San Jacinto River Waste Pits Superfund Site

Comments
of
International Paper Company
and
McGinnes Industrial Maintenance Corporation
on
Environmental Protection Agency Region 6
Proposed Remedial Action Plan

Appendix B

San Jacinto River Site
Review of the Current Cap and Proposed Remedies
by
Danny D. Reible, Ph.D.

January 12, 2017

Memorandum
4611 102nd St
Lubbock, TX 79424

Date: January 11, 2017

From: Danny D. Reible, PhD, PE

To: *McGinnes Industrial Maintenance Corporation*
International Paper Company

Re: *San Jacinto River Site –Review of the Current Cap and Proposed Remedies*

At the request of International Paper Company (IP) and McGinnes Industrial Maintenance Corporation (MIMC), I submitted a report dated June 17, 2014 on planned remedial approaches at the San Jacinto River Site (Site). The purpose of the current report is to update and extend that report based upon reports and analyses conducted since that time. The focus of my review is on the impoundments located north of I-10 that were capped in 2011 as a result of a Time Critical Removal Action (TCRA) at the Site. As part of the review, I have reviewed the following additional materials:

1. Ruiz, Carlos, USACE Evaluation of the San Jacinto Waste Pits Cap Defect ERDC Letter Report, June 2016 (USACE Cap Report)
2. Integral Consulting, Data Summary Report: 2016 Studies, San Jacinto River Waste Pits Superfund Site, September 2016 (2016 Data Summary Report)
3. US EPA, Proposed Plan for San Jacinto River Waste Pits Superfund Site, September 2016 (Proposed Plan)
4. US EPA, Final Interim Feasibility Study Report, San Jacinto River Waste Pits Superfund Site, September 2016 (Final Interim FS)
5. Hayter, Earl, et al. USACE Evaluation of the San Jacinto Waste Pits Feasibility Study Remediation Alternatives, ERDC Letter Report, August 2016 (USACE 2016 Report)

<u>Reviewer's Background and Experience</u>

The basis for my review is approximately 30 years of experience with contaminated sediments and particularly management via in-situ remedial approaches. In 2005, I was elected to the National Academy of Engineering for "developing widely used approaches for managing contaminated sediments." Much of my work in contaminated sediments has been associated with the assessment, design and implementation of capping. I am a co-author of the standard guidance for capping contaminated sediments (Palermo et al. 1998) and in 2004 I led the first demonstration of amended or active capping in the field (Reible et al. 2006). I have coauthored several National Research Council reports that have guided the management of contaminated sediments including "A Risk Management Strategy for PCB-Contaminated Sediments" (2001),"Environmental Cleanup at Navy Facilities: Adaptive Site Management" (2003), and "Assessing the Effectiveness of Dredging at Superfund Megasites" (2007). I recently edited the book "Sediment Processes, Assessment and Remediation"(2014) which is part of a series of environmental management books published by Springer in cooperation with the Strategic Environmental Research and Development Program (a joint Department of Defense, Department of Energy and Environmental

Protection Agency program). I have also peer reviewed many facets of capping projects, including the design, construction and post-construction monitoring phases for government agencies and private parties.

Review of Current Cap Design and Maintenance

The existing cap at the Site is armored to contain contaminated solids, a design that is appropriate for solid-associated contaminants. As discussed in my June 17, 2014 report (a copy of which is attached), capping is particularly appropriate for the paper mill waste at this Site due to the very low measured permeability of the pulp waste and the chemical properties of dioxins and furans, the primary constituent of concern. As stated in my prior report: "Consistent with the general chemical properties of dioxins and furans, the capped pulp waste at this Site should not be considered mobile."

The permanence and protectiveness of an engineered cap is associated with its ability to withstand erosive forces and events. The armored cap at the Site, completed in 2011, incorporates armor stone, geotextile and geomembrane layers over approximately 15.7 acres. It was designed in accordance with USACE guidance to withstand a 100-year storm event with an additional factor of safety to ensure its long-term effectiveness. As discussed in my prior report, the original TCRA 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 USACE 2016 Report.

In December 2015, an EPA Dive Team inspection identified areas in the Western Cell of the cap that were the subject of the USACE Cap Report. The USACE 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."[1]

The EPA Dive Team inspection results prompted additional evaluation which led to the identification via manual probing of several areas in the Eastern Cell where armor stone was not present at the design thickness or there was exposed geotextile. These areas in the Eastern Cell were identified by 12 out of 400 probes. In June 2016, additional areas where the presence of rock or its presence at the design thickness could not be confirmed were identified in the Western Cell. All areas were properly addressed in accordance with an EPA-approved Operations, Monitoring and Maintenance Plan. There is no evidence that this was the result of erosive forces rather than simply cap construction or settling post-construction.

The observed maintenance areas are not expected to pose a challenge to overall cap performance. As noted by an Interstate Technology and Regulatory Council (ITRC) document on contaminated sediment remediation: "Since a cap is an area-based remedy, isolated areas that do

[1] Ruiz, Carlos, USACE Evaluation of the San Jacinto Waste Pits Cap Defect, Letter Report, June 2016, pg. 17.

not meet thickness criteria may not be significant. Instead, statistical measures such as 95% confidence limits on the mean thickness are more relevant performance indicators."[2]

The identification of maintenance areas in 2015/2016 was likely associated with the high density of probing and evaluation conducted at that time. As noted above, it would not be surprising that a small fraction of the cap area, less than 5%, would not meet design requirements during construction. Moreover, future enhancements of the cap as recommended in Alternative 3aN would significantly decrease the potential for future cap maintenance requirements as a result of the much greater stability of the large armoring stone suggested for that alternative (>12 inches median size).

The 2016 Data Summary Report confirmed that the existing cap has performed well. This Report summarizes the results of sampling groundwater, porewater, surface water, sediment and fish tissue at the cap. These results demonstrate that the existing cap is preventing the release of dioxins and furans to the surrounding environment, and is contributing to the environmental recovery of the area.

A potentially more significant question is whether the cap's design requirements would meet the challenges of future low frequency erosive events including barge strikes and flooding events. The USACE evaluation of remedial alternatives documented in the USACE 2016 Report showed that the proposed capping alternative designated as Alternative 3N would be sufficient for all except the most extreme events but that an extreme event (modeled as combining a maximum river discharge, 390,000 cfs, with the maximum storm surge associated with a Hurricane Ike) would require building additional resiliency into the design. During the hypothetical extreme event, the Alternative 3N cap design would see scour up to 2.4 ft. To avoid this, USACE recommended additional thickness and diameter of armor stone (median size of at least 12 inches) on the cap. The USACE recommendations resulted in Remedial Alternative 3aN in the Final Interim FS prepared by EPA.

Summary of Current Cap

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. The identified areas represent a small portion of the cap (approximately 0.6%) and may be typical for cap construction projects that attempt to achieve a high degree of conformance with design, e.g. 95% or more conformance to design specifications. Once observed, the areas were addressed through the placement of additional cap or armoring material. If a very high degree of conformance to cap specifications is required at all locations, continued high spatial resolution monitoring of the type that identified the maintenance areas can be continued and used to trigger maintenance efforts. 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. An analysis of a hypothetical extreme event did suggest the potential for significant erosion

[2] Interstate Technology and Regulatory Council, Contaminated Sediments Remediation: Remedy Selection for Contaminated Sediments, Section 5.6.2, August 2014.

of the Alternative 3N cap, but the USACE then developed a more resilient design (Alternative 3aN) that it concluded could avoid that outcome should such an extreme event ever occur. It should be noted that both upland and in-water containment structures are rarely designed for such a low probability, extreme event although in particular situations, project managers may decide that the consequences of such a failure may encourage use of such an event for design.

Review of Proposed Remedial Alternatives

The Proposed Plan identifies Alternative 6N as EPA's preferred remedy. This alternative includes removal of waste materials exceeding 200 ng/kg, monitored natural recovery and institutional controls. This approach includes removal of the existing cap and use of best management practices and sheet piles or raised berms to manage resuspension and residuals due to dredging. According to the Final Interim FS, the Proposed Plan, and the USACE 2016 Report, there will be significant releases of waste material associated with this alternative, even with the use of enhanced best management practices.

I concur with this conclusion based on a review of the Proposed Plan and experience at other sites where removal operations have occurred (albeit removal operations that did not involve removing an engineered cap, as would be the case here, which might create even more significant releases). 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.[3]

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.

The use of BMPs is proposed to better manage releases but the success of such approaches are very site specific. Moreover, the releases and residuals from the Alternative 6N cannot be predicted with the precision implied by the USACE 2016 Report and they could potentially be much greater. As noted in the USACE 2016 Report, for example, potential releases and implementation issues will be exacerbated during storm events that will occur during the construction period. Events with even a modest return frequency (e.g., less than 2 years) might significantly increase resuspension and residuals. 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. The alternative is expected to require 19 months to implement according to the Final Interim FS and Proposed Plan prepared by EPA; however, this seems optimistic based on my experience at other sites.

[3] National Research Council (US). Committee on Sediment Dredging at Superfund Megasites. (2007). Sediment dredging at Superfund megasites: assessing the effectiveness. National Academies Press.

Alternative 3aN, the alternative mentioned above, 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 USACE 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 fully implement according to the Final Interim FS 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 USACE 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.

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 PTW). EPA considers material at the Site to be a 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 USACE 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.

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.

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. As a result, however, future extreme storm or flow events will likely require cap monitoring and maintenance under any scenario and alternative, just as monitoring and maintenance will likely be needed for upland disposal options that may be considered for placement of the dredged material under Alternative 6N.

Conclusion

I completed a review of the history of the design, construction and maintenance of the original cap and enhancements to it at the San Jacinto River Site, as well as the proposed further enhanced Alternative 3aN cap, which has been proposed to serve as the final remedy for the northern impoundments. The Alternative 3aN armored cap should be effective and protective on a long-term basis, as has been the case of numerous other caps installed in this country and worldwide. As with any remedy, post-construction monitoring should continue to be required to ensure that construction meets design performance.

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Danny D. Reible, PhD, PE

Memorandum
4611 102nd St
Lubbock, TX 79424

Date: June 17, 2014

From: Danny D. Reible, PhD, PE

To: *International Paper and McGinnes Industrial Maintenance Corporation*

Re: *San Jacinto River Site – Remedial Review of the Current Cap and Proposed Enhanced Cap*

At the request of International Paper Company (IP) and McGinnes Industrial Maintenance Corporation (MIMC), I have reviewed the following documents relative to the San Jacinto River Site (Site):

1. Anchor QEA, 2011. Final Removal Action Work Plan, Time Critical Removal Action, Prepared for USEPA, Region 6, on behalf of MIMC and IP. November 2010. Revised February 11, 2011.

2. Anchor QEA, 2012. Revised Draft Final Removal Action Completion Report. Prepared for USEPA, Region 6, on behalf of MIMC and IP. March 9, 2012.

3. Anchor QEA, 2012. Time Critical Removal Action Cap Inspection Notification Letter. Prepared for USEPA, Region 6, on behalf of MIMC and IP. July 23, 2012.

4. Anchor QEA, 2012. Post-TCRA Quarterly Inspection Report – July 2012 Inspection. Prepared for USEPA, Region 6, on behalf of MIMC and IP. August 21, 2012.

5. Anchor QEA, 2012. TCRA Maintenance Completion Report. Prepared for USEPA, Region 6, on behalf of MIMC and IP. August 27, 2012.

6. Anchor QEA, 2013. Armored Cap Enhancement Work Plan. Prepared for USEPA, Region 6, on behalf of MIMC and IP. November 27, 2013.

7. Anchor QEA, 2014. Draft Final Interim Feasibility Study Report. Prepared for USEPA, Region 6, on behalf of MIMC and IP. March 21, 2014.

8. Integral and Anchor QEA, 2013. Remedial Investigation Report. Prepared for USEPA, Region 6, on behalf of MIMC and IP. May 17, 2013.

9. USACE, 2013. Review of Design, Construction and Repair of TCRA Armoring for the West Berm of San Jacinto Waste Pits. Prepared for USEPA, Region 6. USACE Engineer Research and Development Center, 3909 Halls Ferry Road, Vicksburg, Mississippi, 39180-6199. October 2013.

Reviewer's Background and Experience

The basis for my review is approximately 30 years of experience with contaminated sediments and particularly management via in-situ remedial approaches. In 2005, I was elected to the National Academy of Engineering for "developing widely used approaches for managing contaminated sediments". Much of my work in contaminated sediments has been associated with the assessment, design and implementation of capping. I am a co-author of the standard guidance for capping contaminated sediments (Palermo et al. 1998) and in 2004 I led the first demonstration of amended or active capping in the field (Reible et al. 2006). I have coauthored several National Research Council reports that have guided the management of contaminated sediments including "A Risk Management Strategy for PCB-Contaminated Sediments" (2001),"Environmental Cleanup at Navy Facilities: Adaptive Site Management" (2003), "Assessing the Effectiveness of Dredging at Superfund Megasites" (2007). I also have peer reviewed many facets of capping projects, including at the design, construction and post-construction monitoring phases for government agencies and private parties.

Cap Design and Maintenance

The cap at the Site is armored to contain contaminated solids, a design that is appropriate for solid-associated contaminants. The permanence and protectiveness of such a cap is associated with its ability to withstand erosive forces and events.

The armored cap, completed in 2011, incorporates armor stone, geotextile and geomembrane layers over approximately 15.7 acres. It was designed in accordance with USACE guidance to withstand a 100-year storm event with an additional factor of safety to ensure its long-term effectiveness.

In July 2012, an inspection of the cap showed some movement of armor material as a result of the erosive action of a flow event. The reports on this event indicate that the area of the armor movement was limited to 200 square feet of the northern berm and represented approximately only 0.03 percent of the overall cap. Neither the underlying geotextile, nor the waste material underneath the armor layer was disturbed. In this case, the underlying waste material was not exposed due to the presence of geotextiles that would retain the waste, even if localized loss of armor stone were to occur.

The movement of the armor material during the event led to maintenance to restore appropriate cap slopes and armor material at the surface of the cap. Maintenance of a cap is sometimes required to address conditions in localized areas based on site-specific flow conditions that sometimes vary across specific areas of a constructed cap. In response to the armor rock movement, armor rock from an Armor Cap C stockpile (located in the vicinity of the Site as required by the EPA-approved Operations, Monitoring and Maintenance Plan for the cap) was placed in the area of the movement with no greater than a 1:2 slope to ensure stability of the repaired cap.

Cap Review

A review of the cap armoring design and the maintenance efforts was conducted in 2013 by Dr. Paul Schroeder of the USACE. Dr. Schroeder, of USACE's Engineer Research & Development Center, is one of the leading experts on in-situ caps and is one of the lead authors of the anticipated 2014 USACE update of the 1998 USACE Subaqueous Capping Guidance. Dr. Schroeder noted some concerns about the original design and construction that may have contributed to the partial loss of armor material in 2012, He noted the need for the design to consider wave runup and overtopping and the need to ensure appropriate uniformity and limited slope of the placed material. Dr. Schroeder recommended reducing slopes in areas potentially subject to runup and overtopping to no greater than 1:3 while ensuring uniformity of the placed Armor Cap C material.

The January 2014 Enhanced Armored Cap

Following completion of a post-construction engineering review conducted by IP and MIMC and in response to Dr. Schroeder's evaluation, the armored cap was enhanced in January 2014, utilizing larger-sized stones and flattening the grade of the slopes of the cap as follows:

- Placement of larger Armor Rock D. Armor Rock D has a D_{50} of 10 inches compared to a D_{50} of Armor Rock C of 6 inches and a uniformity coefficient of 1.55. Use of Armor Rock D satisfied Dr. Schroeder's concerns about uniformity and provided greater conservatism in the armor rock sizing.
- Ensuring all slopes post-construction will exhibit a slope no greater than 1:3. This satisfied Dr. Schroeder's concerns about slope in some areas which could be potentially subject to runup and overtopping.

These measures resulted in a cap that exceeds the design criteria in the USACE 1998 Subaqueous Capping Guidance. In addition, the enhanced cap exceeds the recommendations of Dr. Schroeder and will effectively ensure long-term stability of the armor stone. The modifications meet the original design criteria of cap stability in a 100 year storm and 500 year flood over the entire cap. In addition, the cap continues to include underlying geotextile and geomembrane layers as additional containment layers. The resulting enhanced armored cap is robust and is not expected to be subject to significant movement, thinning or loss as a result of hydraulic forces as noted above.

As part of my review of the existing and proposed cap enhancements, I also considered the question of potential chemical mobility of the capped dioxins and furans at the Site. Dioxins and furans are organic chemicals that are strongly solid-associated and largely immobile due to their chemical structures. Dioxins and furans have a strong affinity for materials with high organic content, which is the case with the pulp waste present at this Site. Once dioxins and furans sorb onto particulate matter or are bound in an organic phase, they exhibit little potential for leaching or volatilization. At this Site, the very low measured permeability of the pulp waste at the northern impoundments (in the range of 10-6 cm/sec to 10-7 cm/sec) and the design and construction of the armored cap effectively have effectively eliminated and will continue to effectively eliminate the potential release of dioxins associated with the waste materials in the northern impoundment. The groundwater sampling data from wells completed beneath the northern impoundments demonstrated that neither shallow alluvial nor deep groundwater resources have measureable concentrations of dioxins and furans, or other chemicals of potential concern. Results of the groundwater study confirmed that there is no pathway potentially leading to exposures to waste-related dioxins and furans from the area of the northern impoundments to shallow alluvial groundwater or deep groundwater.

In June 2012, I was asked to conduct porewater sampling at the Site of armored cap porewater and surface water. My investigation showed the dissolved surface water concentrations of 2,3,7,8-TCDD and 2,3,7,8-TCDF were below detectable levels in the sampling medium. In addition, there were no detectable concentrations of 2,3,7,8-TCDD or 2,3,7,8-TCDF in the porewater of the armored cap with the exception of one station out of 14 where 2,3,7,8-TCDF was detected, but could only be estimated because it was below the method reporting limit. Consistent with the general chemical properties of dioxins and furans, the capped pulp waste at this Site should not be considered mobile. As such, the existing cap should be effective on a long-term basis, and the proposed Alternative 3N cap will provide even greater protectiveness.

Review of Proposed Alternative 3N

As part of my peer review, I also examined Alternative 3N, which I understand has been proposed by IP and MIMC. Alternative 3N would further strengthen the existing armored cap beyond the substantial enhancements completed in January 2014, by adding more armoring, flattening the slopes and implementing additional measures to provide protection against potential issues (groundings) from vessel traffic. These additional measures should serve to provide an even more robust cap and will improve the long term effectiveness of the cap beyond that of the already protective armored cap as strengthened and enhanced in January 2014.

Conclusion

I completed a review of the history of the design, construction and maintenance of the original cap and enhancements to it at the San Jacinto River site, as well as the proposed further enhanced Alternative 3N cap, which has been proposed to serve as the final remedy for the northern area of the Site. As noted above, I find that the current enhanced armored cap exceeds USACE Subaqueous Cap Guidance (1998) and supplemental comments by Dr. Schroeder and that the proposed Alternative 3N is even more robust and protective than the existing armored cap. The armored cap should be effective and protective on a long-term basis, as has been the case of numerous other caps installed in this country and worldwide. As with any remedy, post-construction monitoring should continue to be required to ensure that construction meets design performance.