediment, Remedial Investigation Report, 4/2013". Other boundaries by EPA R6 SF GIS.
N
W
E
S
0
500
1,000
1,500
Feet
20160829ML01

Figure 35 - Selected Remedial Action
(Alternative 6N)
Cleanup Level: 30 ng/kg



ESTIMATED ADDITIONAL REMOVAL DEPTH SUMMARY

Boring	Interval Depth (ft bgs)	Interval concentration (ng/kg)	Initial Removal depth, to 200 ng/kg (ft bgs)	Revised Removal Depth, to 30 ng/kg (ft bgs)	Estimated Additional Removal Depth (ft)
SJGB013	5	338	6.18	8.88	**2.70**
	7	104			
	9	25.2			
SJGB014	7	213	7.13	8.88	**1.75**
	9	18.6			
SJGB016	1	3520	2.93	4.21	**1.28**
	3	75.3			
	5	0.464			



Appendix A: Remedial Alternative Cost Development

Table 1
Unit Cost Assumptions

Element		Unit Cost	Unit	Source and/or Comment
Mobilization/ Demobilization and Setup	Mobilization and Demobilization – Northern Impoundments	8 to 15% of Direct Construction Costs	%	Engineering judgment. Higher due to marine work/equipment. Includes property rental for transfer sites.
	Mobilization and Demobilization – Area South of Interstate 10	$50,000 - $250,000	Lump Sum	Engineering judgment. Dependent on scope.
	Environmental Protection and Erosion Control	$5,000 - $300,000	Lump Sum	TCRA contractor bids and similar work with larger scope.
	Construction, Payment, and As-built Surveys – Northern Impoundments	$100,000 - $300,000	Lump Sum	Engineering judgment and TCRA contractor bids.
	Construction, Payment, and As-built Surveys – Area South of Interstate 10	$20,000	Lump Sum	Engineering judgment and limited confined area.
	Construction Materials Testing	$15,000	Each	Engineering judgment and TCRA contractor bids.
	Water Quality Engineering Controls	$100,000 - $1,600,000	Lump Sum	Engineering judgment and TCRA contractor bids. Lower cost for silt curtain; higher cost for combination rock berm and sheetpiling.
Permanent Cap Protective Berm	Rock Rubble Mound Construction	$107	Ton	USA Environment costs for installing D rock for TCRA construction. Assumed site access and production rates consistent with those achieved during the TCRA construction.
Permanent Cap Construction	Additional Armor Rock Placement	$107	Ton	USA Environment costs for installing D rock for TCRA construction; assumed site access and production rates consistent with those achieved during the TCRA construction.

Element		Unit Cost	Unit	Source and/or Comment
Treatment	Temporary Sheetpile Installation	$1,300	Linear Foot	TCRA contractor bids used as basis. Increased to account for additional king piles to support dewatering within the sheet piling.
	In Situ Solidification	$34	Cubic Yard	Actual USA Environment TCRA costs.
	Sheetpile Dewatering	$7,800	Day	RS Means and prior project bids for treatment costs.
Removal and Disposal	Upland Armored Cap Removal	$72	Cubic Yard	TXDOT average bid costs. Increased cost to account for slower production (thinner precision cuts) and assumed work can be performed in the dry with land-based construction equipment during low tide windows.
	In-water Armored Cap Removal	$92	Cubic Yard	TCRA contractor bid prices for dredging. Increased due to thinner precision cuts. Assumed that water based excavation equipment is necessary.
	Land-based Sediment Excavation	$12	Cubic Yard	TXDOT Average Bid Costs with increase for environmental considerations and slower production; assume that work can be performed in the dry with land based construction equipment during low tide windows.
	Water-based Sediment Excavation/Dredging	$46	Cubic Yard	TCRA contractor bids.
	Armored Cap Wash Water Treatment and Disposal	$530	Ton	Quote from Veolia assuming > 5% solids to treat water.
	Wellpoint Dewatering and Treatment	$400,000	Lump Sum	Previous project estimates.
	Replace Excavated Soil	$3.50	Cubic Yard	RS Means.

Element		Unit Cost	Unit	Source and/or Comment
	Offsite Haul and Disposal of Armored Cap (Debris Landfill)	$48	Ton	Actual USA Environment TCRA cost.
	Stabilization of Sediment/Soil prior to Shipment	$30	Cubic Yard	Engineering judgment and information from Waste Management. Assumed mixing diatomaceous earth with sediment.
	Offsite Haul and Disposal of Sediment (Class 1)	$110	Ton	Discussion with U.S. Department of Ecology.
	Offsite Haul and Disposal of Soil (Class 2)	$55	Ton	Prior experience in Texas on other similar projects.
	Dredge Residuals Cover/Backfill	$30	Cubic Yard	Prior project experience.
Armored Cap Restoration	Replacement Cap Geotextile	$6.25	Square Yard	USA Environmental TCRA costs.
	Replacement Cap Armor Stone A/B	$78	Ton	USA Environmental TCRA costs.
	Replacement Cap Armor Stone C/D	$107	Ton	USA Environmental TCRA costs.
Ground Water Monitoring Wells	Install Wells	$50,000	Lump Sum	Engineering judgement.
Demolition (Area South of Interstate 10)	Concrete Pad (6 inch thick)	$7.54	Square Foot	RS Means.
	House with 4-inch-thick foundation	$7.89	Square Foot	RS Means.
Replacement Construction (Area South of Interstate 10)	Concrete Pad (6 inch thick)	$5.38	Square Foot	RS Means.
	House with 4-inch-thick foundation	$125	Square Foot	Review of online Houston housing costs.
Soil Management Plan	Bollards	$741.26	Each	RS Means.

Element		Unit Cost	Unit	Source and/or Comment
and Notices (Institutional Controls; Area South of Interstate 10)	Marker Layer	$0.67	Square Yard	Prior project experience.
Indirect Construction Costs	Engineering Design – Northern Impoundments	6 to 12% of Direct Construction Costs	$	Engineering judgment and complexity of marine work.
	Engineering Design – Area South of Interstate 10	$40,000 to $200,000	Lump Sum	Engineering judgment.
	Construction Administration/Observation – Northern Impoundments	6 to 12% of Direct Construction Costs	%	Engineering judgment. More extensive monitoring than upland.
	Construction Administration/Observation – Area South of Interstate 10	5 to 10% of Direct Construction Costs	%	Engineering judgment.
	USEPA 5-Year Review	Net Present Value	Lump Sum	Assumed $50,000 for USEPA costs every 5 years for 30 years for the Northern Impoundments and $50,000 for the Area South of Interstate 10. Assumed discount rate of 7% to determine net present value.
	Institutional Controls – Northern Impoundments	Net Present Value	Lump Sum	Assumed that as part of construction there are Institutional Controls costs for enforcement tools, proprietary controls, and informational devices. After construction, yearly costs of $10,000 for enforcement tools and $5,000 for informational devices for Alternatives 1N through 5aN and $4,000 per year for Alternative 6N for 30 years. Assumed discount rate of 7% to determine net present value.

Element		Unit Cost	Unit	Source and/or Comment
	Soil Management Plan and Notices (Institutional Controls) – Area South of Interstate 10	$100,000	Lump Sum	Two elements: 1) deed notices that document the presence of contamination, specific locations of affected areas, and if appropriate, protective measures that need to be used (e.g., PPE and HAZWOPER training); 2) soil management plan that would be recorded with the deed to describe how any excavated soil would be managed. Engineering judgment.
Indirect Construction Costs (continued)	Long-Term Armored Cap Monitoring	Net Present Value	Lump Sum	Assumed $25,000 cap monitoring events in Year 1, 2, 5, 10, 15, and 30. Assumed discount rate of 7% to determine net present value.
	Long-Term Natural Recovery Monitoring	Net Present Value	Lump Sum	Assumed $75,000 cap monitoring events in years 1, 2, 5, 10, 15, and 30. Assumed discount rate of 7% to determine net present value.
	Armored Cap Maintenance	Net Present Value	Lump Sum	Assumed $100,000 cap maintenance in Year 1 and 2. Assumed discount rate of 7% to determine net present value.
	Ground Water Monitoring	Net Present Value	Lump Sum	Assumed $30,000 ground water monitoring per year. Assumed discount rate of 7% and inflation rate of 3% to determine net present value.

Notes:
% = percent
PPE = personal protective equipment
TCRA contractor bids = prices were based on the bids received for the 2010 TCRA removal action
TXDOT average bid costs = Texas Department of Transportation average low bid unit prices 3-month statewide average January through March 3013 (http://www.txdot.gov/business/letting-bids/average-low-bid-unit-prices.html)
RS Means = prices obtained from 2014 RS Means Online library for the Houston area.
USEPA = U.S. Environmental Protection Agency

Table 2
Quantity Assumptions

Element	Assumption	Source and/or Comment
Sediment and Soil Unit Weight	1.4 tons per cubic yard	Typical assumption for silty and sandy sediments (excavated material)
Armor Stone Unit Weight	1.8 tons per cubic yard	Typical assumption for engineered cap material
Sediment Residual Cover Thickness	12-inch sand layer applied as two 6-inch-thick layers	Assumes 18 inches placed to obtain a 12-inch cover
Rock Rubble Mound Construction	5 foot high, 2 feet horizontal to 1 foot vertical (2H:1V) side slopes along the northwestern perimeter	Create a 5-foot-high rubble mound with the intent of stopping any larger vessels from striking the cap
Permanent Armor Rock on Slopes	5H:1V for upland armor rock and 3H:1V for offshore armor rock	Volume determined from CAD
Removal of Armored Cap	18-inch-thick cap over the area of removal	Typical Armored Cap thickness
Dredging/Excavation	Total removal volume is neat line volume plus 1-foot overdredge plus 10% to account for side slopes	Neatline volume determined from CAD, depths vary with target removal concentrations
Armored Cap Stone Washing	Assumes 0.025 tons of water needed to wash a ton of rock	Based on Armored Cap stone removal volumes and commercial pressure water volumes
Sheetpile Wall	Measured length	Area determined from CAD
Solidification/Stabilization	Volume the same as the calculated excavation volumes with 1-foot overstabilization and 10% growth	Neatline volume determined from CAD, depths vary with target removal concentrations
Landfill Disposal	Tonnage is the calculated excavation volumes increased by the unit weight and amount of additive needed for handling	From dredge volumes
Armor Stone Replacement	1 foot for A and B/C rock and 2 foot for C/D rock	Area determined in CAD and converted to tons
House and Concrete Pad in Area South of Interstate 10	4-inch-thick house foundation and 6-inch-thick concrete pad with rebar	Areas measured in Google Earth. Assumed house debris was 50 pounds per square feet and concrete pad debris was 150 pounds per cubic feet

Estimate of Project Quantities & Probable Cost Worksheet
Alternative 1N
No Further Action

Item	Description	Plan Qty.	Unit	Unit Price	Total
DIRECT CONSTRUCTION COSTS					
0001	Mobilization/Demobilization	$ -	%	15%	$ -
0002	Environmental Protection and Erosion Control	0	LS	$100,000	$ -
0003	Construction Payment and As-Built Surveys	0	LS	$100,000	$ -
0004	Construction Materials Testing	0	EA	$15,000	$ -
0005	Additional Armor Rock Placement	0	TON	$107	$ -

DIRECT CONSTRUCTION TOTAL: $ -

Item	Description	Plan Qty.	Unit	Unit Price	Total
IN-DIRECT CONSTRUCTION COSTS					
0006	Engineering Design	$ -	%	12%	$ -
0007	Construction Administration/Observation	$ -	%	12%	$ -
0008	EPA 5 Year Review (Net Present Value)	1	LS	$108,000	$ -
0009	Institutional Controls (Net Present Value)	0	LS	$286,000	$ -
0010	Long Term MNR Monitoring (Net Present Value)	0	EA	$264,000	$ -
0011	Long Term Cap Monitoring (Net Present Value)	1	LS	$88,000	$ 88,000.00
0012	Cap Maintenance (Net Present Value)	1	LS	$181,000	$ 181,000.00

IN-DIRECT CONSTRUCTION TOTAL: $ 269,000.00

PROJECT TOTAL $ 269,000.00

PROJECT ROUNDED TOTAL: **$** 300,000.00

30% Contingency **$** 90,000.00

TOTAL ESTIMATED COST **$** 390,000.00

Estimate of Project Quantities & Probable Cost Worksheet
Alternative 2N
Cap, ICs, Ground Water Monitoring, and MNR

Item	Description	Plan Qty.	Unit	Unit Price	Total
DIRECT CONSTRUCTION COSTS					
0001	Mobilization/Demobilization	$ -	%	15%	$ -
0002	Environmental Protection and Erosion Control	0	LS	$100,000	$ -
0003	Construction Payment and As-Built Surveys	0	LS	$100,000	$ -
0004	Construction Materials Testing	0	EA	$15,000	$ -
0005	Additional Armor Rock Placement	0	TON	$107	$ -
DIRECT CONSTRUCTION TOTAL:					$ -
IN-DIRECT CONSTRUCTION COSTS					
0006	Engineering and Monitoiring Well Design	$ -	%	12%	$ 50,000
0007	Construction Administration/Observation	$ -	%	12%	$ -
0008	EPA 5 Year Review (Net Present Value)	1	LS	$108,000	$ 108,000.00
0009	Institutional Controls (Net Present Value)	1	LS	$286,000	$ 286,000.00
0010	Long Term MNR & GW Monitoring (Net Present Value)	1	LS	$264,000	$ 794,000.00
0011	Long Term Cap Monitoring (Net Present Value)	1	LS	$88,000	$ 88,000.00
0012	Cap Maintenance (Net Present Value)	1	LS	$181,000	$ 181,000.00
IN-DIRECT CONSTRUCTION TOTAL:					$ 1,507,000
PROJECT TOTAL:					$ 1,507,000
30% Contingency					**$** 452,000
TOTAL ESTIMATED COST					**$** 1,959,000

Estimate of Project Quantities & Probable Cost Worksheet
Alternative 3N
Upgraded Cap, ICs, Ground Water Monitoring, and MNR

Item	Description	Plan Qty.	Unit	Unit Price	Total
DIRECT CONSTRUCTION COSTS					
0001	Mobilization/Demobilization	$ 1,181,135	%	15%	$ 177,170.25
0002	Environmental Protection and Erosion Control	1	LS	$100,000	$ 100,000.00
0003	Construction, Payment and As-Built Surveys	1	LS	$100,000	$ 100,000.00
0004	Construction Materials Testing	1	EA	$15,000	$ 15,000.00
0005	Rock Rubble Mound Construction	2,900	TON	$107	$ 311,300.00
0006	Additional Permanent Cap Rock Placement	6,100	TON	$107	$ 654,835.00
DIRECT CONSTRUCTION TOTAL:					$ 1,358,000.00
IN-DIRECT CONSTRUCTION COSTS					
0007	Engineering & Monitoring Well Design	$ 1,358,000	%	12%	$ 213,000,00
0008	Construction Administration/Observation	$ 1,358,000	%	12%	$ 162,960.00
0009	EPA 5 Year Review (Net Present Value)	1	LS	$108,000	$ 108,000.00
0010	Institutional Controls (Net Present Value)	1	LS	$286,000	$ 286,000.00
0011	Long Term MNR & GW Monitoring (Net Present Value)	1	LS	$264,000	$ 794,000.00
0012	Long Term Cap Monitoring (Net Present Value)	1	LS	$88,000	$ 88,000.00
0013	Cap Maintenance (Net Present Value)	1	LS	$181,000	$ 181,000.00
IN-DIRECT CONSTRUCTION TOTAL:					$ 1,833,000
PROJECT TOTAL:					$ 3,191,000
30% Contingency					$ 957,000
TOTAL ESTIMATED COST					$ 4,148,000

Estimate of Project Quantities & Probable Cost Worksheet
Alternative 3aN
Enhanced Cap, Pilings, ICs, Ground Water Monitoring, and MNR

Item	Description	Plan Qty.	Unit	Unit Price	Total
DIRECT CONSTRUCTION COSTS					
0001	Mobilization/Demobilization	$13,152,500	%	15%	$ 1,972,875
0002	Environmental Protection and Erosion Control	1	LS	$100,000	$ 100,000
0003	Construction, Payment and As-Built Surveys	1	LS	$100,000	$ 100,000
0004	Construction Materials Testing	1	EA	$15,000	$ 15,000
0005	Rock Rubble Mound Construction	2,900	TON	$107	$ 310,300
0006	Pilings	57	EA	$12,500	$ 712,500
0007	Additional Permanent Cap Rock Placement	6,100	TON	$107	$ 652,700
0008	Coarse Gravel Filter Layer	1,300	TON	$60	$ 78,000
0009	Enhanced Permanent Cap Rock Placement	93,200	TON	$120	$ 11,184,000
DIRECT CONSTRUCTION TOTAL:					$ 15,125,375
IN-DIRECT CONSTRUCTION COSTS					
0010	Engineering & Monitoring Well Design	$ 15,125,375	%	8%	$ 1,260,030
0011	Construction Administration/Observation	$ 15,125,375	%	8%	$ 1,210,030
0012	EPA 5 Year Review (Net Present Value)	1	LS	$108,000	$ 108,000
0013	Institutional Controls (Net Present Value)	1	LS	$286,000	$ 286,000
0014	Long Term MNR & GW Monitoring (Net Present Value)	1	LS	$794,000	$ 794,000
0015	Long Term Cap Monitoring (Net Present Value)	1	LS	$88,000	$ 88,000
0016	Cap Maintenance (Net Present Value)	1	LS	$181,000	$ 181,000

IN-DIRECT CONSTRUCTION TOTAL: $ 3,927,060

PROJECT TOTAL: $ 19,052,435

30% Contingency **5,715,731**

TOTAL ESTIMATED COST **$ 24,768,166**

*

Estimate of Project Quantities & Probable Cost Worksheet
Alternative 4N
Partial Solidification, Upgraded Cap, ICs,
Ground Water Monitoring, and MNR

Item	Description	Plan Qty.	Unit	Unit Price	Total
DIRECT CONSTRUCTION COSTS					
0001	Mobilization/Demobilization	$ 7,445,315	%	15%	$ 1,117,000.00
0002	Environmental Protection and Erosion Control	1	LS	$100,000	$ 100,000.00
0003	Construction Payment and As-Built Surveys	1	LS	$100,000	$ 100,000.00
0004	Construction Materials Testing	2	EA	$15,000	$ 30,000.00
0005	Rock Rubble Mound Construction	2,900	TON	$107	$ 311,315.00
0006	Additional Armor Rock Placement	6,100	TON	$107	$ 655,000.00
0007	Remove Armored Cap - Land Based	6,200	CY	$72	$ 443,000.00
0008	Remove Armored Cap - Water Based	2,300	CY	$92	$ 212,000.00
0009	Wash Water Armored Cap - Treat and Dispose	800	TON	$530	$ 424,000.00
0010	Dispose Armored Cap - Debris Landfill	15,300	TON	$48	$ 730,000.00
0011	Temporary Sheet Pile	800	LF	$1,300	$ 1,040,000.00
0012	Sheet Pile Dewatering	22	DAY	$7,800	$ 171,000.00
0013	In situ Solidification	52,000	CY	$34	$ 1,783,000.00
0014	Replace Geotextile	22,600	SY	$6.25	$ 141,000.00
0015	Replace Armor Rock A/B	8,280	TON	$78	$ 648,000.00
0016	Replace Armor Rock C/D	6,120	TON	$107	$ 657,000.00
DIRECT CONSTRUCTION TOTAL:					$ 8,562,000.00
IN-DIRECT CONSTRUCTION COSTS					
0017	Engineering & Monitoring Well Design	$ 8,562,000	%	8%	$ 734,960.00
0018	Construction Administration/Observation	$ 8,562,000	%	8%	$ 684,960.00
0019	EPA 5 Year Review (Net Present Value)	1	LS	$108,000	$ 108,000.00
0020	Institutional Controls (Net Present Value)	1	LS	$286,000	$ 286,000.00
0021	Long Term MNR & GW Monitoring (Net Present Value)	1	LS	$264,000	$ 794,000.00
0022	Long Term Cap Monitoring (Net Present Value)	1	LS	$88,000	$ 88,000.00
0023	Cap Maintenance (Net Present Value)	1	LS	$181,000	$ 181,000.00
IN-DIRECT CONSTRUCTION TOTAL:					$ 2,877,000
PROJECT TOTAL					$ 11,439,000
30% Contingency					**$ 3,400,000**
TOTAL ESTIMATED COST					**$ 14,839,000**

Estimate of Project Quantities & Probable Cost Worksheet
Alternative 5N
Partial Removal, Upgraded Cap, ICs,
Ground Water Monitoring, and MNR

Item	Description	Plan Qty.	Unit	Unit Price	Total
DIRECT CONSTRUCTION COSTS					
0001	Mobilization/Demobilization	$ 17,701,315	%	8%	$ 1,420,000.00
0002	Environmental Protection and Erosion Control	1	LS	$300,000	$ 300,000.00
0003	Construction Payment and As-Built Surveys	1	LS	$300,000	$ 300,000.00
0004	Construction Materials Testing	2	EA	$15,000	$ 30,000.00
0005	Silt Curtain	1	LS	$100,000	$ 100,000.00
0006	Rock Rubble Mound Construction	2,900	TON	$107	$ 311,315.00
0007	Additional Armor Rock Placement	6,100	TON	$107	$ 655,000.00
0008	Remove Armored Cap - Land Based	6,200	CY	$72	$ 443,000.00
0009	Remove Armored Cap - Water Based	2,300	CY	$92	$ 212,000.00
0010	Wash Water Armored Cap - Treat and Dispose	766	TON	$530	$ 406,000.00
0011	Dispose Armored Cap - Debris Landfill	15,300	TON	$48	$ 730,000.00
0012	Water-based Excavation/Dredging	7,300	CY	$46	$ 336,000.00
0013	Land-based Excavation	44,700	CY	$12	$ 536,000.00
0014	Sediment Residuals Cover/Backfill	52,000	CY	$30	$ 1,560,000.00
0015	Sediment Stabilization prior to Shipment	52,000	CY	$30	$ 1,536,000.00
0016	Haul & Disposal of Sediment to Class 1 Landfill	80,000	TON	$110	$ 8,800,000.00
0017	Replace Geotextile	22,600	SY	$6.25	$ 141,000.00
0018	Replace Armor Rock B/C	8,280	TON	$78	$ 648,000.00
0019	Replace Armor Rock C/D	6,120	TON	$107	$ 657,000.00

DIRECT CONSTRUCTION TOTAL: $ 19,121,000.00

Item	Description	Plan Qty.	Unit	Unit Price	Total
IN-DIRECT CONSTRUCTION COSTS					
0020	Engineering and Monitoring Well Design	$ 19,121,000	%	6%	$ 1,197,000.00
0021	Construction Administration/Observation	$ 19,121,000	%	6%	$ 1,147,000.00
0022	EPA 5 Year Review (Net Present Value)	1	LS	$108,000	$ 108,000.00
0023	Institutional Controls (Net Present Value)	1	LS	$286,000	$ 286,000.00
0024	Long Term MNR & GW Monitoring (Net Present Value)	1	LS	$264,000	$ 794,000.00
0025	Long Term Cap Monitoring (Net Present Value)	1	LS	$88,000	$ 88,000.00
0026	Cap Maintenance (Net Present Value)	1	LS	$181,000	$ 181,000.00

IN-DIRECT CONSTRUCTION TOTAL: $ 3,801,000

PROJECT TOTAL $ 22,922,000

30% Contingency Cost **$ 6,900,000**

TOTAL ESTIMATED COST **$ 29,822,000**

Estimate of Project Quantities & Probable Cost Worksheet
Alternative 5aN
Partial Removal, Upgraded Cap, ICs,
Ground Water Monitoring, and MNR

Item	Description	Plan Qty.	Unit	Unit Price	Total
DIRECT CONSTRUCTION COSTS					
0001	Mobilization/Demobilization	$ 43,006,315	%	8%	$ 3,440,000.00
0002	Environmental Protection and Erosion Control	1	LS	$300,000	$ 300,000.00
0003	Construction Payment and As-Built Surveys	1	LS	$300,000	$ 300,000.00
0004	Construction Materials Testing	2	EA	$15,000	$ 30,000.00
0005	Temporary Sheet Pile	1,200	LF	$650	$ 780,000.00
0006	Temporary Perimeter Berm Fill	6,400	TON	$136	$ 871,000.00
0007	Rock Rubble Mound Construction	2,900	TON	$107	$ 311,315.00
0008	Additional Armor Rock Placement	2,500	TON	$107	$ 268,000.00
0009	Remove Armored Cap - Land Based	6,192	CY	$72	$ 443,000.00
0010	Remove Armored Cap - Water Based	21,208	CY	$92	$ 1,951,000.00
0011	Wash Water Armored Cap - Treat and Dispose	2,452	TON	$530	$ 1,300,000.00
0012	Dispose Armored Cap - Debris Landfill	49,000	TON	$48	$ 2,337,000.00
0013	Water-based Excavation/Dredging	137,600	CY	$46	$ 6,330,000.00
0014	Land-based Excavation	0	CY	$12	$ -
0015	Sediment Residuals Cover/Backfill	13,700	CY	$30	$ 411,000.00
0016	Sediment Stabilization prior to Shipment	137,600	CY	$30	$ 4,065,000.00
0017	Haul & Disposal of Sediment to Class 1 Landfill	211,900	TON	$110	$ 23,309,000.00
0018	Replace Geotextile	0	SY	$6.25	$ -
0019	Replace Armor Rock A/B	0	TON	$78	$ -
0020	Replace Armor Rock C/D	0	TON	$107	$ -
DIRECT CONSTRUCTION TOTAL:					$ 46,446,000.00
IN-DIRECT CONSTRUCTION COSTS					
0021	Engineering and Monitoring Well Design	$ 46,446,000	%	6%	$ 2,837,000.00
0022	Construction Administration/Observation	$ 46,446,000	%	6%	$ 2,786,760.00
0023	EPA 5 Year Review (Net Present Value)	1	LS	$108,000	$ 108,000.00
0024	Institutional Controls (Net Present Value)	1	LS	$286,000	$ 286,000.00
0025	Long Term MNR & GW Monitoring (Net Present Value)	1	LS	$264,000	$ 794,000.00
0026	Long Term Cap Monitoring (Net Present Value)	1	LS	$88,000	$ 88,000.00
0027	Cap Maintenance (Net Present Value)	1	LS	$181,000	$ 181,000.00
IN-DIRECT CONSTRUCTION TOTAL:					$ 7,081,000
PROJECT TOTAL					$ 53,527,000
30% Contingency Cost					$ 16,058,000
TOTAL ESTIMATED COST					$ 69,585,000

Estimate of Project Quantities & Probable Cost Worksheet
Alternative 6N
Removal of Waste materials, ICs, and MNR - Enhanced Removal

Item	Description	Plan Qty.	Unit	Unit Price	Total Sheetpile Cutting	Total Sheetpile Extraction
DIRECT CONSTRUCTION COSTS						
0001	Mobilization/Demobilization	Direct Construction Total	%	8%	$ 5,337,300	$ 5,100,900
0002	Environmental Protection and Erosion Control	1	LS	$ 300,000	$ 300,000	$ 300,000
0003	Construction Payment and As-Built Surveys	1	LS	$ 300,000	$ 300,000	$ 300,000
0004	Construction Materials Testing	2	EA	$ 15,000	$ 30,000	$ 30,000
0005	Remove, Wash, and Dispose Armored Cap	29,900	CY	$ 318	$ 9,501,800	$ 9,501,800
0006	Cofferdam*	1	LS	$ 18,066,200	$ 18,066,200	$ 18,033,900
0007	Sheetpile Dewatering and Treatment	182	Days	$ 7,800	$ 1,419,600	$ 1,419,600
0008	Land-based Excavation	162,000	CY	$ 12	$ 1,944,000	$ 1,944,000
0009	Sediment Stabilization prior to Shipment	162,000	CY	$ 30	$ 4,860,000	$ 4,860,000
0010	Haul & Disposal of Sediment to Class 1 Landfill	275,400	TON	$ 110	$ 30,294,000	$ 30,294,000
0011	(OPTIONAL) Extract and Salvage Sheetpile	417,354	SF	$ (7)	-	$ (2,921,500)

*Note: Cofferdam cost is a lump sum based on assumptions and cost estimate provided by USACE in a revised Technical Memorandum on 17 August 2017.

DIRECT CONSTRUCTION TOTAL:	$ 72,052,900	$ 68,862,700

Item	Description	Plan Qty.	Unit	Unit Price	Total Sheetpile Cutting	Total Sheetpile Extraction
IN-DIRECT CONSTRUCTION COSTS						
0020	Engineering Design	Direct Construction Total	%	6%	$ 4,324,000	$ 4,132,000
0021	Construction Administration/Observation	Direct Construction Total	%	6%	$ 4,324,000	$ 4,132,000
0022	EPA 5 Year Review (Net Present Value)	1	LS	$108,000	$ 108,000	$ 108,000
0023	Institutional Controls (Net Present Value)	1	LS	$70,000	$ 70,000	$ 70,000
0024	Long Term MNR Monitoring (Net Present Value)	1	LS	$264,000	$ 264,000	$ 264,000
0025	Long Term Cap Monitoring (Net Present Value)	0	LS	$88,000	$ -	$ -
0026	Cap Maintenance (Net Present Value)	0	LS	$181,000	$ -	$ -

IN-DIRECT CONSTRUCTION TOTAL:	$ 9,090,000	$ 8,706,000
PROJECT TOTAL:	$ 81,142,900	$ 77,568,700
30% CONTINGENCY:	$ 24,342,870	$ 23,270,610
TOTAL ESTIMATED COST:	**$ 105,485,770**	**$ 100,839,310**
DURATION:	**866 CD**	**866 CD**

Estimate of Project Quantities & Probable Cost Worksheet
Alternative 1S
No Action

Item	Description	Plan Qty.	Unit	Unit Price	Total
DIRECT CONSTRUCTION COSTS					
0001	Mobilization/Demobilization	0	LS	$0	$ -
0002	Environmental Protection and Erosion Control	0	LS	$5,000	$ -
0003	Construction Surveys, Site Preparation & Utility Clearance	0	LS	$5,000	$ -
DIRECT CONSTRUCTION TOTAL:					$ -
INDIRECT CONSTRUCTION COSTS					
0004	Engineering Design	$ -	%	12%	$ -
0005	Construction Administration/Observation	$ -	%	10%	$ -
0006	USEPA 5 Year Review (Net Present Value)	1	LS	$108,000	$ -
0007	Soil Management Plan and Notices	0	LS	$100,000	$ -
IN-DIRECT CONSTRUCTION TOTAL:					$ 0
PROJECT TOTAL:					$ 0
PROJECT ROUNDED TOTAL:					**$ 0**
Total Including 30% Contingency					**$ 0**

Estimate of Project Quantities & Probable Cost Worksheet
Alternative 2S
Institutional Controls and Ground Water Monitoring

Item	Description	Plan Qty.	Unit	Unit Price	Total
DIRECT CONSTRUCTION COSTS					
0001	Mobilization/Demobilization	0	LS	$0	$ -
0002	Environmental Protection and Erosion Control, GW Wells	0	LS	$50,000	$ 50,000
0003	Construction Surveys, Site Preparation & Utility Clearance	0	LS	$5,000	$ -
DIRECT CONSTRUCTION TOTAL:					$ 50,000
INDIRECT CONSTRUCTION COSTS					
0004	Engineering Design	$ -	%	12%	$ -
0005	Construction Administration/Observation	$ -	%	10%	$ -
0006	GW Well Monitoring & 5 Year Review (Net Present Value)	1	LS	$108,000	$ 638,000.00
0007	Soil Management Plan and Notices	1	LS	$100,000	$ 100,000.00
IN-DIRECT CONSTRUCTION TOTAL:					$ 738,000
PROJECT TOTAL:					$ 788,000
TTotal With 30% Contingency					$ 1,024,000

Estimate of Project Quantities & Probable Cost Worksheet
Alternative 3S
Enhanced Institutional Controls and Ground Water Monitoring

Item	Description	Plan Qty.	Unit	Unit Price	Total
DIRECT CONSTRUCTION COSTS					
0001	Mobilization/Demobilization	1	LS	$50,000	$ 50,000.00
0002	Environmental Protection and Erosion Control	1	LS	$5,000	$ 5,000.00
0003	Construction Surveys, Site Preparation & Utility Clearance	1	LS	$20,000	$ 20,000.00
0004	Bollards	10	EA	$741.26	$ 7,400.00
0005	Land-based Soil Excavation	8,042	CY	$12.00	$ 96,504.00
0006	Marker Layer	12,000	SY	$0.67	$ 8,000.00
0007	Replace Excavated Soil	10,400	CY	$3.50	$ 36,000.00
0008	Vegetative Cover & GW Monitoring Well Installation	1	LS	$60,000.00	$ 60,000.00
DIRECT CONSTRUCTION TOTAL:					$ 283,000.00
INDIRECT CONSTRUCTION COSTS					
0009	Engineering Design	1	LS	$40,000	$ 40,000.00
0010	Construction Administration/Observation	$ 233,000	LS	10%	$ 23,300.00
0011	GW Well Monitoring & 5 Year Review (Net Present Value)	1	LS	$108,000	$ 638,000.00
0012	Soil Management Plan and Notices	1	LS	$100,000	$ 100,000.00
IN-DIRECT CONSTRUCTION TOTAL:					$ 801,000
PROJECT TOTAL:					$ 1,084,000
Total With 30% Contingency					**$ 1,409,000**

Estimate of Project Quantities & Probable Cost Worksheet
Alternative 4S
Removal with Off-site Dispoal, ICs

Item	Description	Plan Qty.	Unit	Unit Price	Total
DIRECT CONSTRUCTION COSTS					
0001	Mobilization/Demobilization	1	LS	$250,000	$ 250,000.00
0002	Environmental Protection and Erosion Control	1	LS	$5,000	$ 5,000.00
0003	Construction Surveys, Site Preparation & Utility Clearance	1	LS	$20,000	$ 20,000.00
0004	Bollards	0	EA	$741.26	$ -
0005	Land-based Soil Excavation	50,000	CY	$12.00	$ 600,000.00
0006	Marker Layer	0	SY	$0.67	$ -
0007	Replace Excavated Soil	0	CY	$3.50	$ -
0008	Vegetative Cover	3	AC	$4,000.00	$ 14,000.00
0009	Wellpoint Dewatering and Treatment	1	LS	$400,000.00	$ 400,000.00
0010	Stabilization of Soil Prior to Shipment	25,000	CY	$30.00	$ 750,000.00
0011	Off-site Haul and Disposal of Sediment (Class 2)	75,384	TON	$55.00	$ 4,146,000.00
0012	Backfill	50,000	CY	$11.25	$ 563,000.00
0013	Demo 6" Thick Concrete Pad	9,710	SF	$7.57	$ 74,000.00
0014	Demo House	800	SF	$7.89	$ 6,000.00
0015	Replace House	800	SF	$125.00	$ 100,000.00
0016	Replace 6" Thick Concrete Pad	9,710	SF	$5.38	$ 52,000.00
DIRECT CONSTRUCTION TOTAL:					$ 6,980,000.00
INDIRECT CONSTRUCTION COSTS					
0017	Engineering Design	1	LS	$200,000	$ 200,000.00
0018	Construction Administration/Observation	$ 6,980,000	%	5%	$ 349,000.00
0019	USEPA 5 Year Review (Net Present Value)	1	LS	$108,000	$ 108,000.00
0020	Soil Management Plan and Notices	0	LS	$100,000	$ -
IN-DIRECT CONSTRUCTION TOTAL:					$ 657,000
PROJECT TOTAL:					$ 7,637,000
PROJECT ROUNDED TOTAL:					**$ 7,640,000**
Total With 30% Contingency					**$ 9,932,000**