UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

Reply to
Attn of: ECL-110

MEMORANDUM

From: Sean Sheldrake, Remedial Project Manager

Thru: Lori Houck-Cora, Assistant Regional Counsel
Deb Yamamoto, Manager
Site Cleanup Unit #2

To: Daniel D. Opalski, Director
Office of Environmental Cleanup
USEPA Region 10

Date: April 16, 2008

Subject: Arkema EE/CA Workplan Dispute

This memo responds to the questions posed in your April 7, 2008 e-mail to Deb Yamamoto and Doug Loutzenhiser, Legacy Site Services (LSS) from your review of dispute statements and supporting documentation provided by both parties for the Arkema EE/CA Workplan. In addition, a summary of the discourse between EPA and LSS concerning lindane as a Chemical of Interest (COI) is presented at the end of this memo.

Confined Disposal Facility Questions

1. In terms of what we know now about site conditions (e.g. physical environment, waste characteristics including contaminant profile), how does the Arkema site compare to other sites regionally and nationally where CDFs have been employed?

A search for confined disposal facilities (CDFs) constructed at EPA managed sediment cleanups identified four sites; however, none have similar site conditions to the Arkema site or are comparable to Arkema's proposal. The major site conditions for Arkema's proposal is DDx Principal Threat Material (PTM) placed in a freshwater river environment. Another relevant site circumstance is that this action is a removal action.

Waukegan Harbor/Outboard Marine Corp. (Region 5)

The Waukegan Harbor site is located on Lake Michigan north of Chicago. This sediment remedial action is the closest match to the Arkema site conditions since it included a CDF containing principal threat material (PTM, in this case PCB), and is located in a freshwater setting. However, this is a final remedy selected and implemented under a ROD. An amendment to the 1984 ROD allowed for a boat slip (Boat Slip #3) to be sealed off with a sheet pile/slurry wall. A low permeability cap was placed at the surface of the CDF. Two upland disposal cells were also constructed to contain more highly contaminated sediments. The Boat Slip #3 CDF contains approximately 30,000 cubic yards of sediment. PTM (PCB at less than 500 milligrams per kilogram [mg/kg]) was allowed for placement in the CDF during a sediment cleanup that was completed in the early 1990's. Discussion with EPA's Remedial Project Manager (RPM) indicated that quantitative monitoring is not performed on the CDF because water is pumped from the CDF to maintain an inward hydraulic gradient monitored using piezometers. The RPM stated that very little water is generated as the slurry wall and cap minimize infiltration into the CDF. The extracted water is treated using granular activated carbon (GAC). The CDF cover is also monitored for integrity (i.e., no burrowing animals, etc.).

RPM: Kevin Adler [312-886-7078]

http://www.epa.gov/R5Super/npl/illinois/ILD000802827.htm

Alcoa (Point Comfort)/Lavaca Bay Site (Region 6)

Lavaca Bay is located on the Gulf of Mexico about 80 miles northeast of Corpus Christi, Texas. This sediment cleanup was performed in a marine estuary as part of a non-time critical removal action conducted between 1998 and 2001. The CDF was constructed on a dredge disposal island located in the middle of Lavaca Bay. A total of approximately 400,000 cubic yards of "soils" were relocated and contained into the CDF consisting of armored containment dikes designed to withstand a hurricane. "Soils" containing mercury (chemical of concern) concentrations greater than 0.7 mg/kg were placed in the CDF. No pre-treatment was necessary because of the relatively low concentrations of mercury. Mercury concentrations were as high as 30 mg/kg, but the typical concentration was 1-2 mg/kg. Groundwater monitoring on the dredge disposal island showed that there is no pathway for significant loadings of mercury in groundwater migrating to Lavaca Bay. Performance monitoring consists of visual inspections of the cap. Site conditions that differ at Lavaca Bay from the Arkema site include a offshore marine environment, different contaminant of concern (low-level mercury), performance of the work through the remedial process, and a CDF that is part of a larger dredge island measuring approximately ½-mile by 1 mile.

RPM: Gary Baumgarten [214-665-6749]

http://www.epa.gov/region6/6sf/pdffiles/alcoa_lavaca_final_rod.pdf

Hylebos Waterway (Region 10)

About 35,000 cubic yards of highly contaminated sediments at the Occidental Chemical facility were hydraulically dredged and treated on-site as part of a final remedial action performed in 2002/2003. The treatment process consisted of heating the sediment to 40 to 50 degrees centigrade to facilitate volatile organic compound (VOC) mass removal. The sediment underwent treatment prior to being placed in a CDF constructed in the Port of Tacoma's Blair Slip #1. The sediment was placed at the hydraulically upgradient end of the CDF. PCB and metals-impacted sediment from other areas cleaned up in the Hylebos fill the balance of the CDF. Sediment placement combined with the long groundwater flow path and low hydraulic conductivity of the sediment are believed to effectively isolate the material from the Blair Waterway. A groundwater monitoring system is planned for the CDF to check performance; however, the system is yet to be installed. Site conditions that differ at Blair Waterway from the Arkema site include a marine environment, off-channel location, performance of the work through the remedial process, and different contaminants of concern (treated VOCs and untreated PCB/metals-impacted sediment).

RPM: Jonathan Williams [206-553-1369]

http://yosemite.epa.gov/R10/CLEANUP.NSF/webpage/Hylebos+Waterway

Wyckoff-Eagle Harbor (Region 10)

The West Harbor Operable Unit 3 portion of this Superfund site included a CDF constructed in 1997 under a ROD amended in 1995. The CDF was used to contain “hot-spot” metals-contaminated (mercury, zinc, copper) marine sediments dredged from Eagle Harbor. A parking lot was constructed over the CDF. Per the EPA RPM, no pre-treatment was performed on the sediment characterized as PTM. CDM additionally contacted Rob Zisette with Herrera Environmental (consultant to the property owner) to further discuss the CDF. The CDF design was based on mercury concentrations. The typical mercury concentration in sediment that was placed in the CDF was between 5 and 10 mg/kg; however some sediment with a concentration greater than 10 mg/kg was placed in the CDF. Sediment from a mercury hot spot (around 30 mg/kg) was transported off site for landfill disposal. Discussions with the EPA RPM indicated the CDF is designed to remain saturated and anaerobic, and piezometers are utilized to monitor water levels. Seep monitoring at a tidal barrier constructed between the CDF and Eagle Harbor identified unacceptable concentrations of zinc and copper after construction of the CDF. The construction of an additional tidal barrier in 2006 has successfully isolated the upland contamination from Eagle Harbor. Site conditions that differ at the Wyckoff-Eagle Harbor from the Arkema site include a marine environment, “upland” location (paved parking area), performance of the work through the remedial rather than removal process, and different contaminant (mercury).

RPM: Mary Jane Nearman [206-553-6642]

http://yosemite.epa.gov/r10/CLEANUP.NSF/sites/Wyckoff/$FILE/Wyckoff-West-Harbor-fs.pdf

New Bedford Harbor (Region 1)

No permanent CDF has been constructed at this Superfund site; however, several are proposed. Maine sediments at New Bedford Harbor in Region 1 are highly contaminated with PCBs. As initial response, a 5-acre hot spot was dredged to remove 14,000 cubic yards of sediment, with the dredged sediments temporarily stored in a CDF. Seawater removed from the sediments was treated on site, and solidification and chemical destruction of sediments were tested. Incineration of these sediments was proposed but later eliminated due to community objections. These sediments were subsequently disposed of in an off-site landfill as the final component for the hot spot remediation. To address areas of lesser contamination, four CDFs were proposed. The largest of the four CDFs was designed but later eliminated through a ROD modification in 2002, and the RPM suspects the other three CDFs will be eliminated in the future as well. The CDFs at this location are not cost effective due to geotechnical/structural issues, and landfill disposal appears to be the most cost effective means to deal with PTM from this site.

RPM: Dave Dickerson [617-918-1329]

http://www.epa.gov/NE/nbh/history.html

http://www.epa.gov/ne/pr/2002/aug/020817.html

US Army Corps of Engineers operated CDFs

Many existing CDFs are operated by the U.S. Army Corps of Engineers (USACE). A USACE/EPA document describing the 45 CDFs used in the Great Lakes Region to manage "contaminated" sediments dredged from harbors and channels states that over 90 million cubic yards of contaminated sediments have been removed from Federal channels over the last 40 years and placed in CDFs. The report also states that CDFs retain greater that 99.9% of the contaminants they receive with dredged materials; however, this statement appears to be based on an estimate of suspended solids retention. An example USACE project is the Pointe Mouillee CDF in Lake Erie at the mouth of the Huron River near Rockwood, Michigan. This CDF is described as a 700-acre crescent-shaped dike constructed to contain 18 million cubic yards of contaminated dredge material from the Detroit and Rouge Rivers. Water quality monitoring of dredge discharge occurs during disposal operations at "weir overflow, mixing zone, and open water site". An example sediment cleanup which utilized the Pointe Mouillee CDF is the Black Lagoon site located in the Trenton Channel of the Detroit River. Chemicals of concern in sediment included PCBs, lead, mercury, zinc, oil and grease. The 115,000 cubic yards of contaminated sediments removed during the 2004 cleanup underwent solidification prior to placement in the Pointe Mouillee CDF. Another USACE site, the Big Sunflower River Maintenance Project, proposes using "confined disposal areas" to manage low-level DDx-contaminated sediment (<0.2 mg/kg) dredged during flood mitigation channel maintenance in the Big Sunflower River Basin in northwest Mississippi.

http://www.lrd.usace.army.mil/navigation/glnavigation/cdf/

http://www.epa.gov/greatlakes/sediment/legacy/blklagoon/index.html

http://www.lre.usace.army.mil/ETSpubs/HFS/CDFs/Detroit%20River%20Pointe%20Mouille_CDF.pdf

http://www.mvk.usace.army.mil/offices/pp/projects/big_sunflower_maint/index.htm

In conclusion, there are no entirely comparable CDFs that have been constructed with DDx PTM material, on a river, through a removal action process in the country to date.

2. According to the record, Arkema/LSS has agreed to evaluate pre-treatment of the contaminated sediments, if required, in the context of a CDF evaluation. Given what we know about the waste characteristics at the Arkema site, what do we know now or at least can we reasonably presume about viable treatment options, including their likely costs?

EPA's contractor, CDM, performed a technical evaluation and screening-level cost estimate to the respond to this question. This information is presented in the attached technical memo dated April 14, 2008. The purpose of this evaluation is to determine viable treatment options and associated costs for DDx-contaminated sediment removal. The most viable treatment option for Arkema sediment is thermal desorption. The screening level cost estimate is $23 million, which equates to $204 per cubic yard for the 112,500 cubic yards assumed to comprise the Arkema removal action.

It should also be noted that this cost estimate does not include the substantial expense to manage sediments from the Arkema site prior to placement in a CDF. Treatment logistics would likely require long term use of a substantial portion of the Arkema upland to dewater, stage, and treat the contaminated sediment. Additional space would also be required to stage treated sediment so that batch analytical verification could occur prior to material placement into a CDF.

Additionally, based on qualitative information obtained from the RPM for the Occidental site, treatment costs for the Blair Slip #1 CDF are approximately $450/ton based on a $10.5 million dollar cost for the 35,000 cubic yards treated.

3. Where CDFs have been employed at Superfund sites or under similar conditions, has pre-treatment of the waste material been required prior to disposal in the CDF? Examples?

While there are no constructed CDFs fully comparable to the Arkema site (high level DDx-contaminated sediment in a river) sediments at two CDF sites discussed above (Waukegan Harbor and Hylebos Waterway) required pre-treatment.

Waukegan Harbor/Outboard Marine Corp. (Region 5)

Sediment containing less than 500 mg/kg PCB was allowed in the CDF. Sediment containing grater than 500 mg/kg PCB was treated by low temperature thermal technology to recover PCB oil. The two upland disposal cells accepted higher concentrations of PCBs; however, sediment greater that 5,000 mg/kg PCBs was thermally treated before being placed in the upland cells.

Hylebos Waterway (Region 10)

The portion of the sediment in the Blair Slip #1 CDF that was dredged from the Occidental Chemical site was highly contaminated with volatile and semi-volatile organic compounds. The treatment process consisted of heating the sediment to 40 to 50 degrees centigrade to facilitate VOC mass removal. The desorbed VOCs were treated using GAC. Discussions with the EPA RPM indicate that sediment with VOC concentrations in the ppm to percent concentrations underwent treatment prior to being placed in the CDF.

4. How much time does LSS believe it would need to perform the CDF-related evaluations described in the SOW? How much additional time would EPA estimate that the government team would need to review submittals that included a CDF-related evaluation relative to submittals that did not?

EPA has no information from LSS concerning time needed to perform CDF-related evaluations. The alternatives analysis and selection process of the Arkema CDF would likely take two or more years to complete. The engineering studies and concept development, including data collection activities, would likely take a year or more to complete, assuming Terminal 4 CDF performance standards are used, and not disputed. These activities would at least consist of treatability studies, pilot testing, floodway analysis, and 404(b)(1) siting analysis. Reviewing the concept design and holding public outreach sessions and a public comment period, and providing a response to public comment, could take 6 months, which is optimistic. If public comments do not require additional studies, the design documents could be prepared and reviewed in approximately a year. In sum, the timeframe for an Arkema CDF is 3½ to 4 years which is about 2 years longer than other disposal options will require.

It is reasonable to expect that the performance standards for the proposed T-4 CDF will also apply to an Arkema CDF. The estimated three to four year timeframe for evaluation and design at Arkema is supported by EPA's experience with T-4. The preliminary design process for T-4 showed that the biodegradation rates for DDT can not be confidently modeled and seismic issues are of major concern. The T-4 experience leads one to conclude that the significant time for an Arkema CDF analysis, and studies and the amount of time to design and construct the CDF is far more than landfill disposal.

While evaluation, design, and implementation of an Arkema CDF will undoubtedly delay an important "hot spot" removal, it should be noted that disposal alternatives, including a CDF for non-early action Arkema wastes will be part of the Feasibility Study for the Portland Harbor site-wide ROD. The analysis of all proposed CDF locations, particularly any CDF location in the main channel of the Willamette River needs to be undertaken on a site-wide basis. This analysis will be performed in conjunction with all dredging and capping being analyzed in order to perform a comprehensive floodway analysis for the impacts of the site-wide cleanup.

Lindane Issue Review

LSS has objected to the inclusion of lindane (gamma-hexachlorocyclohexane) as a COI for the Arkema removal action. In its workplan (EPA, May 2007), EPA identified lindane as (a) one of several chemicals that exceeded conservative screening criteria and therefore might be a COI for identifying PTM, and (b) might be important for assessing the potential for recontamination of the removal site following completion of the removal action. This identification was based on two factors. First, lindane is frequently detected in sediments adjacent to the Arkema property. Second, lindane concentrations often exceed a conservative screen level values (SLV), in this case a probable effect concentration (PEC) for protection of ecological receptors (EPA, May 2007, Table 5-3a). Frequent detection and relatively high concentrations suggest that lindane could be important when considering both how to identify PTM and how to protect the removal area from subsequent contamination from surrounding sediments.

In its comments on the EPA work plan (LSS, July 2007), LSS objected to the inclusion of lindane as a COI because it believes that lindane was never used at the Arkema facility, is therefore not related to releases from the Arkema site, and because it feels that EPA changed its evaluation criterion when assessing lindane.

"The discussion of lindane focuses on screening level values that exceed 10X SLV. Why has risk scaling been modified in this instance from the previously adopted benchmark of 1000X SLV?" Solution- LSS requests that Lindane be deleted as a COI. LSS reviewed the data and found that Lindane should be deleted as a COI." (LSS Comment #32, A Comment Set, July 2007)

Thus, LSS feels that lindane should not be considered in the design or evaluation of the removal action.

EPA's response to this assertion is two-fold: CERCLA is based on joint and several liability and Arkema releases have clearly contaminated sediments adjacent to the site, even if these releases did not include substantial quantities of lindane. Thus, by identifying lindane as an indicator chemical, EPA is not challenging the LSS assertion that lindane was not used at the Arkema facility, but is proposing that lindane, present in the sediments around the facility could be an indicator chemical, one measure of the success of the removal action. Perhaps more importantly, the removal action needs to be protective regardless of the source of sediment contaminants.

EPA did determine in its workplan that the removal action area could be defined solely on the basis of DDx, because DDT and its degradation products suggest a removal footprint as large or larger than footprints suggested when considering other sediment contaminants. That is, the work plan considered DDx as the best indicator of PTM, but did not dismiss other contaminants as COI. The use of DDx as the sole basis for defining removal action area (RAA) did eliminate the need to consider other COI for this purpose. However, the criteria used for identifying chemicals of concern for preliminary evaluation of recontamination potential focused on both exceedances of 100 times a conservative SLV based on bioaccumulation, and on exceedances of PEC. PECs are criteria that indicate thresholds above which significant toxic effects on some ecological receptors are likely to occur more often than not. Since lindane was not screened out based on PEC (about 47 percent of lindane concentrations exceed its PEC and a number of concentrations exceed 10 x PEC, Work Plan, Table 5-3a), it could be an important COI for evaluation of recontamination.

Surface sediment concentrations of lindane follow a pattern similar to that for PCBs, except that an additional area with high concentrations greater than PEC and 10x PEC occur at Outfall 002. However, concentrations that exceed PEC are widespread along the shoreline and may extend into the navigation channel. The cross-river extent is again somewhat difficult to determine because of lack of data. Relatively high concentrations found upstream of the Salt Dock may represent the most important source for recontamination, if this area is not included in the RAA. Concentrations of lindane greater than PEC and 10× PEC are found in sediments in the 1- to 4-feet below ground surface (bgs) interval from the Salt Dock to the upstream boundary of Lot 1, with some extension into the navigation channel. The extent of contamination in the channel is again difficult to determine because of lack of data. Upstream of the Salt Dock, the data set is limited, and sediments have a potential to contain lindane concentrations that exceed 100× PEC. These sediments could represent a source of recontamination from either ongoing releases and/or dredging operations, depending on the stability of sediments below 1 foot bgs. Concentrations of lindane greater than PEC appear to be limited to small areas downstream of the Salt Dock and between Docks 1 and 2 within the 4- to 8-foot depth interval. These areas are within the likely RAA. The recontamination potential for sediments in this depth interval appears low. In the deepest sediments, lindane concentrations at or above PEC are limited to areas along the shoreline from Outfall 001 to Outfall 002. Contamination could extend into the navigation channel from the Salt Dock, but data are too sparse to draw any useful conclusions. Recontamination potential for sediments below 8 feet bgs appears to be low. Levels of lindane in riverbank soils appear to be low relative to PEC. These soils also do not appear to be a significant source for recontamination by lindane.

Nevertheless, LSS (February 19, 2008 dispute position) continues to indicate that any mention or use of lindane as a COI for any purpose in the context of the removal action is inappropriate. EPA however maintains that lindane, along with several other contaminants, needs to be considered for the evaluation of recontamination (EPA March 25, 2008 dispute position).

References

EPA, 2007, *Arkema Early Action EE/CA Work Plan*, May 11, 2007.

LSS, 2007, Attachment to July 13, 2007 Letter, Legacy Site Services Comments on the Draft Arkema Early Action EE/CA Work Plan Prepared by Parametrix for US EPA, July 13, 2007.

Cc: Lori Houck-Cora, EPA *via email only*
Claudia Powers, Ater-Wynne
Doug Loutzenheiser, LSS

Attachment – Technical Memorandum

To: *Sean Sheldrake, USEPA Region 10*

From: *Lance Peterson, R.G., Project Manager*
Bo Moreland
Gary Hazen

Date: *April 14, 2008*

Subject: *Technical Evaluation and Screening Level Cost Estimate for Treatment of Arkema Sediment*

This technical evaluation and attached screening-level cost estimate was prepared as backup to the response to Question #2 posed by Dan Opalski in an April 7, 2008 e-mail to Deb Yamamoto (EPA) and Doug Loutzenhiser (Legacy Site Services). The purpose of this evaluation is to determine viable treatment options and associated costs for DDx-contaminated sediment removed as part of the Early Action from the Willamette River at the Arkema portion of the Portland Harbor Superfund Site.

The first step of the technical evaluation was to determine the treatment standards required for DDx-contamination by the treatment technology prior to placement of the treated sediments in a confined disposal facility (CDF). CDM performed review of potential chemical-specific ARARs regarding land disposal of the DDx-contaminated sediments. Based on the review, the potential treatment standards for land disposal of the sediments are codified in 40 CFR 268.40 "Treatment Standards for Hazardous Wastes". The treatment standards provided in the citation for DDx constituents (DDT, DDD, and DDE) in sediments are each 0.087 milligrams per kilogram (mg/kg).

The second step of the technical evaluation was to determine potentially viable treatment options for DDx-contaminated sediments. CDM consulted EPA guidance during this step of the evaluation, specifically EPA-823-B23-001, "*Selecting Remediation Techniques For Contaminated Sediment*" (EPA 1993) and EPA EPA-540-R-05-012, "*Contaminated Sediment Remediation Guidance for Hazardous Waste Sites*" (EPA 2005). According to Tables 3-1, 3-2, and 3-3 of EPA-823-B23-001, there are seven treatment options for contaminated sediment: biological, dechlorination, soil washing, solvent extraction, solidification/stabilization, incineration and thermal desorption.

To determine which technologies are suitable options for contaminated sediments from the Arkema site, Tables 3-1 through 3-3 were then used to conduct an initial screening of technologies based on parameter such as the contaminant type (halogenated semivolatile compounds), and specific soil parameters and their effects (such as grain size, moisture content, pH, etc). Each of the identified treatment techniques varies in effectiveness in treating differing contaminant and soil types, and not all are applicable for removing DDx constituents. The biological, dechlorination, soil washing and solvent extraction treatment technologies are not well suited to quickly treat sediments contaminated with DDx constituents (EPA 2005). Solidification/stabilization would have good performance for immobilizing DDx constituents within contaminated sediment, but would not reduce the concentrations of DDx constituents below the required 0.087 mg/kg. Thus, this treatment technique was excluded.

The remaining treatment technologies applicable to DDx contamination in sediments is incineration and thermal desorption. Although incineration is a very effective technology, it operates at a higher temperature and uses more energy than thermal desorption, generally is a more complex system than a thermal desorption system, and usually has a higher unit cost to operate. Thus, thermal desorption was selected as the treatment technology providing the best balance of effectiveness, implementability, and cost.

Thermal desorption has two distinct process types, high temperature thermal desorption (HTTD) and low temperature thermal desorption (LTTD). HTTD works at temperatures of 600 ºF to 1000 ºF while LTTD works between 200 ºF to 600 ºF (Van Deuren, Lloyd, Chhetry, Liou, & Peck, 2002).

There are two common designs that are used for the desorption process: rotary drier and thermal screw. Rotary driers are horizontal, (though slightly inclined), and rotated. This type can be used with either direct fire or indirect fire. Thermal screw units utilized hollow augers or screw conveyors to move the medium into a trough. Steam is used to heat the auger to separate the contaminant from the medium (Van Deuren et al., 2002). The process works by heating wastes to their volatilization point, effectively separating the contaminant from the medium. The left over water and contaminant are then sent, via carrier gas or vacuum, to a treatment system. There are usually up to six process residual streams that result from this process: treated media, oversized media rejects, condensed contaminants and water, emission gas dust, clean off gas, and spent carbon. The off-gas will then require treatment to remove the contaminant and particulates before it is considered clean. The particulates can be removed by standard wet-scrubbers or cloth filters, while the contaminant can be removed by condensation and carbon adsorption. A secondary combustion chamber or catalytic oxidizer can also remove the contaminant (Van Deuren et al., 2002).

Three types of thermal desorption are available and briefly described as following:

1. <u>Direct Fired:</u> Fire is applied directly upon the surface of contaminated media. The main purpose of the fire is to desorb contaminants from the soil though some contaminants may be thermally oxidized.
2. <u>Indirect Fired:</u> An indirect-fired rotary dryer heats an air stream which, by direct contact, desorbs water and organic contaminants from the soil. The Low Temperature Thermal Aeration (LTTA®) developed by Canonie Environmental Services Corporation is a good example of indirect fired system which has been successfully used to remove DDT family compounds from soil.
3. <u>Indirect Heated:</u> An externally fired rotary dryer volatilizes the water and organics from the contaminated media into an inert carrier gas stream. The carrier gas is later treated to remove or recover the contaminants (Van Deuren et al., 2002)

Factors that may limit the applicability and effectiveness of the process include:

- There are specific particle size and materials handling requirements that can impact applicability or cost at specific sites.
- Dewatering would likely be necessary to achieve acceptable soil moisture content levels (<60%). High moisture content will require more energy to complete the process.
- Highly abrasive feed potentially can damage the processor unit.
- Clay and silty soils and high humic content soils increase reaction time as a result of binding of contaminants. (Van Deuren et al., 2002)

A screening level cost estimate for treatment of contaminated sediment using thermal desorption is attachment to this memorandum. Additional cost factors include:

- Dewatering and soil prep/handling.
- Intensive startup and monitoring to ensure effective treatment of the waste and potential by-products.

- Mobilization and de-mobilization of all system equipment and personnel.(Van Deuren et al., 2002)

References

USEPA. (1993). *Selecting Remediation Techniques for Contaminated Sediment*, No. EPA-823-B23-001.

USEPA. (2005). *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites*, No. EPA-540-R-05-012, USEPA.

Van Deuren, J., Lloyd, T., Chhetry, S., Liou, R. & Peck, J. (2002). *Remediation Technologies Screening Matrix and Reference Guide*. Retrieved 04/2008, 2008 from http://www.frtr.gov/matrix2/section4/4-26.html

USEPA. *Treatment Standards for Hazardous Wastes, 40 CFR 268. 40 (1996).*

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TABLE CS-PH-TD

Treatment of Sediment from Willamette River using Thermal Desorption **COST ESTIMATE SUMMARY**

Portland Harbor, Arkema Site

Site:	Portland Harbor, Arkema Site	**Description**	This cost estimate was prepared for EPA Region 10 to provide a concept level cost summary of the thermal desorption component that could be expected during remediation of the Arkema site portion of the Portland Harbor Superfund Site. This cost estimate was prepared using methodology presented in "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000 (EPA 540-R-00-002). Cost sources used for this estimate include costs from projects of similar scope. This cost estimate is classified as Class 4 using AACEI Recommended Practice No. 18R-97 using specific analogy techniques for the major remediation component. The expected accuracy range for this class of estimate is +50%/-30%. Limited scope and quantity data were available for estimate preparation.
Location:	Multnomah County, Portland, Oregon		
Phase:	Engineering Evaluation/Cost Analysis		
AACEI Estimate Class:	Class 4		
Base Year:	2008		
Date:	April 14, 2008		

POTENTIAL COSTS FOR MAJOR WORK COMPONENTS:

DESCRIPTION	QTY	UNITS	UNIT COST	TOTAL	NOTES
Sediment Pre-Treatment using Thermal Desorption	129,375	LCY	$101	$13,066,875	Assumes treatment of sediment above containing DDx concentrations above TS (112,500 bcy with a 15% swell factor)- unit cost from the FRTR database
SUBTOTAL				$13,066,875	
Contingency (Scope and Bid)	40%			$5,226,750	Assumes 25% scope contingency for onsite thermal treatment and 15% bid contingency (mid-range of recommended values used)
SUBTOTAL				$18,293,625	
Project Management	5%			$914,681	Percentage from Exhibit 5-8 was used.
Remedial Design	6%			$1,097,618	Percentage from Exhibit 5-8 was used.
Construction Management	6%			$1,097,618	Percentage from Exhibit 5-8 was used.
Technical Support	10%			$1,829,363	Low value of the recommended range was used.
TOTAL				$23,232,905	
TOTAL CAPITAL COST				**$23,000,000**	Total cost is rounded to the nearest $1,000,000.

Notes:
Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.

Abbreviations:

BCY	Bank Cubic Yards
LCY	Loose Cubic Yards
QTY	Quantity
LS	Lump Sum

TS	Treatment Standards
FRTR	Federal Remediation Technologies Roundtable