San Jacinto River Waste Pits Superfund Site Technical Document Review: US Army Corps of Engineers Evaluation of the San Jacinto Waste Pits Feasibility Study Remediation Alternatives

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What was the purpose of this study?

The U.S. Environmental Protection Agency (EPA) asked the Army Engineer Research and Development Center (ERDC) to prepare an independent assessment of the Potentially Responsible Parties' (PRP) remedial alternative designs for the San Jacinto River Waste Pits Superfund Site, Texas. This ERDC was asked to:

1) Perform an assessment of the design and evaluation of the remediation alternatives presented in the Feasibility Study.

2) Identify other remedial action alternatives or technologies that may be appropriate for the Site.

3) Evaluate the numerical models used by the PRP's modeling contractor for the Site.

4) Assess the hydraulic conditions in and around the San Jacinto River, and utilize surface water hydrologic, hydrodynamic, and sediment transport models appropriate for the Site in performing the assessment.

What did the EDRC assess?

The EDRC Project Delivery Team (PDT) undertook 18 tasks for their assessment. A summary of the tasks is as follows:

Task 1: Site Visit and Planning Meeting, held in November 2014.

Task 2: Assess San Jacinto River flow/hydraulic conditions and river bed scour in and around the Site for severe storms, hurricanes, storm surge, etc.

Task 3: Evaluate the models PRPs, including uncertainties and model assumptions.

Task 4: Provide an uncertainty analysis of the model assumptions.

Task 5: Review of the design and construction of the existing cap and recommend enhancements.

Task 6: Evaluate the potential for migration of dioxin through the cap with and without the geomembrane/geotextile present.

Task 7: Assess the 500-year reliability of the cap under the potential conditions including severe storms, hurricanes, storm surge, subsidence, etc.

Task 8: Assess potential impacts to the cap from barge strikes/accidents.

Task 9: Identify what institutional/engineering controls (e.g., deed restrictions, notices, buoys, signs, fencing, patrols, and enforcement activities) should be incorporated into the remedial alternatives.

Task 10: Identify and document cases, if any, of armoring breaches or confined disposal facility breaches that may have relevance to the San Jacinto site evaluation.

Task 11: Assess the potential for sediment and contaminant resuspension under the remedial alternatives including capping, solidification, and removal.

Task 12: Identify and evaluate techniques, approaches, Best Management Practices (BMPs), temporary barriers, operational controls, and/or engineering controls (i.e., silt curtains, sheet piles, berms, earth cofferdams, etc.) to minimize the amount of sediment resuspension and sediment residuals concentrations during and after dredging/removal. Prepare a new full removal alternative that incorporates the relevant techniques identified as appropriate.

Task 13: Assess the validity of statements made in the Feasibility Study that the remedial alternative with removal, solidification, and placing wastes again beneath the TCRA cap has great uncertainty as to implementation and that such management of the waste will result in significant releases.

Task 14: Provide a model evaluation of the full removal Alternative 6N identified in the Feasibility Study as well any new alternative(s) developed under Task 12 (Identify and evaluate techniques …) above. Include modeling of sediment resuspension and residuals.

Task 15: Evaluate floodplain management and impact considerations of construction.

Task 16: Project the long-term (500 years) effects of capping alternative (3N) compared to the full removal alternative (6N) on water quality.

Task 17: Assess the potential impacts to fish, shellfish, and crabs from sediment resuspension as a result of dredging in the near term and for the long term.

Task 18: Assess the potential for release of material from the waste pits caused by a storm occurring during a removal/dredging operation; identify and evaluate measures for mitigating/reducing any such releases.

Task 19: Estimate the rate of natural attenuation in sediment concentrations/residuals and recommend a monitoring program to evaluate the progress. Discuss the uncertainty regarding the rate of natural attenuation.

Task 2 – Asses Effects of River Bed Scour, Severe Storms, Hurricanes

The PDT modeled the flood conditions during the October 1994 "100-year" flood to evaluate potential effects. The waste pits are located in the 100-year floodplain for the area. The report noted:

> *The low lying Waste Pits are also subject to flooding from storm surges generated by both tropical storms (i.e., hurricanes) and extra-tropical storms. Storm surges generated in the Gulf of Mexico propagate into Galveston Bay and into the Lower SJR. Storm surge modeling conducted by NOAA predicted that category 3 and 5 hurricanes that hit Galveston Bay during high tide would produce surge levels of 23 ft (7.0 m) and 33 ft (10.1 m), respectively, at the Site. In addition, eustatic sea level rise and subsidence also contributes to the vulnerability of the Site. The combined effect of sea level rise and subsidence is reflected in the 1.97 ft (0.6 m) increase in relative sea level rise recorded over the past 100 years in Galveston Bay (Brody et al. 2014).*

For the simulation of the October 1994 flood, the TCRA cap was present in the model grid. Regarding river bed scour modeled for this flood:

- The maximum scour depth in any grid cell within the cap was 1.5 ft, +/- 0.62 ft.
- An average 90 percent of the 12-inch layer of Armor Cap A material (3-inch median diameter sized recycled concrete) was eroded. This area represents 3 acres of the 15.7-acre site.
- An average of 15 percent of the 12-inch layer of Armor Cap B (5-inch median diameter sized recycled concrete) and B/C (6-inch median diameter size natural rock) materials were eroded.
- None of the Armor Cap D (10-inch median diameter size recycled concrete) was eroded.

No modeling results were presented regarding the effects of storm surge, or other potential effects beyond flood-related scour. In addition, there was no discussion of storm scenarios that others have modeled for the area, such as the "Mighty Ike" scenario developed by the Severe Storm Prediction, Education and Evacuation from Disasters (SSPEED) Center at Rice University and the University of Texas at Austin or the Storm 36 scenario modeled by researchers at Jackson State University for the Federal Emergency Management Agency and the U.S. Army Corps of Engineers RiskMAP flood mapping.

"Mighty Ike" is a simulation that envisions Hurricane Ike making landfall near San Luis Pass, about 30 miles southwest of where it actually landed and with wind speeds to 125 mph (15% higher than Hurricane Ike). Under the Storm 36 scenario, the modeled synthetic storm is physically smaller than Hurricane Ike but has much higher wind speeds — 145 mph. Unlike the "Mighty Ike" scenario, which is based on Hurricane Ike, a synthetic storm is based on averaging hundreds of actual storms that have hit the Texas coast. Storm 36 is a synthetic storm that, like some other scenarios, makes landfall near San

Luis Pass. According to JSU researchers, the chances that Storm 36 will occur in any given year is 1 in 500.[1]

Note that neither of these are classified as a Category 5 storm. The modeled scenarios are rare, but Mighty Ike is considered a 350-year event and Storm 36 is considered a 500-year storm, which are worth considering for a cap that will need to be maintained for 500-years. Note, "Scientists widely believe the method of calculating the probability of such storms may no longer be valid, in part because of climate change… "500-year" events could every few decades, climate scientists say… the models … are based on current sea levels. That means such storms will be even more damaging in the future as sea levels continue to rise in the wake of climate change."[2]

Task 3- Evaluate PRPs Models and Discuss Uncertainty

For this task the PDT evaluated Anchor QEA's (AQs) model files and conducted their own evaluation with a different model. Upon review, the PDT:

- Did not agree with the approach AQ used to locate the downstream boundary of the model. The ERDC modeling team thus used Morgan's Point as the downstream boundary for their model. However, effects on the modeled results were small.
- Noted that the main limitation of AQ's model framework is the use of separate hydrodynamic and sediment transport models, making it not possible to simulate sediment changes during flooding events. Thus, the AQ model predicts smaller amounts of net erosion and higher amounts of net deposition. When this is then used in the contaminant transport model, it will "usually result in faster decreases in concentrations of COCs in the sediment bed than actually occur."
- Noted that AQ assumed that if the average sediment particle size was less than 250 µm and if the combined clay and silt content is greater than 15 percent, then the sediment bed was classified as cohesive. The report went on to note "Unless the fraction of clay size sediment is the majority of the combined clay and silt content, it is unlikely if sediment with only these two criteria are cohesive in behavior. *More justification needs to be given to support this assumption as it would definitely have an impact on the erosion and transport of sediment in the SJR estuary*." [emphasis added]
- Noted the AQ model under predicts maximum velocity during both ebb and flood tides, with the problem the largest for flood tides.
- "the PDT does not completely agree with the last sentence in this section that states 'the calibration and validation results demonstrate that the model is able to simulate the hydrodynamics within the Study Area with sufficient accuracy to meet the objectives of this study'."
- "the model does not predict net sedimentation with reasonable accuracy."

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[1] https://www.propublica.org/nerds/item/how-we-made-hell-and-high-water (accessed September 23, 2016)
[2] Satija, N. et. al. 2016. "Hell and High Water" Texas tribune and ProPublica.March 3. https://www.propublica.org/article/hell-and-high-water-text (accessed September 23, 2016)

- The effects of wind waves needed sensitivity analysis.
- Effects of barges and propwash on sediment resuspension at the Site were not addressed by AQ.

Task 4 – Uncertainty Analysis for Model Assumptions

"Overall, the sensitivity analysis performed by AQ is the best method for attempting to put bounds on the uncertainty in results obtained from any transport and fate modeling study."

"the largest source of uncertainty is the application of a model framework that does not account for morphologic feedback between the sediment transport and hydrodynamic models…"

The PDT conducted an expanded sensitivity analysis. The general results were the similar, but the overall uncertainty should be higher than reported by AQ.

Tasks 5 and 6 – Review the Existing Cap and Make Recommendations

The existing TCRA cap has three sections, each have different cap components.

- **Western Cell** is generally above the water line with a cap composed of a geotextile filter, a geomembrane, a protective geotextile cushion, and armor stone.
- **Eastern Cell** is mostly covered with less than 5 ft. of water with a cap composed on geotextile filter and armor stone.
- **Northwestern Area** is mostly covered in greater than 10 ft. of water with a cap primarily composed of a granular filter blended with armor stone.

Western Cell

The PDT conclusions were:

- The cap in this area effectively isolates the contaminated sediment.
- The geotextiles adequately protect the geomembrane to prevent puncture and to provide long-term chemical isolation.
- The geomembrane will control infiltration, seepage, tidal pumping, diffusion and resuspension, effectively isolating the contaminants.
- No groundwater transport in the sediment under the cap across the site is anticipated based on the topography of the region, location of the site, and permeability of the sediment.
- Flattening of slopes steeper than 1V:3H and providing a gradual transition between the slopes was recommended to increase the factor of safety and provide for long-term stability.
- Increasing the armor stone size by two inches is also recommended to provide stability during the most severe hydrodynamic and hydrologic events.

Eastern Cell

"The Eastern Cell does not contain a geomembrane to control resuspension and the advective and diffusive fluxes of contaminants. However, being submerged in relatively flat environs without regional surficial groundwater upwelling, no significant advective flux is anticipated to provide transport of dissolved or colloidal contaminants."

“the geotextile will provide a filter to control particle movement and prevent translocation of the capped sediment to the surface. Therefore, contaminant transport would be restricted to porewater expulsion and diffusion… diffusive releases from the sediment are largely unimpeded by the cap.”

“addition of an amendment like AquaGate™ or SediMite™ to fill the pore spaces and provide activated carbon to sequester the contaminants could further reduce the potential contaminant releases from diffusion throughout the life of the cap.”

Caps of this type can be subject to disruption by gas generation… generated gas pressures may build to a point where local disturbances of submerged caps less than 24 inches thick may occur.

Recommendations:

- Flattening of slopes steeper than 1V:3H and providing a gradual transition between the slopes.
- Increasing the armor stone size by two inches.
- Increasing the thicknesses of sections of the cap that are continuously submerged to at least 24 inches.

Northwestern Area

“does not provide the same level of confidence in its long-term stability and performance.”

“The Armor Cap A material is unlikely to be stable under the most severe hydrodynamic and hydrologic events.”

The current cap slope “promotes separation of the sand-sized particles and perhaps gravel-sized particles from the larger concrete particles. The finer particles would have a tendency to move down the slope before coming to rest, coarsening the cap on the upper portion of the slopes and reducing the effectiveness of the filter on the upper slope.”

“Without a filter being placed on soft sediments (having low bearing capacity) prior to placement of the armor material, the larger particles of recycled concrete would embed themselves in the sediment and promote mixing of the cap with the sediment, thereby limiting the isolation of the sediment. Use of a blended filter would tend to be less effective on very soft sediments than a separate granular filter.”

“the weight of the armor stones and cap may be sufficient to extrude very soft sediment through the large pores between armor stone unless a sufficient quantity of properly sized filter media is in place.”

“It is likely that the filter is inadequate in places and additional capping media will be needed to upgrade the cap performance and prevent future sediment exposure.”

“there are potential contaminant releases by diffusion, porewater expulsion, tidal pumping and groundwater seepage.”

"The armor cap material does not have a significant quantity of organic carbon to retard contaminant transport."

Recommendations:

- Flattening and coarsening of slopes steeper than 1V:3H and providing a gradual transition between the slopes
- Alternatively, ribbing with larger stone or terracing could be used to stabilize the slope while restricting the resulting cap thickness and slope length.
- Increasing the armor stone size to a D50 of 6 inches (15 cm), and probably larger in shallow water, would be needed to prevent erosion during the most severe hydrodynamic and hydrologic events.

Task 7 – Assess the 500-Year Reliability of the Cap

Assessment to include severe storms, hurricanes, storm surge, subsidence, waves, propwash, toe scour and cap undermining, rock particle erosion, substrate material erosion, stream instability, and other potential failure mechanisms. The report notes "It is the PDT's professional judgment that the uncertainty inherent in any quantitative analysis technique used to estimate the long-term (500 years) reliability of the cap is very high." With that uncertainty noted, the PDT modeled the 1994 flooding (see Task 2 above), Hurricane Ike, and a hypothetical "most severe" case of Hurricane Ike storm surge conditions combined with 1994 flood discharge.

Under the PDT Hurricane Ike scenario, during the peak of the storm surge:

- Overall, approximately 60 percent (11 acres) of the 15.7-acre impoundment incurred severe erosion.
- Sections of the cap (mainly in the Northwestern Area and the southwestern area of the Eastern Cell) using Armor Cap A material (3-inch median size) were completely eroded.
- The sections using Cap Armor B/C and C material (6 inch median size) material incurred an average maximum erosion of more than 70 percent.
- Two sections using Cap Armor D material (10 inch median size) were eroded an average of 15 percent.

Under the PDT hypothetical "most severe" scenario, during the peak of the storm surge:

- Overall, approximately 80 percent (12.5 acres) of the 15.7-acre impoundment incurred severe erosion.
- Sections of the cap using Armor Cap A material (3-inch median size) were completely eroded.
- The sections using Cap Armor B/C and C material (6 inch median size) material incurred an average maximum erosion of more than 9 inches in 85 percent of those sections.
- Two sections using Cap Armor D material (10 inch median size) were eroded more than 12 inches in about 25 percent of those sections.

The PDT noted that replacement of all the Cap Armor materials with a median size of at least 12 inches would be needed to greatly reduce the amount of scour that occurs during such an extreme event. Note: the probability of the "most severe" case is not discussed, so it is not possible to evaluate the probability of this most severe scenario over the 500-year timeframe.

The PDT noted "[e]stimation of the 500-year reliability of the cap should include multiple 100-year (or bigger) flood/storm events in the analysis." Other researchers have modeled bigger storm events, including the "Mighty Ike" scenario developed by the SSPEED Center and the University of Texas at Austin, which is described as a 350-year event, and the Federal Emergency Management Agency study where researchers at Jackson State University modeled a Synthetic Storm 36, a 500-year event. Scenarios like these were not modeled.

"The possibility of wave- and current-induced toe erosion that might lead to undermining of a portion of the cap would be greatly reduced if the recommended reductions in some of the cap side slopes are implemented."

"Enhancement of the armor rocks around the toe of the submerged cap would also lessen the possibility of toe erosion and undermining."

The PDT noted that changes in channel morphology (stream stability) 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 PDT noted that that the impact of continued subsidence on the integrity and reliability of the existing cap is dependent on the long-term rate of subsidence, which is not well known and cannot be predicted with any reliability. In general, the PDT stated that subsidence and the slow rise in sea level would both result in slightly deeper water depths over the Eastern Cell and Northwestern Area of the cap, but they did not believe that these effects would be substantial enough to lessen the reliability of the cap.

Task 8 – Barge Strikes

Utilizing national U.S. tugboat/towboat and barge fleet size figures in their assessment, the Corps noted a conservative (high) estimate of 4 significant strikes and about 30 low severity strikes over a 500-year period. The Corps report states that empty barges and pushboats would likely pass over the cap during large flooding events and that many of the strikes during high flow or flood events would only impact the berms and not significantly disrupt the armor cap. Overall, the report recommended strike protection control measures, such as pilings, caissons or a wall, could be used in a 500- to 700-ft reach along the base of the slope in the deep water (15 feet) of the Northwestern Area to prevent barge high severity strikes by runaway barges or disabled pushboats. The report recommended other areas can be protected by signage to advise barge operators and boaters to stay clear of the cap.

Task 9 - Identify Institutional and Engineering controls

The recommended ICs are (Anchor QEA 2014):

- Alert property owners of the presence of subsurface materials exceeding PCLs.
- Describe the need for protective equipment and training if excavation of subsurface materials exceeding PCLs is required.
- Describe management requirements for any excavated soils or sediment exceeding PCLs.
- Describe the need to restore the armored cap following any disturbance.
- Establish limitations on dredging, construction, dragging and anchoring within the footprint of the armored cap by requesting that the U.S. Coast Guard District Commander establish a regulated navigation area.
- Maintain advisory (ADV-49) that is in place regarding consumption of fish and blue crab on the San Jacinto River. Maintain multi-lingual signage and public outreach activities until the tissue concentrations meet risk goals.
- Maintain the perimeter fence that was installed around the perimeter of the impoundments, including a second phase of fencing installed across neighboring property to address unauthorized access that had been observed.
- Maintain Warning signs, No Trespassing signs and USEPA Project Identification signs that were installed as part of the TCRA and remain in place.

Additionally, the PDT noted that deed restrictions should be established to restrict issuing leases, easements, rights-of-entry and use including any activity that alters the cap or fill including the drilling of wells.

The PDT noted: "It appears the existing land-side fencing and warning signs provide sufficient notification and access control. Monitoring should continue to ensure these measures are maintained as long as there continues to be a risk from on-site contaminants… It is unclear whether water-side perimeter controls are sufficient… More robust engineering controls to restrict vessel traffic over the long term could be considered such as the use of caissons, or vessel exclusion barriers.

"A no-wake zone may need to be established for Alternative 6N, as well as for the Upland Sand Separation Area."

There was no discussion of how these institutional controls will be maintained over the life of the cap.

Task 10 – Document Breaches Relevant to the Site

There have been many occurrences of breaches and slope failures of armored dikes, jetties, and breakwaters. These typically occurred due to ineffective filtering between the armor and core material, insufficient armor sizing for wave action velocities, and steep side slopes allowing rock to be more easily displaced. These three modes of armor failure presented above apply as well to the existing San Jacinto River Waste Pits TCRA armor cap. The corps report recommends cap enhancements to address these deficiencies to the existing cap.

Task 11 – Evaluate Resuspension of Contamination During Remediation

The evaluation indicated that sediment would be disturbed placing sheet pile. The volume of contaminant released along with the sediment is primarily a function of the location of the sheet pile wall. When placed in locations with low sediment concentrations, the resuspension of contamination is minimized.

Estimations for contaminant resuspension during removal were based on the assumption of wet dredging, even when the feasibility recommended dry dredging. Therefore, the estimations are a worst-case scenario. The section went on to note:

"*Any remediation, solidification or dredging, that occurs should be completed in the dry to minimize the amount of resuspension releases and residuals that may be exposed to the water column, particularly in the area slated for removal in Alternative 5N. All activities completed in the dry, having a sheet pile wall barrier protecting the water from interacting with contaminated sediment will result in very small amounts of resuspension, and will have limited exposure to the water before the permanent cap is placed over the residual layers*."

Task 12 – Evaluate Best Management Practices to Minimize Contaminant Release During Remediation

Under this task the report identified operational controls, engineering controls and residual controls.

The original FS provides numerous statements on the short- and long-term effectiveness of removal; however, the alternatives did not apply BMPs consistently. As an example, it appears that removal in the Western Cell is performed in the dry with landside operations in Alternatives 5N and 5aN, while its removal is performed in the wet in Alternative 6N. Consequently, the performance of the alternatives as predicted in the fate and transport modeling tends to distort the incremental impacts of expanding the comprehensiveness of the removal alternatives.

"Sheet-pile containment structures are generally more reliable than silt curtains, although the cost is significantly higher with different technological limitations. There is an increased potential for scour to occur around the outside of the containment area; however, the surrounding area could be armored to prevent scour at the base of the wall. If water levels are lowered on one side of the wall, the hydraulic loading effects may result in safety concerns; however, the wall can be designed to allow water exchange to accommodate changes is river stages or tides."

"The FS report suggests limited effectiveness of the sheet pile due to gaps during construction, necessary openings to balance water pressures, and river-induced scour (Anchor QEA 2014). However, use of sheet piles in shallow water such as along the berms of the Western Cell may be able to operate in the dry. In deeper areas the remediation operations would need to proceed in the wet, use of sheet piles for controlling resuspension releases and contaminant releases would be much more effective than silt curtains even if water exchanges were allowed to balance water pressures. Exchanges would occur near the surface with sheet piles but near the bottom for silt curtains, resulting in about one third of the releases observed using silt curtains. Additionally, armoring around the outside of the sheet pile wall could control river-induced scour. For resuspended sediment that is contained within a sheet pile (4N, 5aN) or a turbidity curtain (5N, 6N), flocculants may be added to encourage settling of contaminated particles, but mixing and higher suspended solids concentrations would be needed to be particularly effective."

"Flocculants may also be used to promote settling and create dense, strong flocs that would settle in minutes. Furthermore, dispersal of activated carbon may be used to adsorb dissolved contaminants."

For Alternative 6N with best management practices, the report stated, "This assessment on a sectional basis shows that there is sediment loss, but if completed using best management practices then releases can be considerably lessened. It is recommended that whenever possible, activities should be completed in the dry such as the shallow water portion of the Eastern Cell. By constructing a berm and sheet pile wall structure, the area can be completely dewatered and all activities can be completed in the dry. Releases in the deep water section of the Eastern Cell can be greatly minimized if a sheet pile wall is utilized and does not allow residual releases. There will also be limited exposure to the water before the permanent cap is placed over the residual layers if a sheet pile wall is used."

If sediments from the entire site are removed in the dry, the contaminants releases would be limited to releases from construction of the containment structures and fugitive dust losses which would amount to about 0.1% of the contaminants removed.

"While sheet pile walls may have limited effectiveness, are subject to leakage, and accumulate resuspended sediments at the base of the walls, these walls are much more effective than silt curtains. Leakage through shallow walls can be controlled by covering the walls with plastic sheeting, adding sealants and incorporating the walls within shallow berms, which would allow excavation in the dry. Placing the walls in shallow areas would allow the walls to be taller, limiting their potential overtopping. In deeper waters, sheet pile walls limit flow through the site and can restrict flow to the surface, limiting erosion of residuals, while silt curtains direct flow along the bottom of the water column, promoting the transport of resuspended sediment and allowing erosion of residuals. Accumulated resuspended sediments at the base of the walls can be readily capped or covered in place, if not removed by a suction dredge."

Task 13 – Re-Evaluate Alternative 4N, Solidification

In order to evaluate the human exposure and risks, risk assessors evaluated chemical data for sediments, fish, shellfish, and soil. The report noted that the top three feet of the western cell have already been solidified, so removing that in order to solidify to 10 fee would provide little additional protection and increase the potential for release. For the Eastern Cell, the challenges involve using sheep pile or caissons to minimize sediment loss and with in situ soil mixing with Portland Cement. The report indicates that because dioxin is already strongly adhered to the sediment, the authors did not see additional protection offered by solidification. The advantage of a solid mass instead of unconsolidated sediments in the event of a cap failure was not discussed.

Task 14 – Model Full Removal

"The new Alternative 6N* with enhanced BMPs, despite its much smaller short-term releases, would still set back the natural recovery of the site back 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." Subsequent tasks address longer-term effectiveness.

Task 15 – Floodplain Management

The 2D LRFATE Model was calibrated to the 100-year floodplain and construction scenarios were evaluated. "the construction of any of the proposed Alternatives is not expected to cause any flooding in the vicinity of the SJR Waste Pits Site, and therefore should not require the implementation of any flood control measures during the construction of any of the Alternatives under consideration by the EPA Site team."

Task 16 – Project the 500-year effectiveness of capping and full removal on water quality

The RECOVERY model was used to predict the contaminant flux and release into the overlying water and to analyze the interactions of a contaminant over 500 years in the sediment profile and bioactive zone. Multiple runs were completed for both scenarios. Contaminant releases to groundwater were low for all scenarios.

Task 17 – Assess how sediment resuspended during dredging would impact fish, shellfish, and crabs

"For this analysis, the peak and average sediment concentrations for the mixed layer over the 500-yr simulation period were used in the calculation of the peak and an average TBP over time. This provides a worst-case scenario." Catfish have the highest potential for bioaccumulation. The best practice placement of backfill in the full removal alternative resulted in the lowest potential of bioaccumulation for all species. Both capping as performed in Alternative 3N and removal as performed in Alternative 6N are very effective; however, dredging is only particularly effective if backfill is placed without disturbing the residual. Backfilling must be performed by raining or placement in two layers.

Task 18 – Assess the potential for storm-related releases during removal and identify measures for mitigating these releases

If a storm, *e.g.*, tropical storm or high flows under flood conditions in the SJR, occurred during the actual removal/dredging operation, the likelihood of extremely significant releases of contaminated sediment occurring is very high. A silt curtain would not be able to withstand the forces of high flow or waves and therefore the bottom shear stresses would not be controlled. The only BMPs that would be capable of preventing most of the contaminated sediment releases would be a substantial containment structures to isolate the removal operations, residuals and exposed sediment. The containment structures could consist of berms and sheet pile walls or caissons to an elevation of about +9 NAVD88. If performing excavation of the sediments in the dry, the top of the berms would preferably be no lower than +4 NAVD88. It would be advisable to perform the removals in small sections at a time such that the armor stone and geotextile within the small section would be removed, and then the sediment removed and a thin layer of sacrificial fill placed before advancing to the next section and repeating the process. Under these removal operations, it would also be advisable to limit or restrict removal activities to a period when there is a lower probability of tropical storms and flooding conditions.

Task 19 – Natural Attenuation

Under this task the team modeled the net sedimentation rate, and noted that averaged over the entire cap, there was slightly more deposition than erosion. The rate of degradation of dioxin or the expected time likely to be required to attenuate to PCLs was not discussed.

HARC Recommendations

EPA or independent 3rd party should address the following items:

- Provide an estimation of the probability of the modeled Hurricane Ike + 1996 flooding.
- Evaluate the effects to the cap from the Mighty Ike and Storm 36 scenarios.
- Provide modeling for propwash and wind-driven waves using local data.
- Specify the recommended method to increase the size of the armored cap material in the Western Cell and Eastern Cell, i.e. will the existing material be removed or will more armoring of the appropriate size be added to the existing cap? Determine if the additional weight of the armoring material due to increased median grain size or thickness may cause the underlying waste material to be pushed out of the sides of the cap or will cause any other containment issue.
- Provide a recommendation for filter media in the Northwestern Area.
- Provide a recommendation for best practice cap design.
- Address the suspected cause of the 25x20 foot "hole"/armored cap deficiency" discovered in the Northwestern Area in December 2015 and estimate the amount of time this deficient area was present before repairs were completed.
- Evaluate barge strike frequency using local numbers of barges, tugboats, and towboats and projected increases over time rather than U.S. averages.
- Discuss the differences in potential releases in the event of a cap failure if the mass is solidified vs. unconsolidated.
- Model the time it will take for the dioxin to naturally attenuate to PCLs under a capping scenario, so that estimations of long-term risk are based on the best estimate of the time required to meet PCLs.
- Discuss how institutional and engineering controls will be assured over the estimated time required for natural attenuation under a capping scenario.