UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

March 1999

To All Interested Parties:

The U.S. Environmental Protection Agency (EPA) is pleased to release the *Evaluation of Removal Action Alternatives, Thompson Island Pool, Early Action Assessment* (Early Action report) for the Hudson River PCBs Superfund Site. This report presents alternatives which were evaluated for potential early action in the Thompson Island Pool.

In July of 1998, EPA issued the *Low Resolution Sediment Coring Report* (LRC). One of the most significant conclusions in this report was that "From 1984 to 1994, there had been a net loss of approximately 40 percent of the PCB inventory from highly contaminated sediments in the Thompson Island Pool." This means that the Thompson Island Pool lost PCB mass to locations within the Thompson Island Pool and to other locations in the Hudson River. On July, 23, 1998, EPA issued a statement regarding the conclusions in the LRC and indicating that the Agency would consider taking early action in the Hudson River to mitigate any further migration of PCBs throughout the river.

To that end, EPA tasked TAMS Consultants, an EPA contractor, to perform an evaluation of possible early action alternatives for the Thompson Island Pool. This evaluation explored different possible interim actions to address PCB-contaminated sediments in the Thompson Island Pool. The principal technologies considered were dredging, capping, and a combination of dredging and capping.

On December 17, 1998, EPA issued a press release stating that the Agency was not able to identify a feasible and appropriate interim action. EPA will continue to focus its full attention and resources on completing the ongoing Hudson River PCBs Reassessment so that a Proposed Plan can be presented to the public by December 2000.

If you need additional information regarding the Early Action report, please contact Ann Rychlenski, the Community Relations Coordinator for this site, at 212-637-3672.

Sincerely yours,

Richard L. Caspe, Director
Emergency and Remedial Response Division

HUDSON RIVER PCBs REASSESSMENT RI/FS

EVALUATION OF REMOVAL ACTION ALTERNATIVES
THOMPSON ISLAND POOL
EARLY ACTION ASSESSMENT

March 1999

For

U.S. Environmental Protection Agency
Region II

and

U.S. Army Corps of Engineers
Kansas City District

TAMS CONSULTANTS, Inc.

HUDSON RIVER PCBS REASSESSMENT RI/FS
EVALUATION OF REMOVAL ACTION ALTERNATIVES
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CONTENTS

FIGURES

403143

CONTENTS (CONTINUED)

TABLES

DRAWINGS

403144

1. BACKGROUND AND PURPOSE

In August 1998, the US Environmental Protection Agency (USEPA) directed that an investigation be undertaken immediately of the feasibility and cost of early action to forestall further loss of PCB mass in the Thompson Island Pool (TIP). This directive was prompted by the finding of the Low Resolution Sediment Coring Report (USEPA, 1998) that the inventory of PCBs in the sediments of the TIP may have decreased by as much as 40 percent since 1984 through erosion or other non-degradative forces. In response to this directive, representatives of USEPA, the US Army Corps of Engineers (USACE) and TAMS Consultants, Inc. (TAMS) in a meeting on August 10, 1998 established the alternatives for such early action based on preliminary technology and alternatives screening previously performed for the Reassessment Phase 3 Feasibility Study. The screening process conducted for the purposes of this evaluation is documented in Table 1-1. At the August 10 meeting among USEPA, USACE and TAMS, the following alternatives were agreed upon for further evaluation:

- Excavation/dredging of selected sediments and off-site disposal of spoils;
- Capping of selected sediments; and
- Combined excavation/dredging and capping.

The objective of this report is to provide USEPA with supporting documentation which will assist the Agency in making an informed decision regarding early action to address sediments in the TIP. The work documented herein should not be considered a recommendation by TAMS or its subcontractors either for early action or for No Action. While the information developed may be incorporated into the final Reassessment Phase 3 Feasibility Study, this evaluation is not intended as a substitute for the Feasibility Study effort.

The purpose of this evaluation is to assess the feasibility and cost of dredging and capping alternatives at a preliminary conceptual level against a No Action alternative for reducing the ultimate loss of PCB mass downstream. In the interests of addressing the directive in an expeditious manner, methods have been selected for conceptual and cost estimating purposes which are believed to be technically feasible and environmentally acceptable, with consideration of community constraints. It has not been determined that the methods described represent the optimum approach for dredging or capping of the sediments. Additional work would be necessary to advance development of the alternatives presented in order to prepare a refined cost estimate or to serve as a basis for detailed planning for the purposes of early action.

In order to address the entire TIP, it is necessary to target and categorize specific sediment areas, and calculate the individual inventories and sediment volumes involved in those individual areas. However, there is more confidence in the reported PCB inventory of the entire TIP than for any individually designated zone of sediment. Therefore, confidence in the cost estimate and outcome for the whole is greater than confidence in the category, cost or outcome for any individual area. Implementation of an early action may require additional investigation to reduce uncertainty where there are few sediment samples to define the PCB inventory.

403145

The Data Evaluation and Interpretation Report (or DEIR, USEPA, 1997a) reports the continuing transport of PCB mass over the Thompson Island Dam, originating from the sediment. Therefore, as an alternative to sediment removal and capping, consideration is given to the feasibility of treatment of the water flow over the Thompson Island Dam to reduce the PCB transport to downstream areas.

Specific tasks included in the scope of work for this evaluation include:

- Combine side-scan sonar mapping, bathymetry, and low resolution sediment data from USEPA's Phase 2 investigations (USEPA, et al., 1997a and 1998) with General Electric Company's (GE) 1996 to 1997 Thompson Island Pool Studies (O'Brien & Gere, February 1998) into GIS maps for the TIP and determine areas and volumes for consideration in coordination with USEPA and USACE.

- Prepare cost estimates of the two alternatives selected for further evaluation, in coordination with USACE.

- Develop a comparison table which summarizes the evaluation factors for the alternatives. The evaluation will consider the criteria pertinent to a Superfund removal action.

- Predict the temporary impacts to fish during the action in relation to current levels of PCBs in fish in the TIP, based on the estimated short-term increase in PCB loading due to implementation of the alternatives.

- Determine ecological impacts of the alternatives.

- Prepare a parametric cost analysis of treating the water flow over the Thompson Island Dam to remove PCBs to the Maximum Contaminant Level (MCL), as an alternative to sediment removal.

Each of these scope items is addressed in sequence in the chapters below. Chapter 3 combines the cost estimate and comparison of the removal alternatives, while other items are presented individually in separate chapters. Figures, tables and other supporting information for each scope item are provided immediately following the text of each chapter. Drawings are presented separately at the back of the report.

403146

TABLE 1-1
HUDSON RIVER PCBs -THOMPSON ISLAND POOL EARLY ACTION ASSESSMENT
PRELIMINARY TECHNOLOGY SCREENING

GENERAL RESPONSE	REMEDIAL TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	SUPPORTING REFERENCE
NO ACTION	NONE	NONE	No institutional or remedial actions. Does not meet remedial action objectives.	Easily implemented.	---	---
INSTITUTIONAL ACTIONS	MONITORING	WATER COLUMN SAMPLING	Monitors PCB trends in water column - shows flux from sediment and sources. Does not meet remedial action objectives.	Easily implemented. May be implemented with other remedial action(s).	Low capital; moderate O&M.	
		SEDIMENT CORING	Monitors depositional trends over time. Does not meet remedial action objectives.	Easily implemented, May be implemented with other remedial action(s).	Low capital; moderate O&M.	---
		FISH SAMPLING	Monitors acceptability of resident and transient fish populations for human consumption. Does not meet remedial action objectives.	Easily implemented. May be implemented with other remedial action(s).	Low capital; moderate O&M.	---
		BIOTA SAMPLING	Monitors health of biotic communities with respect to PCB concentrations. Does not meet remedial action objectives.	Easily implemented. May be implemented with other remedial action(s).	Low capital; moderate O&M.	---
		GROUNDWATER SAMPLING	Monitors potential PCB source inputs to the water column. Does not meet remedial action objectives.	Easily implemented. May be implemented with other remedial action(s).	Low capital; moderate O&M.	---
		AIR SAMPLING	Monitors volatilization of PCBs from the water column and airborne input from atmospheric sources. Does not meet remedial action objectives.	Easily implemented. May be implemented with other remedial action(s).	Low capital; moderate O&M.	---
	SITE USE RESTRICTIONS	FISHING BAN	Provides protection of human health by limiting consumption of contaminated fish species. Does not reduce environmental impacts.	Easily implemented from an institutional perspective. Enforcement may be difficult.	Los maintenance cost. Existing force of Environmental Conservation officers.	--
		LIMIT RECREATIONAL USE	Potentially effective in limiting contact with contaminated media. Does not reduce environmental impacts	Easily implemented from an institutional perspective. Enforcement may be difficult.	Low maintenance cost. Existing force of Environmental Conservation officers.	--

403147

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GEMERAL RESPONSE	REMEDIAL TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	SUPPORTING REFERENCE
		SEDIMENT REMOVAL CONTROLS	Will minimize non-natural resuspension of sediment and downstream transport.	Will require interaction with state agencies and possibly legislative action to suspend state constitutional requirements. Potentially implementable.	Capital costs will depend on measures necessary to upgrade dredging fleet and possibly to reassign crews; moderate O&M cost.	Malcolm Pirnie (1984)
CONTAINMENT	SUBAQUEOUS CAPPING	INERT MATERIALS	If properly designed and installed, capping is effective in containing PCBs in sediments if groundwater flux is not an issue. Also not appropriate where point source discharges are continuing.	Potentially implementable in deeper areas. May significantly modify shoreline and affect hydraulics of river if implemented in shallow areas.	Varies depending on cap materials.	
	RETAINING DIKES AND BERMS	EARTHEN EMBANKMENTS BULKHEADS SHEET PILING SPUR DIKES	Proven and conventional technology for reducing downstream sediment transport. Will not reduce diffusive flux of PCBs from sediment. Suitable for hot spots with a history of deposition. Most effective in shallow waters (<10 ft) with a flow velocity <2 ft/min.	Implementable in limited areas. May impede navigation. Rocky soils can hinder implementability of such containment options as sheet piling.	Maintenance dependent on containment method selected.	AD-A184 930 (1986), P.245 EM 110-2-5025 p. 4.23 Ebasco Services Inc. Vol. II August 1990, p.5.54-5.55 Sirrine p. 143-145
IN-SITU TREATMENT	BIOREMEDIATION	ANAEROBIC TREATMENT	Effective only with highly chlorinated PCBs. Indicative of ongoing process in older sediments. Not effective alone in mineralizing PCBs.	Technology is still in developmental stage.	No costs are available.	EPA/625/6-91/028 (1991), p.34-36. EPA/600/K-93/002 (1992) General Electric Co.(1992) p. 179
		AEROBIC TREATMENT	Potentially effective for dechlorinating and mineralizing lightly chlorinated PCBs as based on laboratory and field studies. Not effective alone in dechlorinating highly chlorinated PCBs.	Technology is still in developmental stage.	No costs are available.	EPA/625/6-91/-.028,p.34-36 EPA/600/K-93/002 (1993) General Electric Co.(1992) p. 167
		ANAEROBIC/ AEROBIC CYCLING	Potentially effective in reducing the overall PCB concentration. Plans exist for field testing in the Great Lakes using a confined treatment facility. Bioavailability may be a problem.	Containment system to control process may be difficult to construct without significant disruption. Sequential management of smaller areas using temporary containment systems. There is no evidence available that this technique has been developed or demonstrated for a riverine setting at the scale necessary for the Hudson. Implementability requires further analysis.	No costs are available.	EPA/600R-92/126 (1992), p. 51-52 EPA/600/K-93/002 (1993)

403148

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GEMERAL RESPONSE	REMEDIAL TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	SUPPORTING REFERENCE
IN SITU TREATMENT	SOLIDIFICATION STABILIZATION	IWT/GEO-CON	Process appears to immobilize PCBs. Confirmation of PCB immobilization has not been possible in field scale demonstration. Long-term monitoring is difficult and long-term effectiveness is unknown.	Employs a deep soil mixing system composed of auger mounted blades. Volume increase may significantly modify shoreline if implemented in shallow areas. Bottom debris/shallow, uneven bedrock may hinder implementation.	$111/ton	EPA-823-B93-001 (1993),p.3.34-3.35 EPA 540/R-92/077 (1992),p114-115 NTIS PB90-1113291 (1989)
	DECHLORINATION/ SOLIDIFICATION	FUNDERBURK FORMERLY HAZCON	Effective demonstration in bench-scale and field-scale treatability studies.	Employs a barge-mounted soil mixing system. Processes 60-80 tons of sediment per batch. Typically 10-15% volume increase associated with process. Volume increase may significantly modify shoreline if implemented in shallow areas. Bottom debris/shallow, uneven bedrock may hinder implementation.	$100/ton	EPA 540/R-92/077 (1992),p.92-93 Funderburk & Associates (1993)
REMOVAL TECHNOLOGIES	ENVIRONMENTAL DREDGING	MECHANICAL	Proven and conventional technology. Handles small volumes of material. Useful in confined areas or near structures. Provides high solids content. Typically high sediment resuspension; resuspension can be reduced through operational controls.	Widely available. Cannot excavate highly consolidated sediment. Typical production rates of 30 - 700 cy/hr. Dredging with environmental watertight buckets may be appropriate.	Dredging costs range from $5.00-$25.00/cy for contaminated sediments. Unit cost for mechanical dredges is typically higher than for hydraulic dredges.	Herbich (1992), p.4.1-4.4 Randall (1992), p.2 EPA/625/6-91/028 (1991), p.15 EL-88-15 Rpt 10/12 (1988),p.13-15, 29-36 EPA/540/2-91/010 (1991),p.32-37 EM 1110-2-5025 (1983),p.3.1-3.34 EPA-823-B93-001 (1993), p.3.9-3.11, 3.15-3.17
		HYDRAULIC	Proven and conventional technology. Can operate at shallow depths. Provides low solids content and moderate sediment resuspension; resuspension can be reduced through operational controls.	Susceptible to debris damage. Typical production rates of 10-10,000 cy/hr. Cutterhead dredging may be appropriate in deeper areas (>5 feet)		Herbich (1992), p.4.4-4.5 EPA/625/6-91/028 (1991), p.16 EL-88-15 rPT 10/12 (1988), P.15-19 29-36 EPA/540/2-91/010 (1991), p.38 EM 1110-2-5025 (1983), p.3.1-3.34 EPA-823-B93-001 (1993), p.3.9, 3.23-3,14, 3.15-3.17.
DISPERSION CONTROLS	VERTICAL BARRIERS	COFFERDAMS	Proven and conventional technology. Effective in shallow waters (<10 ft) and in areas of low velocity (<1-2 ft/min.). Sediment suspension is associated with barrier removal.	Implementable in limited areas. Silt curtains not recommended in situations which require frequent curtain movement, as for hydraulic dredging.		Sirrine (1990), p. 143-145 AD-A184-930 (1986), p. 2.45
		SILT CURTAINS				American Marine (undated) AD-A184 930 (1986), p.2.44-2.45 Serrine (1990), p. 144-145 EL-88-15 Rpt. 10 pg. 42-46
	OPERATIONAL CONTROLS	EQUIPMENT MODIFICATIONS	Equipment modifications are effective in reducing resuspension of sediment. Productivity of modified dredging equipment may be decreased.	Implementable. Availability of modified equipment may be limited. Used as available to minimize sediment resuspension during dredging.		Herbich, P. 9.9-9.16 AD-A184-930 (1986), p.2-23-2-34 New Bedford Harbor Superfund Pilot Study, May 1990, p.13

403149

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GEMERAL RESPONSE	REMEDIAL TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	SUPPORTING REFERENCE
		PROCEDURE MODIFICATIONS	Procedural modifications are effective in reducing sediment resuspension. Modifications may decrease productivity.	Implementable. Used as available to minimize sediment resuspension during dredging.	Controls typically increase cost as compared to conventional dredging techniques.	AD-A184 930 (1986), p. 2.34-2.46
		SUBMERGED DIFFUSERS	Effective in reducing sediment resuspension associated with disposal of dredged material in open water. Unnecessary due to elimination of CAD and near shore confinement options.	Requires support barge with a small crane to position and adjust diffuser. Effective use of diffuser requires high level of control.		New Bedford Harbor Superfund Pilot Study, May 1990, p.16,36 AD-A184 930 (1986) p. 6.9-6.10
	DEWATERING	UPLAND IMPOUNDMENT(S)	Traditional method. Effective in dewatering sediments to a solids content of 60% with up to 99% solids removal. System can achieve a 40% solids content after 10-15 days. Efficiency decreases as basin capacity decreases.	Requires substantial amount of land. Systems using gravity drainage are prone to clogging. Slow process.	High capital costs.	Herbich (1992), ch.8 AD-A184 930 (1986), p.? EPA 823-B93-001 (1993), p.3.18-3.19 EPA/625/6-91/028 p.22-23
		CLARIFIERS	Potentially effective. Capable of attaining solids content of 15-20%. Typically not cost effective for influent solids content >6%. Potentially effective for material with lower solids content (i.e., hydraulically dredged material).	Best suited to small or moderate scale operations or where impoundments are impractical. Can be barge mounted.	Low-medium cost method.	AD-A184 930 (1986), p.4.53-4.63 EPA 823-B93-001 (1993), p.3.22 EPA/625/6-91//028 (1991), p.21-22 Sirrine (1990), p.141
		DECANTING	Potentially efective for mechanical dredging.	Implementable. Useful for initial removal of excess water.	Low cost method.	
SEDIMENT PRETREATMENT		FILTRATION SYSTEMS	Potentially effective. Capable of attaining solids contents of 35-80% Effectiveness is dependent on type of filter, particle size, and solids concentration of influent. Limited application to contaminated sediments.	Requires less area than air drying processes (CDFs).	Typically costly and energy intensive.	EPA/540/2-91/010 (1991) Sirrine (1990),p142-143 EPA 823-B93-001 (1993), p. 3.21 EPA/625/6-91/028, p.22-24
	SOLIDS CLASSIFICATION	STATIONARY SCREENS & SIEVES	Potentially effective. Oversized material removed tends to have fines content. Less efficient than vibratory screens. Can be modified with water spray addition to facilitate fines removal. Not applicable when dreding is confined to fine-grained sediments.	Hydrosieves with capabilities of 1500 gpm are available.	Low cost method.	AD-A184 930 (1986), p. 4.51-4.52 EPA 823-B93-001 (1993), p. 3.22

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		VIBRATORY SCREENS	Potentially effective. Can separate particles from ⅛ to 6 in. diameter. High speed models range from 4 to 325 mesh. Best suited for dry materials. Not applicable when dredging is confined to fine-grained sediments	Wet materials tend to blind screen. Wet screening with water sprays (3-6 gpm at 20 psi) tends to reduce blinding.	Wet screening modifications can be costly.	AD-A184 930 (1986), p. 4.53-4.62 EPA 823-B93-001 (1993), p. 3.22.
EX SITU TREATMENT	DECHLORINATION	APEG	Effective in treating aromatic halides. Less toxic byproducts are produced. TOC is not reduced.	Excess reagent required with high moisture content and presence of alkaline reactive metals. Clay and humic content increase required reaction time. Processing time too limiting.	$200-$500/ton including pretreatment size reduction (1990).	Galson Research Corp.(1991) EPA/625/6-91//028 (1991)p.34 EPA/600/S2-90/026 (1990)
	SOLVENT EXTRATION	B.E.S.T.(RCC)	Effective. Obtained >99% PCB removal efficiency for bench scale test of New Bedford Harbor Sediments.	Not suited for particle size >1" diameter. Requires anoxic treatment environmental due to flammability of extraction solvent. Solvent is recovered. Procesing time too limiting.	$100/cy for unit that will treat 680 cy/day	EPA/540/2-88/004 (1988), p.63-67 EPA/540/MR-92/079 (1992) EPA/625/6-91/028 (1991),p.30 EPA-823-B93-001,p.3.45-3.50 EPA/540/R-92/077 (1992) p. 136-137 Resources Conservative Co. (1993)
		L.E.E.P. (ART INTL.)	Effective. PCB concentration reduction from 3,200 ppm to 1 ppm in bench scale test at Waukegan Harbor, Illinois. Can potentially process sediment containing up to 50% water with efficiencies up to 85%.	Has been effectively demonstrated at pilot-scale (100 lb/hr). Extraction solvent is not recovered. Subsequent treatment of PCB-containing solvent is necessary. Processing time too limiting.	$200-$150/ton (for a 40,000 ton site)	EPA/625/6-91/028 (1991), p.31 EPA-823-B93-001, p.3.45-3.49 ART International (1990)
		PROPANE EXTRACTION (CF SYSTEMS)	Effective. PCB extration efficiency of 90-98% for sediments containing 360-2575 ppm PCBs.	Not suited for particle size >1/4" diameter Solvent is recovered and reused. Processing time too limiting.	$100-150/ton. Cost includes mobilization/ demobilization, operating utilities, and labor. Cost does not include materials	EPA/625/6-91//028 (1991), p.30 EPA/540/A5-90/002 (1990) EPA-823-B93-001,p.3.45-3.49 EPA/540/R-92/077 (1992), p. 58-59 CF Systems (1993)

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GEMERAL RESPONSE	REMEDIAL TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	SUPPORTING REFERENCE
EX SITU TREATMENT	THERMAL DESORPTION	X*TRAX SYSTEM (CHEMICAL WASTE MANAGEMENT)	Effective. Soils containing 120-6000 ppm PCB reduced to 2-25 ppm PCBs. Demonstrated effectiveness in full scale application.	Carrier gas is recovered and reused. Feed stream must contain <10% organics (BP >800°F) and less than 60% moisture content. PCBs are not destroyed and must undergo subsequent treatment/disposal. Not suited for particle size >2" diameter. Processing time too limiting.	$120/ton variable cost with $1.5 million for mobilization/demobilization and permitting. Pre/post treatment costs are not included (1993).	EPA/540/MR-93/503 (1993) EPA-823-B93-001, p. 3.59-3.64 EPA/540/R-92/077 (1992) p. 66-67 Chemical Waste Management (1993)
	COMBINATION PHYSICAL/ CHEMICAL	AOSTRA TACUIK (Soiltech)	Potentially effective. Demonstrated in full scale to reduce PCB concentrations from 28.2 ppm to <0.05 ppm in contaminated soil.	Dewatering required to optimize process economics. Not suited for particle size >2". End product loses some soil characteristics. Transportable plant capacities of 3-25 tons/hr are available. Processing time too limiting.	$200-220/ton based on a 10-15% moisture content. Cost impacted significantly by moisture content of waste.	SoilTech (1993) EPA/540/R-92/077 (1992), p. 166-167
		THERMAL GAS PHASE REDUCTION (ECO LOGIC)	Potentially effective. Demonstrated in pilot-scale to achieve 99.9999% PCB destruction. Presence of water enhances reaction.	No full-scale demonstration. Not enough available existing treatment units for full scale implementation.	$400/ton	Eco Logic (1993) EPA/540/R-92/077 (1992), p.80-81
	INCINERATION	ROTARY KLIN INCINERATION	Effective. Demonstrated technology in treatment of PCB containing sediments. Not required for concentrations expected in dredge spoils.	Special permits may be required. Dewatering pretreatment is required. Treatment of residual ash prior to disposal may be necessary. Flue gases must be treated prior to discharge. Ash content, particle size, waste density, and the presence of sulfonated compounds affect the process. BTU should be <8,000. Process has been demonstrated on full scale basis. On-site incineration may have significant local opposition.	High capital; $100-$400/ton onsite, >30,000 tons, >10 tph. $1,300 - $1,400/cy offsite.	EPA/625/6-91/028 (1991), p. 32-34 AD-A184 930 (1986), p.4.71-4.76
		CIRCULATING FLUID BED INCINERATION	Demonstrated treatment in field studies of PCB contaminated sediments from Swanson River, Oak Field, Alaska. Suited to homogenous materials with low heating values. Not required for concentrations expected in dredge spoils.	Special permits may be required. Dewatering pretreatment is required. Treatment of residual ash prior to disposal may be necessary. Ash content, particle size, waste density, and the presence of sulfonated compounds affect the process. On-site incineration may have significant local opposition	High capital;$100-$400/ton onsite, >30,000 tons, >10 tph. $1,300 - $1,400/cy offsite	EPA/625/6-91/028 (1991) p. 32-34

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EX SITU TREATMENT		CONVEYOR FURNACE				
		ELECTRIC PYROLYZER	Potentially effective. An emerging technology. Vendor data is the primary data source and is limited in scope and quantity. Engineering scale tests on PCB contaminated soils indicate >99.99999% destruction and removal after off-gassing. Oxidation products and large air emissions are not created with this process. Less proven than alternate treatments offering similar benefits. Not required for concentrations expected in dredge spoils.	Organic content is limited to 10%. Process requirements are standard for thermal treatment technologies. Not efficient for sediments with high moisture content. On site incineration may have significant local opposition.	High capital. 20,000 tons. 3.3 tph soil $465/ton if online 80% of the time. $529/ton if online 60% of the time.	EPA/625/6-91/028 (1991), p, 32-34
		OFF-SITE CONTRACT THERMAL DESTRUCTION	Effective. Demonstrated technology in treatment of PCB containing sediments. Not required for concentrations expected in dredge spoils.	Implementability may be limited by transportation issues.	Higher unit cost than on-site incineration because ash disposal costs included.	
	SOIL WASHING	BERGMANN USA	Potentially effective. Has been demonstrated in pilot scale for treating PCB contaminated sediments from Saginaw Bay, Michigan. Less than 0.2 ppm PCBs were retained in the coarse fraction (influent sediment contained 1.6 ppm PCBs). Not effective for material with high concentration of fines.	Moisture content >20% hinders process. Sediment should contain <40% silt and clay material. Capable of processing 20-100 tons/hr.	$75-125/ton (1993).	EPA/540/2-90/017 (1990) EPA/540/R-92/077 (1992), p.38-39 Bergmann USA (1993)
	SOLIDIFICATION/ STABILIZATION	SOLIDIFICATION/ STABILIZATION	Generally low PCB concentration supports selection of S/S. Use of pozzolanic material mixed with proprietary reagents demonstrated at the Imperial Oil Company/Champion Chemical Site. PCBs not detected in TCLP tests. Long term effectiveness is unknown. The process is sensitive to numerous interference mechanisms. S/S can be applied for water absorption in dredged sediments for transport and landfill disposal.	Increased volume and weight of end product are a process disadvantage.	Application of S/S to hazardous waste is estimated at $20-50/ton. Cost varies with amount of setting agent required.	AD-A184 930 (1986), p 4.64-4.70 EL-88-15 Rpt 9/12 (1989) EPA/540/55-89/005 (1990)
	DECHLORINATION/ SOLIDIFICATION	FUNDERBURK (FORMERLY HAZCON)	Effective demonstration in bench-scale and field-scale treatability studies.	Typically 10-15% volume increase associated with process.	$150/ton	EPA 540/R-92/077 (1992), p. 92-93 Funderburk & Associates (1993)

403153

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GENERAL RESPONSE	REMEDIAL TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	SUPPORTING REFERENCE
DISPOSAL TECHNOLOGIES	BENEFICIAL USE	FILLER FOR ASPHALT/CEMENT	Effective disposal option for dewatered spoils.	Potentially implementable.	Transportation costs.	
		SANITARY LANDFILL COVER	Effective disposal option for treated and dewatered spoils (<1-2 ppm PCBs)	Potentially implementable. May encounter public opposition and difficulty in delisting treated material.	Transportaton costs.	EM 1110-2-5026, p.13.7-13.9
	LAND DISPOSAL	**UPLAND LANDFILL**	An effective containment option. A high degree of isolation with a low probability of discharge if disposed in a lined, secure landfill meeting all regulatory requirements.	Requires large land area to construct. May encounter difficulty in siting the landfill, particularly within time frame of early action. Landfill must be EPA approved for PCB contaminated materials in order to accept material with PCB concentration greater than 50 ppm.	Very high capital; moderate O&M.	EPA/625/6-91/028 (1991), p. 43 EPA-823-B93-001 (1993), p. 3.73
		PERMITTED OFF-SITE DISPOSAL FACILITY	Effective means of containment.	Potentially implementable. Availability of landfill space for large quantities of sediments may limit implementability. De-watering of sediment to reduce volume is preferable pretreatment. Landfill must be EPA approved for PCB contaminated materials in order to accept PCB contaminated materials exceeding 50 ppm.	$20-$30/cy for <50 ppm PCBs. $100-200/cy for disposal in hazardous waste landfill. Transportation costs additional.	EPA/625/6-91/028 (1991), p. 43 EPA-823-B93-001 (1993), p. 3.73
	CONFINED DISPOSAL FACILITY	**IN-RIVER CDF**	Effective means of containment.	Significant changes in river geometry would result in changes in channel hydraulic characteristics. Will result in disturbance of water front property and shoreline location. Siting very difficult, particularly within time frame of early action.		
		UPLAND CDF	Effective means of containment Demonstrated technology.	May significantly modify shoreline and water front properties. May be difficult to site, particularly within time frame of early action.	Costs range from $5-20/cy.	EL-88-15 Rpt 11/12 (1989), p. 11-13 EPA-823-B93-001 (1993), p. 3.27-3.30

NOTE: General responses, remedial technologies, and process options which are screened out are shown in bold-outlined boxes.

403154

2. MAPPING AND DETERMINATION OF EARLY ACTION TARGET AREAS

Mapping for this evaluation was created by combining side-scan sonar maps, bathymetry, and low resolution sediment data from USEPA's Phase 2 investigations (USEPA, et al., 1997a and 1998) into Geographic Information System (GIS) coverages for the TIP. These coverages provide definition of the shoreline, interpretation of the side-scan sonar images for designation of fine-grained, coarse-grained and rocky or bedrock outcrop areas, bathymetry (converted to water depth at base flow conditions of 3,090 cfs), locations of 1984 sampling points with the depth interval where PCB concentration is diminished to 10 ppm, along with "polygons of influence" for each sampling point based upon a polygonal declustering analysis (Thiessen polygons) providing a calculation of PCB mass per unit area for each polygon. Coverages of water column sampling conducted during "float surveys" for GE's 1996 to 1997 Thompson Island Pool Studies (O'Brien & Gere, February 1998) were also used as a reference but are not shown on the base mapping for this evaluation.

Base map coverages are shown on the drawing entitled "Early Action Target Areas," overlaid by the outlines of the fine-grained sediment areas targeted for early action, which have been designated "target areas" for purposes of this evaluation. The boundaries of these target areas are not necessarily geographically coincident with *Hot Spots* 5 through 20 in the TIP as previously defined by NYSDEC. For reference, the approximate boundaries of the NYSDEC *hot spots* are also shown on the drawings. For purposes of cost-effectiveness, the following parameters were used in targeting sediments for early action:

- Fine-grained sediments as delineated by interpretation of side-scan sonar data;
- Areas where PCB mass per unit area is at least 7.5 to 10 g/m^2 (equivalent to approximately 23 to 30 ppm in the top foot of sediment) based upon the 1984 sampling data; and
- Depth limited to intervals of PCB concentrations greater than 10 ppm.

Using these parameters, blocks of sediment were delineated as target areas and listed on the drawing. Small, isolated or inaccessible areas of sediments were not targeted even though they may fall within the criteria listed above. In preparing the mass estimates for the various target areas, TAMS used a polygonal declustering analysis (Thiessen polygons). In this analysis, two coverages of polygons were prepared, the first representing all fine-grained sediment samples (described as cohesive sediments) and the second representing all coarse-grained sediments (described as noncohesive sediments). The coverage representing the cohesive sediments was used to estimate the PCB inventory of the various fine-grained sediment areas. The areas themselves were originally defined by the side-scan sonar texture boundaries. The 1984 sample location textures were based on the visual field descriptions compiled as part of the 1984 NYSDEC survey. Thus the nearest fine-grained 1984 sediment samples to any given side-scan sonar fine-grained area were used to define the sediment PCB inventory for the area.

Based on the intersection of the fine-grained side-scan sonar areas and the 1984 cohesive sediment Thiessen polygons, areas representing higher levels of PCB contamination were selected as target areas. In the refinement of the target areas, the boundaries were straightened and squared, resulting in the inclusion of small areas of noncohesive (coarse-grained) sediments. Final target area inventories were then prepared consisting of an area-weighted mean for each target area based on the proportion of each target area assigned to a specific sampling location, with fine-grained areas defined by cohesive sampling points and the small additional coarse-grained areas defined by noncohesive sampling points.

In most cases, the intersection of the fine-grained sediment areas and the actual 1984 sampling locations placed the sampling location within the target area. However, since the side-scan sonar results, and not the 1984 data set, were used to define the target areas, some target area inventories were defined with few or no sampling points internal to their area. For example, Target Areas A, B, and C, which are listed in Table 3-1, Dredging Target Area Summary, did not have fine-grained sediment samples available to estimate each of these areas' PCB mass[1]. In these instances, the PCB concentration within the target area was inferred from the nearest 1984 cohesive sediment sampling locations using polygonal declustering techniques. Clearly in these instances, the degree of uncertainty is greater than for those areas which contain some or all of the sampling points used to estimate the inventory. Also beneficial to the inventory estimate is simply a large number of sampling points on which to base the inventory estimate. A large number of points is evident when a large number of polygons forms the basis for the mass estimate.

In sum, the target areas comprise approximately 240,000 cubic yards (cy), which is slightly under 45 percent of a total of approximately 550,000 cy of fine-grained sediments in the TIP affected by PCB contamination. This volume is estimated to contain 90 percent of the 1984 PCB mass calculated to reside in fine-grained sediments of the TIP (*i.e.*, about 7,950 of 8,700 kg), and 55 percent of the total 1984 PCB mass calculated to reside in the TIP (*i.e.*, about 14,900 kg), including that found in coarse-grained sediments.

While target areas form the basis for dredging scenarios, two constraints further limit the areas amenable to capping. First, capping in very shallow areas would not only change the shoal geometry, perhaps unacceptably limiting access to shore by small craft, but could actually move the shoreline toward the center of the river by tens of feet. This would expose portions of the cap to dehydration during base flow conditions and would possibly adversely affect shore-front activities and property use. An additional consideration in this regard is the potential for disruption of the integrity of the cap resulting from moving blocks or sheets of ice during the spring thaw. For this reason, capping scenarios were limited to depths of about six feet or greater. Thus, assuming an 18-inch thick cap, at least 4.5 feet of water should be present over almost all portions of the cap. Since the flow during the thaw will be increased due to upstream snow melt, the water will likely be deeper than during base flow conditions, reducing the chance for disturbance of the cap. However, this issue warrants further consideration if capping is implemented. The second constraint involves maintenance of the Champlain Canal for navigation. Since the deeper channel areas of the river generally coincide with the Champlain Canal, capping was not considered for sediments deeper than about 12 feet.

Categorization of the target areas for action is discussed in the next chapter.

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[1] Sampling of fine-grained sediments in areas of the river coincident with Target Areas A, B, and C was performed in the fall of 1998. The additional data were not incorporated into this report since the volume of sediment and PCB inventory represented by these areas are small and do not materially affect USEPA's early action decision.

3. EVALUATION OF ACTION ALTERNATIVES AND COST

3.1 Categorization of Early Action Target Areas

For the purposes of this assessment, the action objective is to reduce to the lowest extent feasible the loss of PCB mass out of the TIP to downstream areas. It is estimated that, with the dredging technique described below, approximately 60,000 to 70,000 cy of sediment can be dredged in one season (May through November), while the capping operation can follow the dredging operation downstream during the same time frame. Depending on the funds available and the level of PCB removal or isolation required (to be determined by USEPA), an early action program comprising some or all of the target areas could be undertaken, with progressively diminishing relative effectiveness as lower concentration sediments are targeted. For purposes of establishing and comparing sub-alternatives involving various quantities of sediment to be removed or capped in programs of varying lengths (*i.e.*, from one to four years), the target areas were categorized based upon estimated volume-weighted (by polygon) bulk wet weight PCB concentration, as shown on Tables 3-1 and 3-5. The following exceptions to the categorization scheme are noted:

- Because Target Area D is located proximate to the proposed docking/barge unloading facility, Target Area D must be dredged in every scenario developed; thus it was included with the highest category sediments even though its bulk PCB concentration would place it lower.

- Target areas where the concentrations are represented only by cohesive, *i.e.*, fine-grained, sediment sampling points outside their boundaries were moved to the lowest category. These appear as the last 10 entries in Table 3-1 and have a listed sampling density of 0.0 samples per acre. In some cases, the presence of only non-cohesive sediment samples within a target area boundary adds to the uncertainty in the PCB inventory.

- For capping and dredging scenarios, dredging target areas divided into smaller segments by capping locations were kept together with the segment having the highest assigned category.

3.2 Alternatives Development

Three early action alternatives were developed for the TIP sediments by combining selected remedial technologies and process options. The alternatives include: a No-Action alternative (Alternative 1), a dredging alternative (Alternative D), and a combined capping and dredging alternative (Alternative CD). Capping alone was not considered based on its limitations (*i.e.*, it is only applicable at water depths between about 6 and 12 feet) and the categorization of the sediments for action (*i.e.*, some of the shallower sediments are in a higher category than those which could be capped).

Alternatives D and CD each include three sub-alternatives (Alternatives D-1, D-2, D-3, and Alternatives CD-1, CD-2, CD-3, respectively) which involve different volumes to be dredged, areas to be capped, and length of time to accomplish remediation, based upon the categorization scheme discussed above.

403157

Based upon preliminary calculations for the dredging method selected, approximately 60,000 to 70,000 cy can be removed in a single dredging season. Therefore, removal of all target areas, comprising about 238,000 cy, would require four years. Alternatives D-2 and D-3 have been developed to require two years (to remove 120,000 cy) and one year (to remove 59,000 cy), respectively, with overall increasing bulk concentrations of PCBs. Tables 3-2 through 3-4 present the target areas associated with Alternatives D-1, D-2 and D-3, respectively, listed in the sequence in which dredging would be performed, *i.e.*, upstream to downstream. Drawings at the back of the report depict the target areas associated with each of the alternatives.

Since the amount of sediment to be removed in the event the maximum amount of capping were employed is about 172,000 cy, all target areas could be addressed in three years with a combined capping and dredging scenario. Thus, Alternatives CD-2 and CD-3 require two years and one year, respectively. Most of the areas identified as amenable for capping are in the lower end of the TIP. Since the operation will proceed following dredging in sequence, it is assumed that no capping will be performed during the first year for Alternative CD-1 (a three-year program). Therefore, a maximum of two construction seasons of capping is assumed for Alternatives CD-1 and CD-2, with only one season required for Alternative CD-3. Tables 3-6 through 3-8 present the target areas and portions of target areas associated with Alternatives CD-1, CD-2 and CD-3, respectively. On each table, the dredging sequence is presented first, followed by the capping sequence; upstream to downstream in each case. Drawings at the back of the report depict the target areas associated with each of the alternatives.

More detailed description of each major alternative is provided below.

No Action

Alternative 1 leaves the TIP undisturbed, with no removal or capping of contaminated sediments.

Dredging with Off-Site Disposal

Alternative D involves removing the contaminated sediments by dredging. According to information obtained from the US Army Engineer Waterways Experiment Station (WES) in Vicksburg, Mississippi (1998), the most important means of controlling sediment resuspension are the use of the appropriate equipment and control of the dredging operation. While production rates may be lowered, dredging with well-calculated and controlled movements is the best way to control resuspension. Sediment barriers are of secondary importance.

With this in mind, dredging would be conducted from upstream to downstream using a modified backhoe mounted to a small deck barge. The backhoe has a hydraulically operated lid and is fitted with specialized sensors for accurate positioning and environmental control measures to minimize sediment resuspension. While they are considered secondary in controlling resuspension, the use of sediment barriers to enclose dredging areas is included in the concept and cost estimate. Dredged sediments would be transferred directly to 30-cubic yard watertight containers on a flat-top transport barge. The number of containers a barge will haul depends on depth of water in the area of operation, with fewer containers on the transport barge when operating in shallow areas.

403158

The transport barge would proceed to a docking facility and treatment area located on land where the filled containers would be off-loaded using a cable crane. It is assumed some settling of solids would occur on the transport barges. Decant water from the containers would be pumped to a water treatment system. Settled dredged material would be blended with Portland cement and/or other stabilization agents within the containers. A conventional backhoe with a specialized mixing head would be used to blend cement into the dredged material. The containers with the stabilized material would be loaded from the treatment area to rail cars for off-site disposal. It is proposed that transport to disposal will be conducted entirely by rail.

Based on on-site testing, sediments with PCB concentration less than 50 ppm would be disposed at the CECOS landfill in Niagara Falls, NY, which has direct rail access. Since the CECOS landfill is not permitted to handle wastes with PCB concentrations greater than 50 ppm, these sediments would be hauled to the nearest facility with direct rail access which could accept them. No such facility exists in New York State at present. For example, the rail head closest to the Model City landfill is approximately 30 miles away; containers would need to be off-loaded and hauled the remaining distance by truck. However, a rail spur is currently planned to be constructed soon directly to the Environmental Quality Wayne Disposal Landfill in Belleville, Michigan (Fulton, 1998). As this is the closest landfill identified with existing or planned rail access, it was assumed disposal would occur there. For purposes of estimating costs, it has been assumed that sediment from target areas having bulk wet-weight PCB concentrations greater than 35 ppm would require disposal at the Michigan landfill.

Based on information developed for the Landfill/Treatment Facility Siting Survey (USEPA, 1997b), the area of the Old Moreau Landfill was selected for conceptual purposes as the location of the docking facility, treatment area, and rail transfer area. Advantages of this location are its proximity to the TIP (limited dredging would be necessary to extend a navigable channel to the site), it has both rail and truck access, its immediate neighbor is a commercial facility, and improvements necessary to adapt the site for this purpose could be performed in a way which would allow long-term commercial development following the completion of the project. No investigation has been performed for the purposes of this evaluation to determine the availability of the parcel, although it is assumed to be owned by the municipality. The concept proposed assumes a temporary docking facility, although a full bulkhead could be installed for additional cost (probably no more than $1.5 million extra, approximately doubling the cost of the unloading area proper).

Dredged areas would not be backfilled, except for replacing rocks/boulders (after some washing process to remove fines) when dredging is completed to enhance fish habitat. Other oversized debris (besides rocks/boulders) would be disposed of in a nonhazardous landfill.

The water decanted during gravity settling of the dredged material would be treated by settling in a clarifier and followed by gravity sand filtration. Provisions for addition of flocculating chemicals in the clarifier(s) can be included as required. Treated water would be returned to Hudson River.

Dredging with Off-Site Disposal, and Capping

Alternative CD involves removing some of the contaminated sediments by dredging and isolating the remaining contaminated sediments by capping. For the dredging operation, all material handling procedures including removal, stabilization, transport, and disposal of dredged material, as well as water treatment procedures, are the same as described previously. The cap would be installed after dredging has been completed in successive individual areas. Consequently, capping would also be conducted from upstream to downstream.

For conceptual purposes, the cap would consist of three layers: two inches of sand, an Aquablok bentonite layer (~35 cm, or 14 inches, thick) overlain by a silty material (~10 cm, or 4 inches, thick). Prior to implementation, treatability studies should be conducted to determine the most appropriate thickness to achieve early action goals.

The Aquablok product is in pellet form consisting of gravel encapsulated in a clay/bentonite layer. The pellets can be manufactured on-site if the raw materials (gravel, clay, proprietary polymers) are available. The material would be applied from a barge. As the material is released to water, it hydrates and expands to form a continuous layer, typically twice the initial product thickness. A thick layer of Aquablok (*i.e.*, greater than eight inches) will take up to seven days or more to hydrate. The material can withstand erosion in water with velocity up to six fps. A two-inch layer of sand would be placed on top of the sediments prior to applying Aquablok to minimize sediment resuspension during Aquablok application. A four-inch layer of silt would be placed on top of the Aquablok layer to provide habitat for benthic biota. It is assumed that silt material is readily accessible from a dredge spoil disposal site upstream in the Champlain Canal within a few miles of the TIP.

Discussion Common to Alternatives D and CD

Alternatives D and CD assume all construction activities including mobilization and demobilization would be conducted from mid-May through mid-November when the locks on Hudson River are open. Most of the construction equipment including dredge, barges, and transport crane would be mobilized to the site at the beginning of each construction season and demobilized offsite at the end of each construction season. During the winter seasons, equipment that remains onsite, such as the water treatment plant, would be insulated for protection. In addition, water treatment units and piping would be completely drained of water during this time.

A treatment area would be prepared for Alternatives D and CD. The treatment area would include at a minimum: docking facilities, container handling equipment, water treatment facilities, material blending equipment (for stabilization). Subbase preparation, construction of access road(s), and extension of the rail spur would be conducted as appropriate depending on the area selected.

Monitoring of PCBs and concentration of suspended sediments in the water column, will be conducted during remediation to verify compliance with environmental requirements.

Prior to detailed design, several issues should be addressed to further define the remediation processes. Some of the issues may be resolved by obtaining information from vendors or other appropriate sources; several issues may require some type of treatability study or laboratory testing. The issues that have been identified are:

- the volume of water potentially entrained during dredging when an environmental backhoe is used

- the settleability and rate of settling of sediments
- the amount and type of stabilization reagent most appropriate to absorb water in the dredged sediment
- will mechanical dewatering be more effective than stabilization in providing a drier sediment product for transport and disposal
- rate of dredging for selected dredging equipment
- availability of equipment, particularly transport containers and flat cars
- most appropriate cap thickness to achieve the cap's goals

3.3 Alternatives Comparison and Cost Estimates

For purposes of comparison, an analysis of the three alternatives using the criteria for evaluating remedial alternatives defined under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and under 40 CFR 300.430, is provided in Table 3-9. (These criteria would not apply directly to an early action conducted as a removal action under 40 CFR 300.415, although EPA would, as appropriate, consider these and other factors when selecting removal actions. The criteria presented in Table 3-9 are nevertheless instructive as a basis for comparing the options presented in this report.) This comparison does not consider differences among sub-alternatives. A summary of the amounts of sediments and PCBs removed and capped under the various sub-alternatives, along with the associated costs, is shown in Table 3-10. This table shows a range of costs for the various alternatives from $47 million to $101 million depending on the length of time and amounts of sediment addressed.

If all target areas are dredged over a four-year period, approximately 90 percent of the PCB mass in fine-grained sediment of the TIP will be removed, at a cost of $101 million. This is equivalent to approximately 55 percent of the total PCBs in the TIP. On the other hand, an equivalent amount of sediments and PCB contamination could be addressed by a combination of capping and dredging over a period of three years at a cost of approximately $83 million. Dredging for one year would result in removal of approximately 40 percent of the PCBs in TIP fine-grained sediments (*i.e.*, about 25 percent of the total TIP PCB mass) at a cost of $48 million. With the one-year capping and dredging program, approximately the same volume of sediments would be removed, but additional PCB mass would be addressed through capping. This would result in management of about 55 percent of the PCB in fine-grained sediments, which is equivalent to 30 percent of total TIP PCB mass. While the costs presented for capping and dredging alternatives are lower than those estimated for dredging alone to address equivalent volumes of sediments, costs associated with monitoring and long-term maintenance of the cap have not been included. Also, dredging provides a more permanent action, while capping leaves some amount of high concentration PCBs in place, with greater long-term risk of future exposure through disruption of the cap.

TABLE 3-1

DREDGING TARGET AREA SUMMARY

Target Area	Depth (ft)	Area (ft^2)	Area (acres)	Volume (cy)	Cumul. Volume (cy)	PCB Mass (kg)	Bulk Density (g/cc)	Fraction Solids	Sediment Mass (kg) dry	PCB Conc. (ppm) dry	Sediment Mass (kg) wet	PCB Conc. (ppm) wet
D[1]	1.0	31,192	0.72	1,155	1,155	30	1.42	0.55	689,835	44	1,254,245	24.2
C	1.0	21,633	0.50	801	1,957	204	1.42	0.55	478,420	426	869,854	234.3
AS	3.0	38,075	0.87	4,231	6,187	511	1.45	0.60	2,579,538	198	4,299,230	118.8
AW	2.0	10,565	0.24	783	6,970	90	1.45	0.60	477,171	188	795,285	112.9
AU	2.0	23,256	0.53	1,723	8,693	180	1.45	0.60	1,050,358	171	1,750,596	102.9
K	1.0	79,668	1.83	2,951	11,643	296	1.42	0.55	1,761,906	168	3,203,465	92.4
P	3.0	32,906	0.76	3,656	15,300	272	1.45	0.60	2,229,334	122	3,715,557	73.1
AT	1.0	10,063	0.23	373	15,673	24	1.42	0.55	222,546	108	404,629	59.4
X	1.0	10,740	0.25	398	16,070	25	1.42	0.55	237,519	105	431,853	57.8
BA	1.0	80,184	1.84	2,970	19,040	165	1.42	0.55	1,773,315	93	3,224,209	51.1
AB	2.0	69,420	1.59	5,142	24,183	257	1.45	0.60	3,135,412	82	5,225,687	49.2
AY	3.0	13,879	0.32	1,542	25,725	75	1.45	0.60	940,269	79	1,567,115	47.7
AV	4.0	36,069	0.83	5,344	31,069	253	1.45	0.60	3,258,144	78	5,430,240	46.5
AE	1.5	15,732	0.36	874	31,943	36	1.45	0.60	532,925	68	888,209	40.9
AL	2.0	349,197	8.02	25,868	57,810	1,062	1.45	0.60	15,771,688	67	26,286,147	40.4
BB	3.0	12,848	0.29	1,428	59,238	56	1.45	0.60	870,447	64	1,450,744	38.3
U	3.0	156,752	3.60	17,418	76,656	596	1.45	0.60	10,619,726	56	17,699,543	33.6
Z	3.0	3,144	0.07	349	77,005	12	1.45	0.60	212,992	56	354,987	33.4
M	1.0	130,101	2.99	4,819	81,824	171	1.42	0.55	2,877,257	60	5,231,376	32.7
G	3.0	30,137	0.69	3,349	85,172	110	1.45	0.60	2,041,705	54	3,402,841	32.3
W	1.5	138,782	3.19	7,710	92,883	241	1.45	0.60	4,701,137	51	7,835,228	30.8
AR	2.0	54,978	1.26	4,073	96,955	127	1.45	0.60	2,483,128	51	4,138,546	30.6
Q	2.0	150,825	3.46	11,173	108,128	336	1.45	0.60	6,812,096	49	11,353,493	29.6
AJ	3.0	107,187	2.46	11,910	120,038	346	1.45	0.60	7,261,724	48	12,102,874	28.6
AK	2.0	154,902	3.56	11,475	131,513	275	1.45	0.60	6,996,246	39	11,660,410	23.6
AF	2.0	21,621	0.50	1,602	133,115	38	1.45	0.60	976,524	39	1,627,541	23.3
V	2.0	110,101	2.53	8,156	141,271	189	1.45	0.60	4,972,764	38	8,287,940	22.8
S	2.0	103,402	2.37	7,660	148,930	177	1.45	0.60	4,670,194	38	7,783,657	22.8
L	1.0	165,189	3.79	6,118	155,049	150	1.42	0.55	3,653,254	41	6,642,279	22.6
AA	3.0	35,741	0.82	3,971	159,020	88	1.45	0.60	2,421,384	36	4,035,639	21.8
AP	3.0	66,338	1.52	7,371	166,391	159	1.45	0.60	4,494,287	35	7,490,478	21.2
AX	2.0	160,470	3.68	11,887	178,278	245	1.45	0.60	7,247,724	34	12,079,540	20.3
AI	1.0	46,522	1.07	1,723	180,002	38	1.42	0.55	1,028,866	36	1,870,665	20.1
R	2.0	182,809	4.20	13,542	193,544	269	1.45	0.60	8,256,686	33	13,761,143	19.5
J	1.0	44,230	1.02	1,638	195,182	34	1.42	0.55	978,182	34	1,778,514	18.9
AM	4.0	12,617	0.29	1,869	197,051	36	1.45	0.60	1,139,732	31	1,899,553	18.7
AZ	2.0	70,682	1.62	5,236	202,287	95	1.45	0.60	3,192,409	30	5,320,681	17.8
AO	2.0	120,364	2.76	8,916	211,203	160	1.45	0.60	5,436,292	29	9,060,487	17.7
AN	1.5	10,552	0.24	586	211,789	10	1.45	0.60	357,428	28	595,713	16.8
AD	1.0	10,070	0.23	373	237,738	7	1.42	0.55	222,701	30	404,911	16.6
H	2.0	38,473	0.88	2,850	214,639	45	1.45	0.60	1,737,678	26	2,896,130	15.4
F	3.0	29,418	0.68	3,269	217,908	50	1.45	0.60	1,993,008	25	3,321,680	15.1
AH	2.0	16,952	0.39	1,256	219,164	17	1.4[illegible]	0.60	765,644	23	1,276,074	13.6
I	3.0	77,819	1.79	8,647	227,811	96	1.45	0.60	5,272,100	18	8,786,833	10.9
AG	1.5	3,406	0.08	189	228,000	16	1.45	0.60	115,366	134	192,277	80.6
Y	1.0	6,528	0.15	242	228,242	18	1.42	0.55	144,365	126	262,482	69.5
AQ	1.5	38,963	0.89	2,165	230,407	104	1.45	0.60	1,319,837	79	2,199,729	47.3
O	1.0	24,222	0.56	897	231,304	29	1.42	0.55	535,684	53	973,972	29.3
E	4.0	5,956	0.14	882	232,186	26	1.45	0.60	537,993	48	896,655	29.0
N	1.0	10,643	0.24	394	232,580	10	1.42	0.55	235,374	43	427,952	23.7
B	3.0	8,666	0.20	963	233,543	19	1.45	0.60	587,110	33	978,517	19.8
T	2.0	48,797	1.12	3,615	237,158	69	1.45	0.60	2,203,941	31	3,673,235	18.8
AC	1.0	5,598	0.13	207	237,365	4	1.42	0.55	123,799	34	225,089	18.8
A	2.0	4,751	0.11	352	238,090	3	1.45	0.60	214,571	12	357,618	7.3

NOTE

[1] Area D was moved to the top of the list because this area would require dredging for navigation purposes regardless of the alternative implemented

TABLE 3-2

DREDGING TARGET AREA SEQUENCE: ALTERNATIVE D-1

Target Area	Depth (ft)	Area (ft^2)	Volume (cy^3)	Cumul. Volume (cy^3)	PCB Mass (kg)	PCB Conc. (ppm) wet
A	2.0	4,751	352	352	3	7
B	3.0	8,666	963	1,315	19	20
C	1.0	21,633	801	2,116	204	234
D	1.0	31,192	1,155	3,271	30	24
E	4.0	5,956	882	4,154	26	29
F	3.0	29,418	3,269	7,423	50	15
G	3.0	30,137	3,349	10,771	110	32
H	2.0	38,473	2,850	13,621	45	15
I	3.0	77,819	8,647	22,268	96	11
J	1.0	44,230	1,638	23,906	34	19
K	1.0	79,668	2,951	26,857	296	92
L	1.0	165,189	6,118	32,976	150	23
M	1.0	130,101	4,819	37,794	171	33
N	1.0	10,643	394	38,189	10	24
O	1.0	24,222	897	39,086	29	29
P	3.0	32,906	3,656	42,742	272	73
Q	2.0	150,825	11,173	53,915	336	30
R	2.0	182,809	13,542	67,457	269	20
S	2.0	103,402	7,660	75,116	177	23
T	2.0	48,797	3,615	78,731	69	19
U	3.0	156,752	17,418	96,149	596	34
V	2.0	110,101	8,156	104,305	189	23
W	1.5	138,782	7,710	112,015	241	31
X	1.0	10,740	398	112,413	25	58
Y	1.0	6,528	242	112,655	18	69
Z	3.0	3,144	349	113,004	12	33
AA	3.0	35,741	3,971	116,976	88	22
AB	2.0	69,420	5,142	122,118	257	49
AC	1.0	5,598	207	122,325	4	19
AD	1.0	10,070	373	122,698	7	17
AE	1.5	15,732	874	123,572	36	41
AF	2.0	21,621	1,602	125,174	38	23
AG	1.5	3,406	189	125,363	16	81
AH	2.0	16,952	1,256	126,619	17	14
AI	1.0	46,522	1,723	128,342	38	20
AJ	3.0	107,187	11,910	140,252	346	29
AK	2.0	154,902	11,475	151,727	275	24
AL	2.0	349,197	25,868	177,595	1,062	40
AM	4.0	12,617	1,869	179,464	36	19
AN	1.5	10,552	586	180,050	10	17
AO	2.0	120,364	8,916	188,966	160	18
AP	3.0	66,338	7,371	196,337	159	21
AQ	1.5	38,963	2,165	198,502	104	47
AR	2.0	54,978	4,073	202,575	127	31
AS	3.0	38,075	4,231	206,806	511	119
AT	1.0	10,063	373	207,178	24	59
AU	2.0	23,256	1,723	208,901	180	103
AV	4.0	36,069	5,344	214,245	253	47
AW	2.0	10,565	783	215,027	90	113
AX	2.0	160,470	11,887	226,915	245	20
AY	3.0	13,879	1,542	228,457	75	48
AZ	2.0	70,682	5,236	233,693	95	18
BA	1.0	80,184	2,970	236,663	165	51
BB	3.0	12,848	1,428	238,090	56	38

TABLE 3-3

DREDGING TARGET AREA SEQUENCE: ALTERNATIVE D-2

Target Area	Depth (ft)	Area (ft^2)	Volume (cy^3)	Cumul. Volume (cy^3)	PCB Mass (kg)	PCB Conc. (ppm) wet
C	1.0	21,633	801	801	204	234
D	1.0	31,192	1,155	1,957	30	24
G	3.0	30,137	3,349	5,305	110	32
K	1.0	79,668	2,951	8,256	296	92
M	1.0	130,101	4,819	13,075	171	33
P	3.0	32,906	3,656	16,731	272	73
Q	2.0	150,825	11,173	27,904	336	30
U	3.0	156,752	17,418	45,322	596	34
W	1.5	138,782	7,710	53,032	241	31
X	1.0	10,740	398	53,430	25	58
Z	3.0	3,144	349	53,779	12	33
AB	2.0	69,420	5,142	58,922	257	49
AE	1.5	15,732	874	59,796	36	41
AJ	3.0	107,187	11,910	71,706	346	29
AL	2.0	349,197	25,868	97,573	1,062	40
AR	2.0	54,978	4,073	101,646	127	31
AS	3.0	38,075	4,231	105,877	511	119
AT	1.0	10,063	373	106,249	24	59
AU	2.0	23,256	1,723	107,972	180	103
AV	4.0	36,069	5,344	113,316	253	47
AW	2.0	10,565	783	114,099	90	113
AY	3.0	13,879	1,542	115,641	75	48
BA	1.0	80,184	2,970	118,611	165	51
BB	3.0	12,848	1,428	120,038	56	38

TABLE 3-4

DREDGING TARGET AREA SEQUENCE: ALTERNATIVE D-3

Target Area	Depth (ft)	Area (ft^2)	Volume (cy^3)	Cumul. Volume (cy^3)	PCB Mass (kg)	PCB Conc. (ppm) wet
C	1.0	21.633	801	801	204	234
D	1.0	31.192	1,155	1,957	30	24
K	1.0	79.668	2,951	4,907	296	92
P	3.0	32.906	3.656	8,564	272	73
X	1.0	10.740	398	8,962	25	58
AB	2.0	69.420	5,142	14.104	257	49
AE	1.5	15,732	874	14.978	36	41
AL	2.0	349.197	25,868	40.846	1,062	40
AS	3.0	38.075	4.231	45,076	511	119
AT	1.0	10.063	373	45,449	24	59
AU	2.0	23,256	1.723	47.172	180	103
AV	4.0	36,069	5.344	52,516	253	47
AW	2.0	10.565	783	53,298	90	113
AY	3.0	13.879	1.542	54,840	75	48
BA	1.0	80.184	2.970	57.810	165	51
BB	3.0	12.848	1,428	59.238	56	38

TABLE 3-5

CAPPING AND DREDGING TARGET AREA SUMMARY

DREDGING TARGET AREAS

Dredge Target Area	Depth (ft)	Area (ft^2)	Volume (cy)	Cumul. Volume (cy)	PCB Mass (kg)	Bulk Density (g/cc)	Fraction Solids	Sediment Mass (kg) dry	PCB Conc. (ppm) dry	Sediment Mass (kg) wet	PCB Conc. (ppm) wet
D*	1.0	31,181	1,155	1,155	30	1.42	0.55	689,575	44	1,253,773	24
C	1.0	21,633	801	1,956	204	1.42	0.55	478,420	426	869,854	234
AS	3.0	38,075	4,231	6,187	511	1.45	0.60	2,579,507	198	4,299,178	119
AW	2.0	10,565	783	6,969	90	1.45	0.60	477,171	188	795,285	113
AU	2.0	23,256	1,723	8,692	180	1.45	0.60	1,050,387	171	1,750,645	103
K	1.0	79,668	2,951	11,643	296	1.42	0.55	1,761,906	168	3,203,465	92
P	3.0	32,906	3,656	15,299	272	1.45	0.60	2,229,334	122	3,715,557	73
AL3	2.0	34,195	2,533	17,833	181	1.45	0.60	1,544,459	117	2,574,098	70
AL2	2.0	35,091	2,599	20,432	60	1.45	0.60	1,584,909	38	2,641,515	23
AL1	2.0	69,529	5,151	25,583	94	1.45	0.60	3,140,329	30	5,233,882	18
AT	1.0	10,063	373	25,955	24	1.42	0.55	222,546	108	404,629	59
X	1.0	10,740	398	26,353	25	1.42	0.55	237,519	105	431,853	58
BA	1.0	80,184	2,970	29,323	165	1.42	0.55	1,773,315	93	3,224,209	51
AY1	3.0	6,703	745	30,068	36	1.45	0.60	454,110	80	756,850	48
AY2	3.0	494	55	30,123	2	1.45	0.60	33,481	70	55,802	42
AV	4.0	36,046	5,340	35,463	252	1.45	0.60	3,256,066	77	5,426,777	46
BB	3.0	12,848	1,428	36,891	56	1.45	0.60	870,447	64	1,450,744	38
U1	3.0	55,102	6,123	43,013	229	1.45	0.60	3,733,088	61	6,221,813	37
U2	3.0	32,527	3,614	46,628	117	1.45	0.60	2,203,659	53	3,672,765	32
U3	3.0	15,063	1,674	48,301	52	1.45	0.60	1,020,474	51	1,700,791	31
AB1	2.0	7,418	550	48,851	21	1.45	0.60	335,039	61	558,398	37
AB2	2.0	420	31	48,882	0.1	1.45	0.60	18,984	3	31,640	2
W2	1.5	26,782	1,488	50,370	51	1.45	0.60	907,219	56	1,512,032	34
W3	1.5	11,769	654	51,024	20	1.45	0.60	398,665	51	664,442	31
W1	1.5	32,601	1,811	52,835	46	1.45	0.60	1,104,338	42	1,840,563	25
Z	3.0	3,144	349	53,184	12	1.45	0.60	212,992	56	354,987	33
M	1.0	130,101	4,819	58,003	171	1.42	0.55	2,877,257	60	5,231,376	33
G	3.0	29,700	3,300	61,303	110	1.45	0.60	2,012,106	55	3,353,510	33
AR	2.0	36,804	2,726	64,030	89	1.45	0.60	1,662,285	54	2,770,476	32
AA2	3.0	6,811	757	64,786	23	1.45	0.60	461,451	49	769,084	30
AA1	3.0	9,147	1,016	65,803	16	1.45	0.60	619,699	26	1,032,832	16
Q	2.0	150,825	11,173	76,976	336	1.45	0.60	6,812,096	49	11,353,493	30
AJ	3.0	107,187	11,910	88,886	346	1.45	0.60	7,261,727	48	12,102,878	29
F	3.0	8,278	920	89,805	26	1.45	0.60	560,814	46	934,690	28
AF	2.0	21,621	1,602	91,407	38	1.45	0.60	976,524	39	1,627,541	23
S	2.0	103,402	7,660	99,067	177	1.45	0.60	4,670,194	38	7,783,657	23
L	1.0	165,189	6,118	105,185	150	1.42	0.55	3,653,254	41	6,642,279	23
AP	3.0	66,338	7,371	112,556	159	1.45	0.60	4,494,287	35	7,490,478	21
AI	1.0	19,101	707	113,264	16	1.42	0.55	422,429	38	768,053	21
AX1	2.0	83,908	6,216	119,480	131	1.45	0.60	3,789,776	35	6,316,293	21
AX2	2.0	8,286	614	120,093	12	1.45	0.60	374,223	32	623,704	19
R	2.0	182,809	13,542	133,635	269	1.45	0.60	8,256,686	33	13,761,143	20
J	1.0	44,230	1,638	135,274	34	1.42	0.55	978,182	34	1,778,514	19
AZ	2.0	70,682	5,236	140,510	95	1.45	0.60	3,192,409	30	5,320,681	18
AO	2.0	120,364	8,916	149,426	160	1.45	0.60	5,436,292	29	9,060,487	18
AN	1.5	10,552	586	150,012	10	1.45	0.60	357,428	28	595,713	17
H	2.0	38,067	2,820	152,832	44	1.45	0.60	1,719,297	26	2,865,495	16
AH	2.0	16,952	1,256	154,088	17	1.45	0.60	765,644	23	1,276,074	14
AK	2.0	13,089	970	155,057	11	1.45	0.60	591,183	19	985,305	11
I	3.0	77,819	8,647	163,704	96	1.45	0.60	5,272,100	18	8,786,833	11
AG	1.5	3,406	189	163,893	16	1.45	0.60	115,366	134	192,277	81
Y	1.0	6,528	242	164,135	18	1.42	0.55	144,365	126	262,482	69
AQ	1.5	26,127	1,452	165,587	70	1.45	0.60	885,017	79	1,475,029	48
O	1.0	24,222	897	166,484	29	1.42	0.55	535,684	53	973,972	29
N	1.0	10,643	394	166,878	10	1.42	0.55	235,374	43	427,952	24
B	3.0	8,666	963	167,841	19	1.45	0.60	587,110	33	978,517	20
T	2.0	48,797	3,615	171,456	69	1.45	0.60	2,203,941	31	3,673,235	19
AC	1.0	5,598	207	171,663	4	1.42	0.55	123,799	34	225,089	19
AD	1.0	10,070	373	172,036	7	1.42	0.55	222,701	30	404,911	17
A	2.0	4,751	352	172,388	3	1.45	0.60	214,571	12	357,618	7

NOTE

*Area D was moved to the top of the list because this area would require dredging for navigation purposes regardless of the alternative implemented

TABLE 3-5

CAPPING AND DREDGING TARGET AREA SUMMARY (continued)

CAPPING TARGET AREAS

Cap Target Area	Area (ft^2)	Cumul. Area (ft^2)	PCB Mass (kg)
AB	61,049	61,049	237
AY	6,613	67,663	36
AE	15,732	83,395	36
AL	210,801	294,196	741
U	50,329	344,525	186
W	67,055	411,580	123
AR	17,934	429,514	37
AA	19,080	448,594	48
AI	25,525	474,119	20
AX	64,767	538,886	99
AK	141,576	680,462	264
V	101,330	781,793	182
F	13,450	795,243	20
AQ	12,532	807,774	33
E	3,316	811,091	19

TABLE 3-6

CAPPING AND DREDGING TARGET AREA SEQUENCE: ALTERNATIVE CD-1

DREDGING SEQUENCE

Dredge Target Area	Depth (ft)	Area (ft^2)	Volume (cy^3)	Cumul. Volume (cy^3)	PCB Mass (kg)	PCB Conc. (ppm) wet
A	2.0	4,751	352	352	3	7
B	3.0	8,666	963	1,315	19	20
C	1.0	21,633	801	2,116	204	234
D	1.0	31,181	1,155	3,271	30	24
F	3.0	8,278	920	4,191	26	28
G	3.0	29,700	3,300	7,491	110	33
H	2.0	38,067	2,820	10,311	44	16
I	3.0	77,819	8,647	18,958	96	11
J	1.0	44,230	1,638	20,596	34	19
K	1.0	79,668	2,951	23,547	296	92
L	1.0	165,189	6,118	29,665	150	23
M	1.0	130,101	4,819	34,484	171	33
N	1.0	10,643	394	34,878	10	24
O	1.0	24,222	897	35,775	29	29
P	3.0	32,906	3,656	39,432	272	73
Q	2.0	150,825	11,173	50,604	336	30
R	2.0	182,809	13,542	64,146	269	20
S	2.0	103,402	7,660	71,806	177	23
T	2.0	48,797	3,615	75,421	69	19
U1	3.0	55,102	6,123	81,543	229	37
U2	3.0	32,527	3,614	85,158	117	32
U3	3.0	15,063	1,674	86,831	52	31
W1	1.5	32,601	1,811	88,643	46	25
W2	1.5	26,782	1,488	90,131	51	34
W3	1.5	11,769	654	90,784	20	31
X	1.0	10,740	398	91,182	25	58
Y	1.0	6,528	242	91,424	18	69
Z	3.0	3,144	349	91,773	12	33
AA1	3.0	9,147	1,016	92,790	16	16
AA2	3.0	6,811	757	93,547	23	30
AB1	2.0	7,418	550	94,096	21	37
AB2	2.0	420	31	94,127	0.1	2
AC	1.0	5,598	207	94,335	4	19
AD	1.0	10,070	373	94,708	7	17
AF	2.0	21,621	1,602	96,309	38	23
AG	1.5	3,406	189	96,498	16	81
AH	2.0	16,952	1,256	97,754	17	14
AI	1.0	19,101	707	98,462	16	21
AJ	3.0	107,187	11,910	110,372	346	29
AK	2.0	13,089	970	111,341	11	11
AL1	2.0	69,529	5,151	116,492	94	18
AL2	2.0	35,091	2,599	119,091	60	23
AL3	2.0	34,195	2,533	121,624	181	70
AN	1.5	10,552	586	122,211	10	17
AO	2.0	120,364	8,916	131,127	160	18
AP	3.0	66,338	7,371	138,498	159	21
AQ	1.5	26,127	1,452	139,950	70	48
AR	2.0	36,804	2,726	142,676	89	32
AS	3.0	38,075	4,231	146,907	511	119
AT	1.0	10,063	373	147,279	24	59
AU	2.0	23,256	1,723	149,002	180	103
AV	4.0	36,046	5,340	154,343	252	46
AW	2.0	10,565	783	155,125	90	113
AX1	2.0	83,908	6,216	161,341	131	21
AX2	2.0	8,286	614	161,955	12	19
AY1	3.0	6,703	745	162,699	36	48
AY2	3.0	494	55	162,754	2	42
AZ	2.0	70,682	5,236	167,990	95	18
BA	1.0	80,184	2,970	170,960	165	51
BB	3.0	12,848	1,428	172,388	56	38

TABLE 3-6

CAPPING & DREDGING TARGET AREA SEQUENCE: ALTERNATIVE CD-1 (continued)

CAPPING SEQUENCE

Cap Target Area	Area (ft^2)	Cumul. Area (ft^2)	PCB Mass (kg)
E	3,316	3,316	19
F	13,450	16,767	20
U	50,329	67,095	186
V	101,330	168,426	182
W	67,055	235,481	123
AA	19,080	254,560	48
AB	61,049	315,610	237
AE	15,732	331,342	36
AI	25,525	356,867	20
AK	141,576	498,443	264
AL	210,801	709,244	741
AQ	12,532	721,776	33
AR	17,934	739,710	37
AX	64,767	804,478	99
AY	6,613	811,091	36

TABLE 3-7
CAPPING AND DREDGING TARGET AREA SEQUENCE: ALTERNATIVE CD-2

DREDGING SEQUENCE

Dredge Target Area	Depth (ft)	Area (ft^2)	Volume (cy^3)	Cumul. Volume (cy^3)	PCB Mass (kg)	PCB Conc. (ppm) wet
C	1.0	21,633	801	801	204	234
D	1.0	31,181	1,155	1,956	30	24
G	3.0	29,700	3,300	5,256	110	33
K	1.0	79,668	2,951	8,207	296	92
L	1.0	165,189	6,118	14,325	150	23
M	1.0	130,101	4,819	19,144	171	33
P	3.0	32,906	3,656	22,801	272	73
Q	2.0	150,825	11,173	33,973	336	30
S	2.0	103,402	7,660	41,633	177	23
U1	3.0	55,102	6,123	47,756	229	37
U2	3.0	32,527	3,614	51,370	117	32
U3	3.0	15,063	1,674	53,044	52	31
W1	1.5	32,601	1,811	54,855	46	25
W2	1.5	26,782	1,488	56,343	51	34
W3	1.5	11,769	654	56,997	20	31
X	1.0	10,740	398	57,395	25	58
Z	3.0	3,144	349	57,744	12	33
AA1	3.0	9,147	1,016	58,760	16	16
AA2	3.0	6,811	757	59,517	23	30
AB1	2.0	7,418	550	60,067	21	37
AB2	2.0	420	31	60,098	0.1	2
AF	2.0	21,621	1,602	61,699	38	23
AI	1.0	19,101	707	62,407	16	21
AJ	3.0	107,187	11,910	74,317	346	29
AK	2.0	13,089	970	75,287	11	11
AL1	2.0	69,529	5,151	80,437	94	18
AL2	2.0	35,091	2,599	83,037	60	23
AL3	2.0	34,195	2,533	85,570	181	70
AP	3.0	66,338	7,371	92,941	159	21
AR	2.0	36,804	2,726	95,667	89	32
AS	3.0	38,075	4,231	99,898	511	119
AT	1.0	10,063	373	100,271	24	59
AU	2.0	23,256	1,723	101,993	180	103
AV	4.0	36,046	5,340	107,334	252	46
AW	2.0	10,565	783	108,116	90	113
AX1	2.0	83,908	6,216	114,332	131	21
AX2	2.0	8,286	614	114,946	12	19
AY1	3.0	6,703	745	115,691	36	48
AY2	3.0	494	55	115,746	2	42
BA	1.0	80,184	2,970	118,715	165	51
BB	3.0	12,848	1,428	120,143	56	38

CAPPING SEQUENCE

Cap Target Area	Area (ft^2)	Cumul. Area (ft^2)	PCB Mass (kg)
U	50,329	50,329	186
W	67,055	117,384	123
AA	19,080	136,464	48
AB	61,049	197,513	237
AE	15,732	213,245	36
AI	25,525	238,770	20
AK	141,576	380,346	264
AL	210,801	591,147	741
AR	17,934	609,082	37
AX	64,767	673,849	99
AY	6,613	680,462	36

TABLE 3-8
CAPPING AND DREDGING TARGET AREA SEQUENCE: ALTERNATIVE CD-3

DREDGING SEQUENCE

Dredge Target Area	Depth (ft)	Area (ft^2)	Volume (cy^3)	Cumul. Volume (cy^3)	PCB Mass (kg)	PCB Conc. (ppm) wet
C	1.0	21,633	801	801	204	234
D	1.0	31,181	1,155	1,956	30	24
G	3.0	29,700	3,300	5,256	110	33
K	1.0	79,668	2,951	8,207	296	92
M	1.0	130,101	4,819	13,026	171	33
P	3.0	32,906	3,656	16,682	272	73
U1	3.0	55,102	6,123	22,805	229	37
U2	3.0	32,527	3,614	26,419	117	32
U3	3.0	15,063	1,674	28,093	52	31
W1	1.5	32,601	1,811	29,904	46	25
W2	1.5	26,782	1,488	31,392	51	34
W3	1.5	11,769	654	32,046	20	31
X	1.0	10,740	398	32,444	25	58
Z	3.0	3,144	349	32,793	12	33
AB1	2.0	7,418	550	33,343	21	37
AB2	2.0	420	31	33,374	0.1	2
AL1	2.0	69,529	5,151	38,524	94	18
AL2	2.0	35,091	2,599	41,124	60	23
AL3	2.0	34,195	2,533	43,657	181	70
AS	3.0	38,075	4,231	47,888	511	119
AT	1.0	10,063	373	48,260	24	59
AU	2.0	23,256	1,723	49,983	180	103
AV	4.0	36,046	5,340	55,323	252	46
AW	2.0	10,565	783	56,106	90	113
AY1	3.0	6,703	745	56,851	36	48
AY2	3.0	494	55	56,906	2	42
BA	1.0	80,184	2,970	59,876	165	51
BB	3.0	12,848	1,428	61,303	56	38

CAPPING SEQUENCE

Cap Target Area	Area (ft^2)	Cumul. Area (ft^2)	PCB Mass (kg)
U	50,329	50,329	186
W	67,055	117,384	123
AB	61,049	178,433	237
AE	15,732	194,165	36
AL	210,801	404,966	741
AY	6,613	411,580	36

TABLE 3-9
COMPARISON OF ALTERNATIVES

	Alternative 1: No Action	**Alternatives D-1, D-2, D-3: Dredging & Offsite Disposal**	**Alternatives CD-1, CD-2, CD-3: Capping Dredging & Offsite Disposal**
Major Components	No remedial action	Removal of PCB-contaminated fine-grained sediments using environmental backhoe, suction removal of excess water from containers, stabilization of sediments with Portland Cement, transporting dewatered sediments to disposal landfill. Three scenarios involving increasing amounts of contaminated sediments with diminishing bulk concentration of PCBs.	Same as Alternatives D1, D2, D3, except contaminated areas in water depths of >6 feet are capped rather than dredged. Three scenarios involving increasing amounts of contaminated sediments with diminishing bulk concentration of PCBs.
Short-Term Effectiveness • Protection of community • Protection of workers • Environmental impacts • Time to achieve protection	No short-term, construction related effects would be incurred as there are no onsite construction activities.	Sediment resuspension during dredging can result in increased exposure to fish/biota and recreational users. Will be reduced by using environmental backhoe, prohibition of barge/container overflow, and use of sediment barriers where feasible. Exposure of workers will be minimized through use of personal protective equipment. Some interference to navigation and recreational activities may occur. Spill/leaking during transportation minimized through use of watertight containers. Disrupts benthic habitat temporarily; since fine-grained sediments will remain in most locations, communities will recover. Implementation would require 1 to 4 dredging seasons (May to November).	Similar impacts as for dredging alone. Two operations during part of the season as capping operation follows behind dredging. A 4-inch layer of silt will be placed on top of the Aquablok layer to provide habitat environment for benthic biota in capped areas. Implementation would require 1 to 3 construction seasons (May to November).
Long-Term Effectiveness and Permanence • Magnitude of residual risk • Adequacy of controls • Reliability	Long-term residual risks will not be affected by this alternative.	At this time, residual risk after implementation will not be quantified, although qualitatively there is expected to be some reduction in overall risk as a removal of PCB mass. Dredging using backhoe is a proven technology for sediment removal.	At this time, residual risk after implementation will not be quantified, although qualitatively there is expected to be some reduction in overall risk as a result of removal and capping of PCB mass. Dredging using backhoe is a proven technology for sediment removal. Capping with bentonite is a proven method for chemical isolation, though not in riverine environments. Long-term performance and reliability of cap depends on annual inspection and proper cap maintenance. Long-term effectiveness of cap may be affected by ice flow in river during spring.

TABLE 3-9
COMPARISON OF ALTERNATIVES

	Alternative 1: No Action	**Alternatives D-1, D-2, D-3: Dredging & Offsite Disposal**	**Alternatives CD-1, CD-2, CD-3: Capping Dredging & Offsite Disposal**
Reduction in Mobility, Toxicity, or Volume	No reduction in mobility, toxicity, or volume is expected except through natural processes such as biodegradation.	Reduction in volume of PCBs is achieved through removal and offsite landfill disposal. Will remove 40% to 90% of PCB mass of TIP, depending on option selected.	Dredging will remove 40% to 65% of PCB mass of TIP, depending on option selected. Capping will isolate 15% to 25% of PCB mass of TIP and decrease mobility of PCBs, depending on option selected. Total removal and isolation will be 55% to 90% of the PCB mass of the TIP.
Implementability • Technical feasibility • Administrative feasibility • Availability of services	Implementable	All elements of this alternative are technically feasible. Dredging services and equipment are readily available. Availability of containers and rail flat cars for transportation is uncertain. Determination of administrative feasibility will involve discussions with NYSDEC, USACE, NYS Thruway.	All elements of this alternative are technically feasible. Dredging and capping services, supplies and equipment are readily available. Availability of containers and rail flat cars for transportation is uncertain. Determination of administrative feasibility will involve discussions with NYSDEC, USACE, NYS Thruway.
Cost	No cost associated with remediation	Alt. D-1 (Dredge ~238,000 cy over 4 year): $101M Alt. D-2 (Dredge ~120,000 cy over 2 years): $66M Alt. D-3 (Dredge ~59,000 cy over 1 years): $48M	Alt. CD-1 (Dredge ~172,000 cy over 3 years, cap 811,000 sf over 2 years): $83M Alt. CD-2 (Dredge ~120,000 cy, cap 680,000 sf over 2 years): $66M Alt. CD-3 (Dredge ~61,000 cy, cap 412,000 sf over 1 year): $47M
Compliance with ARARs	To be determined.		
Overall Protection of Human Health & the Environment	Residual risk levels are unchanged. PCB levels in fish will remain elevated.	This option is expected to result in overall protection of human health and the environment due to removal of PCB mass.	This option is expected to result in overall protection of human health and the environment due to removal and capping of PCB mass. Provided that the cap is maintained, capping limits PCB migration to water column and decreases exposure of PCBs to biota.
State Acceptance	To be addressed after public comment period.		
Community Acceptance	To be addressed after public comment period.		

TABLE 3-10

Hudson River PCB Reassessment RI/FS
Thompson Island Pool
Dredging and Capping/Dredging Alternatives Summary Data

Alternative	Volume Sediment Removed (cy)	Fraction TIP Fine-Grained Sediment Removed (%)	Mass PCBs Removed (Kg)	Fraction TIP FG Sed PCBs Removed (%)	Vol Wtd Mean PCB Conc Removed (ppm)	Vol Wtd Mean PCB Conc (FG) Not Removed (ppm)	Sediment Area Capped (sf)	Fraction TIP FG Sediment Capped (% - sf)	Mass PCBs Capped (Kg)	Fraction TIP FG Sed PCBs Capped (%)	Mass PCBs Removed & Capped (Kg)	Fraction TIP FG Sed PCBs Removed & Capped (%)	Fraction Total TIP PCBs Removed & Capped (%)	Estimated Cost (1998$)
D-1 Dredging Only - 4-Year Program	238,000	45	7,950	90	55	4					7,950	90	55	101 MM
D-2 Dredging Only - 2-Year Program	120,000	20	5,450	65	75	12					5,450	65	35	66 MM
D-3 Dredging Only - 1-Year Program	59,000	10	3,550	40	98	17					3,550	40	25	48 MM
CD-1 Capping & Dredging - 3-Year Program	172,000	30	5,800	65	55	12	811,000	15	2,100	25	7,900	90	55	83 MM
CD-2 Capping & Dredging - 2-Year Program	120,000	20	4,800	55	66	14	680,000	10	1,850	20	6,650	75	45	66 MM
CD-3 Capping & Dredging - 1-Year Program	61,000	10	3,300	40	89	17	412,000	5	1,350	15	4,650	55	30	47 MM

NOTES:
1. Total PCB mass in TIP fine-grained sediments is estimated to be 8.7 metric tons.
2. Total PCB mass in TIP sediments is estimated to be 14.9 metric tons (including 6.2 metric tons in coarse-grained sediments).
3. All figures are rounded to convenient multiples of 1 (concentrations), 5 (mass fractions), 50 (PCB mass), 1,000 (volumes and areas), or 10**6 ($).

HUDSON RIVER THOMPSON ISLAND POOL REMEDIATION ESTIMATED COSTS
DREDGING ALTERNATIVE D-1 - 4 YEAR PROGRAM

ITEM	QUANTITY	UNIT	UNIT COST	COST
General Conditions	1	LS	$1,920,000	$1,920,000
Mobilization (Contractor's facilities)	1	LS	$102,300	$102,300
Site Preparation - Treatment Area				
Clearing	19	acre	$3,925	$74,575
Base preparation (grading, compaction, aggregate)	19	acre	$2,655	$50,445
Construct/repair road and work areas	10,000	sy	$9.20	$92,000
Dredging channel (incl. handling, transport, and disposal)	11,400	cy	$173	$1,971,744
Railroad spur	1,200	lf	$243	$291,000
Install fence	1	each	$63,640	$63,640
Decon facility (incl. containment pad for mixing station)	1	pad	$44,865	$44,865
Surveying (channel/land)	1	LS	$72,450	$72,450
Unloading Facility Construction	1	each	$3,200,000	$3,200,000
Water Treatment Facility	1	each	$200,000	$200,000
Dredging				
Mobilization/Demobilization	4	each	$34,290	$137,160
Mechanical (closed-bucket environmental backhoe)	238,000	cy	$12.27	$2,920,577
Sediment barriers	20	month	$39,405	$788,100
Sampling crew (confirmation sampling during dredging)	20	month	$18,040	$360,800
Confirmation sampling (field screening) (1 sample/5000 sf)	8	100 assay kit	$1,300	$10,400
Confirmation sampling analysis (10% field screening samples)	72	each	$320	$23,040
Testing and Monitoring (during remediation)				
Sampling crew (turbidity, water, fish)	20	month	$14,260	$285,200
Suspended sediment monitoring equipment	1	LS	$1,500	$1,500
Fish sample analysis	20	month	$14,220	$284,400
Water sample analysis	20	month	$17,700	$354,000
Barging				
Mobilization/Demobilization	4	each	$29,675	$118,700
Barges and tugs	238,000	cy	$9.89	$2,353,820
Stabilization				
Processing (cement, equipment, labor)	238,000	cy	$22.685	$5,399,030
Sediment Handling/Transport				
Container purchase (30-cy containers)	260	container	$6,000	$1,560,000
Container handling	20	month	$41,920	$838,400
Unload barge w/ crane/Load RR car w/ crane (incl. crane mob/demob)	20	month	$75,720	$1,514,400
Flat car leasing (65 cars for 24 months)	1,560	car-month	$550	$858,000
Rail transport (to CECOS)	3,214	car-trip	$1,722	$5,534,508
Rail transport (to Wayne Disposal, Michigan)	1,037	car-trip	$1,922	$1,993,114
Sediment unloading (at landfill)	238,000	cy	$2	$476,000
Landfill Fees				
Sediment Disposal (0-50 ppm PCBs)	270,000	ton	$22	$5,940,000
Sediment Disposal (>50 ppm PCBs)	87,125	ton	$110	$9,583,750
Sediment Sampling prior to Disposal (Non-hazardous landfill only)	270	1000 tons	$1,268	$342,360
Water Treatment	16,025	1000 gal	$17.13	$274,508
Debris Handling	20	month	$2,500	$50,000
Debris Disposal (incl. transport)	10,000	ton	$85	$850,000
Demobilization	1	LS	$87,600	$87,600
Project Closeout	1	LS	$20,000	$20,000
DIRECT COSTS				$51,042,386
G & A (15% Direct Costs)				$7,656,358
SUBTOTAL (Direct Costs + G&A)				$58,698,744
Profit (8% (Direct Costs + G&A))				$4,695,899
SUBTOTAL				$63,394,643
Bond (2.5% (Direct Costs + G&A + Profit))				$1,584,866
SUBTOTAL				$64,979,509
Design Contigency (20% (Direct Costs + G&A + Profit + Bond))				$12,995,902
SUBTOTAL				$77,975,411
Escalation (4% (Direct Costs + G&A + Profit + Bond + Design Contingency))				$3,119,016
SUBTOTAL				$81,094,428
Contingency (15% (Direct Costs + G&A + Profit + Bond + Design Contingency + Escalation))				$12,164,164
SUBTOTAL				$93,258,592
SIOH (8% (Direct Costs + G&A + Profit + Bond + Design Contingency + Escalation + Contingency))				$7,460,687
TOTAL PROJECT COSTS				**$100,719,000**

HUDSON RIVER THOMPSON ISLAND POOL REMEDIATION ESTIMATED COSTS
DREDGING ALTERNATIVE D-2 - 2 YEAR PROGRAM

ITEM	QUANTITY	UNIT	UNIT COST	COST
General Conditions	1	LS	$990,060	$990,060
Mobilization (Contractor's facilities)	1	LS	$98,300	$98,300
Site Preparation - Treatment Area				
Clearing	19	acre	$3,925	$74,575
Base preparation (grading, compaction, aggregate)	19	acre	$2,655	$50,445
Construct/repair road and work areas	10,000	sy	$9.20	$92,000
Dredging channel (incl. handling, transport, and disposal)	11,400	cy	$173	$1,971,744
Railroad spur	1,200	lf	$243	$291,000
Install fence	1	each	$63,640	$63,640
Decon facility (incl. containment pad for mixing station)	1	pad	$44,865	$44,865
Surveying (channel/land)	1	LS	$72,450	$72,450
Unloading Facility Construction	1	each	$3,200,000	$3,200,000
Water Treatment Facility	1	each	$200,000	$200,000
Dredging				
Mobilization/Demobilization	2	each	$34,290	$68,580
Mechanical (closed-bucket environmental backhoe)	120,000	cy	$12.27	$1,472,560
Sediment barriers	10	month	$39,405	$394,050
Sampling crew (confirmation sampling during dredging)	10	month	$18,040	$180,400
Confirmation sampling (field screening) (1 sample/5000 sf)	4	100 assay kit	$1,300	$5,200
Confirmation sampling analysis (10% field screening samples)	36	each	$320	$11,520
Testing and Monitoring (during remediation)				
Sampling crew (turbidity, water, fish)	10	month	$14,260	$142,600
Suspended sediment monitoring equipment	1	LS	$1,500	$1,500
Fish sample analysis	10	month	$14,220	$142,200
Water sample analysis	10	month	$17,700	$177,000
Barging				
Mobilization/Demobilization	2	each	$29,675	$59,350
Barges and tugs	120,000	cy	$9.89	$1,186,800
Stabilization				
Processing (cement, equipment, labor)	120,000	cy	$22.685	$2,722,200
Sediment Handling/Transport				
Container purchase (30-cy containers)	260	container	$6,000	$1,560,000
Container handling	10	month	$41,920	$419,200
Unload barge w/ crane/Load RR car w/ crane (incl. crane mob/demob)	10	month	$75,720	$757,200
Flat car leasing (65 cars for 12 months)	780	car-month	$550	$429,000
Rail transport (to CECOS)	1,107	car-trip	$1,722	$1,906,254
Rail transport (to Wayne Disposal, Michigan)	1,037	car-trip	$1,922	$1,993,114
Sediment unloading (at landfill)	120,000	cy	$2	$240,000
Landfill Fees				
Sediment Disposal (0-50 ppm PCBs)	93,000	ton	$22	$2,046,000
Sediment Disposal (>50 ppm PCBs)	87,125	ton	$110	$9,583,750
Sediment Sampling prior to Disposal (Non-hazardous landfill only)	93	1000 tons	$1,268	$117,924
Water Treatment	8,080	1000 gal	$17.13	$138,410
Debris Handling	10	month	$2,500	$25,000
Debris Disposal (incl. transport)	5,000	ton	$85	$425,000
Demobilization	1	LS	$87,600	$87,600
Project Closeout	1	LS	$20,000	$20,000
DIRECT COSTS				$33,461,491
G & A (15% Direct Costs)				$5,019,224
SUBTOTAL (Direct Costs + G&A)				$38,480,715
Profit (8% (Direct Costs + G&A))				$3,078,457
SUBTOTAL				$41,559,172
Bond (2.5% (Direct Costs + G&A + Profit))				$1,038,979
SUBTOTAL				$42,598,151
Design Contigency (20% (Direct Costs + G&A + Profit + Bond))				$8,519,630
SUBTOTAL				$51,117,781
Escalation (4% (Direct Costs + G&A + Profit + Bond + Design Contingency))				$2,044,711
SUBTOTAL				$53,162,493
Contingency (15% (Direct Costs + G&A + Profit + Bond + Design Contingency + Escalation))				$7,974,374
SUBTOTAL				$61,136,866
SIOH (8% (Direct Costs + G&A + Profit + Bond + Design Contingency + Escalation + Contingency))				$4,890,949
TOTAL PROJECT COSTS				**$66,028,000**

HUDSON RIVER THOMPSON ISLAND POOL REMEDIATION ESTIMATED COSTS
DREDGING ALTERNATIVE D-3 - 1 YEAR PROGRAM

ITEM	QUANTITY	UNIT	UNIT COST	COST
General Conditions	1	LS	$525,100	$525,100
Mobilization (Contractor's facilities)	1	LS	$96,300	$96,300
Site Preparation - Treatment Area				
Clearing	19	acre	$3,925	$74,575
Base preparation (grading, compaction, aggregate)	19	acre	$2,655	$50,445
Construct/repair road and work areas	10,000	sy	$9.20	$92,000
Dredging channel (incl. handling, transport, and disposal)	11,400	cy	$173	$1,971,744
Railroad spur	1,200	lf	$243	$291,000
Install fence	1	each	$63,640	$63,640
Decon facility (incl. containment pad for mixing station)	1	pad	$44,865	$44,865
Surveying (channel/land)	1	LS	$72,450	$72,450
Unloading Facility Construction	1	each	$3,200,000	$3,200,000
Water Treatment Facility	1	each	$200,000	$200,000
Dredging				
Mobilization/Demobilization	1	each	$34,290	$34,290
Mechanical (closed-bucket environmental backhoe)	59,000	cy	$12.27	$724,008
Sediment barriers	5	month	$39,405	$197,025
Sampling crew (confirmation sampling during dredging)	5	month	$18,040	$90,200
Confirmation sampling (field screening) (1 sample/5000 sf)	2	100 assay kit	$1,300	$2,600
Confirmation sampling analysis (10% field screening samples)	19	each	$320	$6,080
Testing and Monitoring (during remediation)				
Sampling crew (turbidity, water, fish)	5	month	$14,260	$71,300
Suspended sediment monitoring equipment	1	LS	$1,500	$1,500
Fish sample analysis	5	month	$14,220	$71,100
Water sample analysis	5	month	$17,700	$88,500
Barging				
Mobilization/Demobilization	1	each	$29,675	$29,675
Barges and tugs	59,000	cy	$9.89	$583,510
Stabilization				
Processing (cement, equipment, labor)	59,000	cy	$22.685	$1,338,415
Sediment Handling/Transport				
Container purchase (30-cy containers)	260	container	$6,000	$1,560,000
Container handling	5	month	$41,920	$209,600
Unload barge w/ crane/Load RR car w/ crane (incl. crane mob/demob)	5	month	$75,720	$378,600
Flat car leasing (65 cars for 6 months)	390	car-month	$550	$214,500
Rail transport (to CECOS)	17	car-trip	$1,722	$29,274
Rail transport (to Wayne Disposal, Michigan)	1,037	car-trip	$1,922	$1,993,114
Sediment unloading (at landfill)	59,000	cy	$2	$118,000
Landfill Fees				
Sediment Disposal (0-50 ppm PCBs)	1,400	ton	$22	$30,800
Sediment Disposal (>50 ppm PCBs)	87,125	ton	$110	$9,583,750
Sediment Sampling prior to Disposal (Non-hazardous landfill only)	2	1000 tons	$1,268	$2,536
Water Treatment	4,000	1000 gal	$17.13	$68,520
Debris Handling	5	month	$2,500	$12,500
Debris Disposal (incl. transport)	2,500	ton	$85	$212,500
Demobilization	1	LS	$87,600	$87,600
Project Closeout	1	LS	$20,000	$20,000
DIRECT COSTS				$24,441,616
G & A (15% Direct Costs)				$3,666,242
SUBTOTAL (Direct Costs + G&A)				$28,107,859
Profit (8% (Direct Costs + G&A))				$2,248,629
SUBTOTAL				$30,356,488
Bond (2.5% (Direct Costs + G&A + Profit))				$758,912
SUBTOTAL				$31,115,400
Design Contigency (20% (Direct Costs + G&A + Profit + Bond))				$6,223,080
SUBTOTAL				$37,338,480
Escalation (4% (Direct Costs + G&A + Profit + Bond + Design Contingency))				$1,493,539
SUBTOTAL				$38,832,019
Contingency (15% (Direct Costs + G&A + Profit + Bond + Design Contingency + Escalation))				$5,824,803
SUBTOTAL				$44,656,822
SIOH (8% (Direct Costs + G&A + Profit + Bond + Design Contingency + Escalation + Contingency))				$3,572,546
TOTAL PROJECT COSTS				**$48,229,000**

HUDSON RIVER THOMPSON ISLAND POOL REMEDIATION ESTIMATED COSTS
CAPPING AND DREDGING ALTERNATIVE CD-1 - 3 YEAR PROGRAM

ITEM	QUANTITY	UNIT	UNIT COST	COST
General Conditions	1	LS	$1,564,500	$1,564,500
Mobilization (Contractor's facilities)	1	LS	$99,600	$99,600
Site Preparation - Treatment Area				
Clearing	19	acre	$3,925	$74,575
Base preparation (grading, compaction, aggregate)	19	acre	$2,655	$50,445
Construct/repair road and work areas	10,000	sy	$9.20	$92,000
Dredging channel (incl. handling, transport, and disposal)	11,400	cy	$173	$1,971,744
Railroad spur	1,200	lf	$243	$291,000
Install fence	1	each	$63,640	$63,640
Decon facility (incl. containment pad for mixing station)	1	pad	$44,865	$44,865
Surveying (channel/land)	1	LS	$72,450	$72,450
Unloading Facility Construction	1	each	$3,200,000	$3,200,000
Water Treatment Facility	1	each	$200,000	$200,000
Dredging				
Mobilization/Demobilization	3	each	$34,290	$102,870
Mechanical (closed-bucket environmental backhoe)	172,000	cy	$12.27	$2,110,669
Sediment barriers	15	month	$39,510	$592,650
Sampling crew (confirmation sampling during dredging)	15	month	$18,040	$270,600
Confirmation sampling (field screening) (1 sample/5000 sf)	6	100 assay kit	$1,300	$7,800
Confirmation sampling analysis (10% field screening samples)	53	each	$320	$16,960
Testing and Monitoring (during remediation)				
Sampling crew (turbidity, water, fish)	15	month	$14,260	$213,900
Suspended sediment monitoring equipment	1	LS	$1,500	$1,500
Fish sample analysis	15	month	$14,220	$213,300
Water sample analysis	15	month	$17,700	$265,500
Barging				
Mobilization/Demobilization	3	each	$29,675	$89,025
Barges and tugs	172,000	cy	$9.89	$1,701,080
Stabilization				
Processing (cement, equipment, labor)	172,000	cy	$22.744	$3,911,968
Sediment Handling/Transport				
Container purchase (30-cy containers)	260	container	$6,000	$1,560,000
Container handling	15	month	$41,920	$628,800
Unload barge w/ crane/Load RR car w/ crane	15	month	$75,720	$1,135,800
Flat car leasing (65 cars for 18 months)	1,170	car-month	$550	$643,500
Rail transport (to CECOS)	2,453	car-trip	$1,722	$4,224,066
Rail transport (to Wayne Disposal, Michigan)	619	car-trip	$1,922	$1,189,718
Sediment unloading (at landfill)	172,000	cy	$2	$344,000
Landfill Fees				
Sediment Disposal (0-50 ppm PCBs)	206,000	ton	$22	$4,532,000
Sediment Disposal (>50 ppm PCBs)	52,000	ton	$110	$5,720,000
Sediment Sampling prior to Disposal (Non-hazardous landfill only)	206	1000 tons	$1,268	$261,208
Capping				
Cap installation (Aquablok, sand, silt)	811	1000 sf	$3,168.60	$2,569,735
Silt retrieval dredging	10,000	cy	$8.09	$80,900
Storage facility (for Aquablok)	1	each	$30,000	$30,000
Mobilization/Demobilization barge for capping	2	each	$22,190	$44,380
Barge and tug	10	month	$88,500	$885,000
Water Treatment	11,600	1000 gal	$17.28	$200,448
Debris Handling	15	month	$2,500	$37,500
Debris Disposal (incl. transport)	7,500	ton	$85	$637,500
Demobilization	1	LS	$87,600	$87,600
Project Closeout	1	LS	$20,000	$20,000
DIRECT COSTS				$42,054,795
G & A (15% Direct Costs)				$6,308,219
SUBTOTAL (Direct Costs + G&A)				$48,363,015
Profit (8% (Direct Costs + G&A))				$3,869,041
SUBTOTAL				$52,232,056
Bond (2.5% (Direct Costs + G&A + Profit))				$1,305,801
SUBTOTAL				$53,537,857
Design Contigency (20% (Direct Costs + G&A + Profit + Bond))				$10,707,571
SUBTOTAL				$64,245,429
Escalation (4% (Direct Costs + G&A + Profit + Bond + Design Contingency))				$2,569,817
SUBTOTAL				$66,815,246
Contingency (15% (Direct Costs + G&A + Profit + Bond + Design Contingency + Escalation))				$10,022,287
SUBTOTAL				$76,837,533
SIOH (8% (Direct Costs + G&A + Profit + Bond + Design Contingency + Escalation + Contingency))				$6,147,003
TOTAL PROJECT COSTS				**$82,985,000**

HUDSON RIVER THOMPSON ISLAND POOL REMEDIATION ESTIMATED COSTS
CAPPING AND DREDGING ALTERNATIVE CD-2 - 2 YEAR PROGRAM

ITEM	QUANTITY	UNIT	UNIT COST	COST
General Conditions	1	LS	$1,063,070	$1,063,070
Mobilization (Contractor's facilities)	1	LS	$97,850	$97,850
Site Preparation - Treatment Area				
Clearing	19	acre	$3,925	$74,575
Base preparation (grading, compaction, aggregate)	19	acre	$2,655	$50,445
Construct/repair road and work areas	10,000	sy	$9.20	$92,000
Dredging channel (incl. handling, transport, and disposal)	11,400	cy	$173	$1,971,744
Railroad spur	1,200	lf	$243	$291,000
Install fence	1	each	$63,640	$63,640
Decon facility (incl. containment pad for mixing station)	1	pad	$44,865	$44,865
Surveying (channel/land)	1	LS	$72,450	$72,450
Unloading Facility Construction	1	each	$3,200,000	$3,200,000
Water Treatment Facility	1	each	$200,000	$200,000
Dredging				
Mobilization/Demobilization	2	each	$34,290	$68,580
Mechanical (closed-bucket environmental backhoe)	120,000	cy	$12.27	$1,472,560
Sediment barriers	10	month	$39,510	$395,100
Sampling crew (confirmation sampling during dredging)	10	month	$18,040	$180,400
Confirmation sampling (field screening) (1 sample/5000 sf)	4	100 assay kit	$1,300	$5,200
Confirmation sampling analysis (10% field screening samples)	37	each	$320	$11,840
Testing and Monitoring (during remediation)				
Sampling crew (turbidity, water, fish)	10	month	$14,260	$142,600
Suspended sediment monitoring equipment	1	LS	$1,500	$1,500
Fish sample analysis	10	month	$14,220	$142,200
Water sample analysis	10	month	$17,700	$177,000
Barging				
Mobilization/Demobilization	2	each	$29,675	$59,350
Barges and tugs	120,000	cy	$9.89	$1,186,800
Stabilization				
Processing (cement, equipment, labor)	120,000	cy	$22.744	$2,729,280
Sediment Handling/Transport				
Container purchase (30-cy containers)	260	container	$6,000	$1,560,000
Container handling	10	month	$41,920	$419,200
Unload barge w/ crane/Load RR car w/ crane	10	month	$75,720	$757,200
Flat car leasing (65 cars for 12 months)	780	car-month	$550	$429,000
Rail transport (to CECOS)	1,524	car-trip	$1,722	$2,624,328
Rail transport (to Wayne Disposal, Michigan)	619	car-trip	$1,922	$1,189,718
Sediment unloading (at landfill)	120,000	cy	$2	$240,000
Landfill Fees				
Sediment Disposal (0-50 ppm PCBs)	128,000	ton	$22	$2,816,000
Sediment Disposal (>50 ppm PCBs)	52,000	ton	$110	$5,720,000
Sediment Sampling prior to Disposal (Non-hazardous landfill only)	128	1000 tons	$1,268	$162,304
Capping				
Cap installation (Aquablok, sand, silt)	680	1000 sf	$3,168.60	$2,154,648
Silt retrieval dredging	8,400	cy	$8.09	$67,956
Storage facility (for Aquablok)	1	each	$30,000	$30,000
Mobilization/Demobilization barge for capping	2	each	$22,190	$44,380
Barge and tug	10	month	$88,500	$885,000
Water Treatment	8,080	1000 gal	$17.28	$139,622
Debris Handling	10	month	$2,500	$25,000
Debris Disposal (incl. transport)	5,000	ton	$85	$425,000
Demobilization	1	LS	$87,600	$87,600
Project Closeout	1	LS	$20,000	$20,000
DIRECT COSTS				$33,591,005
G & A (15% Direct Costs)				$5,038,651
SUBTOTAL (Direct Costs + G&A)				$38,629,656
Profit (8% (Direct Costs + G&A))				$3,090,372
SUBTOTAL				$41,720,028
Bond (2.5% (Direct Costs + G&A + Profit))				$1,043,001
SUBTOTAL				$42,763,029
Design Contigency (20% (Direct Costs + G&A + Profit + Bond))				$8,552,606
SUBTOTAL				$51,315,635
Escalation (4% (Direct Costs + G&A + Profit + Bond + Design Contingency))				$2,052,625
SUBTOTAL				$53,368,260
Contingency (15% (Direct Costs + G&A + Profit + Bond + Design Contingency + Escalation))				$8,005,239
SUBTOTAL				$61,373,499
SIOH (8% (Direct Costs + G&A + Profit + Bond + Design Contingency + Escalation + Contingency))				$4,909,880
TOTAL PROJECT COSTS				**$66,283,000**

HUDSON RIVER THOMPSON ISLAND POOL REMEDIATION ESTIMATED COSTS
CAPPING AND DREDGING ALTERNATIVE CD-3 - 1 YEAR PROGRAM

ITEM	QUANTITY	UNIT	UNIT COST	COST
General Conditions	1	LS	$560,620	$560,620
Mobilization (Contractor's facilities)	1	LS	$96,080	$96,080
Site Preparation - Treatment Area				
Clearing	19	acre	$3,925	$74,575
Base preparation (grading, compaction, aggregate)	19	acre	$2,655	$50,445
Construct/repair road and work areas	10,000	sy	$9.20	$92,000
Dredging channel (incl. handling, transport, and disposal)	11,400	cy	$173	$1,971,744
Railroad spur	1,200	lf	$243	$291,000
Install fence	1	each	$63,640	$63,640
Decon facility (incl. containment pad for mixing station)	1	pad	$44,865	$44,865
Surveying (channel/land)	1	LS	$72,450	$72,450
Unloading Facility Construction	1	each	$3,200,000	$3,200,000
Water Treatment Facility	1	each	$200,000	$200,000
Dredging				
Mobilization/Demobilization	1	each	$34,290	$34,290
Mechanical (closed-bucket environmental backhoe)	61,000	cy	$12.27	$748,551
Sediment barriers	5	month	$39,510	$197,550
Sampling crew (confirmation sampling during dredging)	5	month	$18,040	$90,200
Confirmation sampling (field screening) (1 sample/5000 sf)	2	100 assay kit	$1,300	$2,600
Confirmation sampling analysis (10% field screening samples)	20	each	$320	$6,400
Testing and Monitoring (during remediation)				
Sampling crew (turbidity, water, fish)	5	month	$14,260	$71,300
Suspended sediment monitoring equipment	1	LS	$1,500	$1,500
Fish sample analysis	5	month	$14,220	$71,100
Water sample analysis	5	month	$17,700	$88,500
Barging				
Mobilization/Demobilization	1	each	$29,675	$29,675
Barges and tugs	61,000	cy	$9.89	$603,290
Stabilization				
Processing (cement, equipment, labor)	61,000	cy	$22.744	$1,387,384
Sediment Handling/Transport				
Container purchase (30-cy containers)	260	container	$6,000	$1,560,000
Container handling	5	month	$41,920	$209,600
Unload barge w/ crane/Load RR car w/ crane	5	month	$75,720	$378,600
Flat car leasing (65 cars for 6 months)	390	car-month	$550	$214,500
Rail transport (to CECOS)	476	car-trip	$1,722	$819,672
Rail transport (to Wayne Disposal, Michigan)	619	car-trip	$1,922	$1,189,718
Sediment unloading (at landfill)	61,000	cy	$2	$122,000
Landfill Fees				
Sediment Disposal (0-50 ppm PCBs)	40,000	ton	$22	$880,000
Sediment Disposal (>50 ppm PCBs)	52,000	ton	$110	$5,720,000
Sediment Sampling prior to Disposal (Non-hazardous landfill only)	40	1000 tons	$1,268	$50,720
Capping				
Cap installation (Aquablok, sand, silt)	412	1000 sf	$3,168.60	$1,305,463
Silt retrieval dredging	5,100	cy	$8.09	$41,259
Storage facility (for Aquablok)	1	each	$30,000	$30,000
Mobilization/Demobilization barge for capping	1	each	$22,190	$22,190
Barge and tug	10	month	$88,500	$885,000
Water Treatment	4,100	1000 gal	$17.28	$70,848
Debris Handling	5	month	$2,500	$12,500
Debris Disposal (incl. transport)	2,500	ton	$85	$212,500
Demobilization	1	LS	$87,600	$87,600
Project Closeout	1	LS	$20,000	$20,000
DIRECT COSTS				$23,881,929
G & A (15% Direct Costs)				$3,582,289
SUBTOTAL (Direct Costs + G&A)				$27,464,219
Profit (8% (Direct Costs + G&A))				$2,197,137
SUBTOTAL				$29,661,356
Bond (2.5% (Direct Costs + G&A + Profit))				$741,534
SUBTOTAL				$30,402,890
Design Contigency (20% (Direct Costs + G&A + Profit + Bond))				$6,080,578
SUBTOTAL				$36,483,468
Escalation (4% (Direct Costs + G&A + Profit + Bond + Design Contingency))				$1,459,339
SUBTOTAL				$37,942,807
Contingency (15% (Direct Costs + G&A + Profit + Bond + Design Contingency + Escalation))				$5,691,421
SUBTOTAL				$43,634,228
SIOH (8% (Direct Costs + G&A + Profit + Bond + Design Contingency + Escalation + Contingency))				$3,490,738
TOTAL PROJECT COSTS				$47,125,000

HUDSON RIVER PCB R/Rev 12/14/98
Dredging of Hudson River to
Remove PCB Contaminated
Sediments

Designed By: Conceptual Idea Only - No Design
Estimated By: PE-C

Prepared By: RCM

Preparation Date: 09/21/98
Effective Date of Pricing: 01/01/98
Est Construction Time: 540 Days

Sales Tax: 0.00%

HUDSON RIVER PCB REMEDIATION

Contract Loading is as follows:

General conditions (site overhead and home office support) are itemized as a direct item.

G & A	=	15%
Profit	=	8%
Bond	=	2.5%
Design Contingency	=	20%
Escalation	=	4%
Reserve Contingecy	=	15%
SIOH	=	8%

The base for the estimate is judged to be current with midpoint of construction in two years.

** PROJECT OWNER SUMMARY - Contract **

		QUANTY	UOM	CONTRACT	ESCALATN	CONTINGN	SIOH	TOTAL COST	UNIT COST
01	General Conditions	1.00	EA	2,933,022	117,321	457,551	280,632	3,788,526	3788525.71
02	Mobilization	1.00	EA	156,296	6,252	24,382	14,954	201,885	201884.73
03	Site Preparation	1.00	EA	4,064,308	162,572	634,032	388,873	5,249,785	5249785.35
04	Unloading Facility - Dock	1.00	EA	4,888,512	195,540	762,608	467,733	6,314,393	6314393.18
05	Water Treatment Plant			305,532	12,221	47,663	29,233	394,650	
06	Mechanical Dredging	238000	CY	6,476,798	259,072	1,010,381	619,700	8,365,951	35.15
07	Testing/Monitoring - River			1,413,263	56,531	220,469	135,221	1,825,483	
08	Tug and Barges	238000	CY	3,777,574	151,103	589,301	361,438	4,879,416	20.50
09	Soil Stabilization	238000	CY	8,248,079	329,923	1,286,700	789,176	10,653,878	44.76
10	Handling and Transportation	238000	CY	19,514,990	780,600	3,044,338	1,867,194	25,207,122	105.91
11	Landfill Fees	238000	CY	24,238,063	969,523	3,781,138	2,319,098	31,307,821	131.55
12	Water Treatment	16025000	GAL	419,446	16,778	65,434	40,133	541,790	0.03
13	Debris Handling	20.00	MON	76,383	3,055	11,916	7,308	98,662	4933.12
14	Debris Disposal	10000	TNS	1,298,511	51,940	202,568	124,242	1,677,261	167.73
15	Demob			133,811	5,352	20,875	12,803	172,841	
16	Project Closeout			30,553	1,222	4,766	2,923	39,465	
TOTAL	HUDSON RIVER PCB R/Rev 12/14/98	238000	CY	77,975,141	3,119,006	12164122	7,460,661	100,718,930	423.19

	QUANTY	UOM	CONTRACT	ESCALATN	CONTINGN	SIOH	TOTAL COST	UNIT COST
01 General Conditions								
01.01 Field Labor	24.00	MO	1,055,919	42,237	164,723	101,030	1,363,909	56829.54
01.02 Home Office Labor	24.00	MON	684,881	27,395	106,841	65,529	884,646	36860.27
01.05 Travel and Per Diem			360,528	14,421	56,242	34,495	465,686	
01.11 Equipment	24.00	MO	92,925	3,717	14,496	8,891	120,029	5001.22
01.12 Material	24.00	MO	13,993	560	2,183	1,339	18,075	753.12
01.13 Photos	20.00	MO	2,246	90	350	215	2,901	145.03
01.22 Plans	1.00	EA	86,878	3,475	13,553	8,312	112,219	112218.61
01.24 Pre-Construction Conference	1.00	EA	5,041	202	786	482	6,512	6511.72
01.41 Office Trailers	1.00	EA	59,044	2,362	9,211	5,649	76,266	76266.03
01.42 Storage Trailer	1.00	EA	8,097	324	1,263	775	10,458	10458.21
01.44 Electrical	24.00	MO	7,333	293	1,144	702	9,472	394.65
01.45 Telephone	24.00	MO	9,166	367	1,430	877	11,839	493.31
01.46 Toilets	1.00	EA	7,333	293	1,144	702	9,472	9471.59
01.51 Truck Scales	1.00	EA	21,998	880	3,432	2,105	28,415	28414.77
01.60 Health and Safety	1.00	EA	517,641	20,706	80,752	49,528	668,627	668626.99
TOTAL General Conditions	1.00	EA	2,933,022	117,321	457,551	280,632	3,788,526	3788525.71
02 Mobilization								
02.02 Equipment Rental-Mobilization	16.00	HR	6,046	242	943	579	7,810	488.11
02.21 Setup Trailers	1.00	EA	4,125	165	643	395	5,328	5327.77
02.29 Travel and Per Diem	1.00	EA	12,221	489	1,907	1,169	15,786	15785.98
02.31 Field Labor	2.00	MO	87,993	3,520	13,727	8,419	113,659	56829.54
02.32 Signs	2.00	EA	4,688	188	731	449	6,056	3027.76
02.34 Electrical Connection	1.00	EA	22,127	885	3,452	2,117	28,581	28581.02
02.35 Telephone Connection	1.00	EA	764	31	119	73	987	986.62
02.36 Water Distribution	800.00	LF	18,332	733	2,860	1,754	23,679	29.60
TOTAL Mobilization	1.00	EA	156,296	6,252	24,382	14,954	201,885	201884.73
03 Site Preparation								
03.11 Clearing and Grubbing	19.00	ACR	113,934	4,557	17,774	10,901	147,167	7745.61
03.12 Earth Shaping	10000	CY	77,036	3,081	12,018	7,371	99,505	9.95
03.13 Install/Remove Fence	1.00	EA	97,222	3,889	15,167	9,302	125,579	125579.07
03.15 Railroad Spur	1200.00	LF	444,461	17,778	69,336	42,526	574,101	478.42
03.41 Construct/Repair Road/Work Area	10000	SY	140,284	5,611	21,884	13,422	181,202	18.12
03.42 Mixing Sta. Containment Pad	1.00	EA	61,483	2,459	9,591	5,883	79,416	79415.99
03.44 Decontam Facil for Equi/Vehicle	1.00	EA	7,056	282	1,101	675	9,114	9113.83
03.55 Channel Dredging	11400	EA	3,012,154	120,486	469,896	288,203	3,890,740	341.29
03.56 Surveying	1.00	EA	110,679	4,427	17,266	10,590	142,962	142961.81
TOTAL Site Preparation	1.00	EA	4,064,308	162,572	634,032	388,873	5,249,785	5249785.35

	QUANTY UOM	CONTRACT	ESCALATN	CONTINGN	SIOH	TOTAL COST	UNIT COST
04 Unloading Facility - Dock							
04.01 Unloading Facility - Dock	1.00 EA	4,888,512	195,540	762,608	467,733	6,314,393	6314393.18
TOTAL Unloading Facility - Dock	1.00 EA	4,888,512	195,540	762,608	467,733	6,314,393	6314393.18
05 Water Treatment Plant							
05.01 Water Clarification/Filtration		305,532	12,221	47,663	29,233	394,650	
TOTAL Water Treatment Plant		305,532	12,221	47,663	29,233	394,650	
06 Mechanical Dredging							
06.01 Mob/Demob Dredge	4.00 EA	209,541	8,382	32,688	20,049	270,660	67665.03
06.02 Mechanical Dredging	238000 CY	4,461,649	178,466	696,017	426,891	5,763,022	24.21
06.03 Sediment Barrier Crew	20.00 MON	1,203,960	48,158	187,818	115,195	1,555,131	77756.55
06.04 Boat Rental/Testing Crew	20.00 MON	551,177	22,047	85,984	52,737	711,944	35597.22
06.05 River Water Sampling	1.00 EA	50,471	2,019	7,874	4,829	65,193	65192.67
TOTAL Mechanical Dredging	238000 CY	6,476,798	259,072	1,010,381	619,700	8,365,951	35.15
07 Testing/Monitoring - River							
07.03 Boat Rental/Test Crew	20.00 MON	435,713	17,429	67,971	41,689	562,802	28140.09
07.05 Sample Analysis	1.00 EA	977,550	39,102	152,498	93,532	1,262,681	1262681.31
TOTAL Testing/Monitoring - River		1,413,263	56,531	220,469	135,221	1,825,483	
08 Tug and Barges							
08.01 Mob/Demob - 4 @	200.00 HR	181,324	7,253	28,286	17,349	234,212	1171.06
08.02 Tug and Barges-Rental/Operation	238000 CY	3,596,250	143,850	561,015	344,089	4,645,204	19.52
TOTAL Tug and Barges	238000 CY	3,777,574	151,103	589,301	361,438	4,879,416	20.50
09 Soil Stabilization							
09.04 Soil Stabilization	238000 CY	8,248,079	329,923	1,286,700	789,176	10,653,878	44.76
TOTAL Soil Stabilization	238000 CY	8,248,079	329,923	1,286,700	789,176	10,653,878	44.76
10 Handling and Transportation							
10.01 30 CY Containers		2,383,150	95,326	371,771	228,020	3,078,267	

	QUANTY UOM	CONTRACT	ESCALATN	CONTINGN	SIOH	TOTAL COST	UNIT COST
10.02 Transport Cost	238000 CY	11,499,647	459,986	1,793,945	1,100,286	14,853,864	62.41
10.05 Rent RR Flat Cars	60.00 EA	1,310,732	52,429	204,474	125,411	1,693,047	28217.44
10.11 Mob/Demob Crane - 4@	4.00 EA	113,659	4,546	17,731	10,875	146,811	36702.63
10.12 Unload Barge with Crane	20.00 MON	1,099,924	43,997	171,588	105,241	1,420,750	71037.48
10.13 Load RR Car with Crane	20.00 MON	1,099,924	43,997	171,588	105,241	1,420,750	71037.48
10.14 Container Handling		1,280,789	51,232	199,803	122,546	1,654,369	
10.15 Unloading Fee	238000 CY	727,166	29,087	113,438	69,575	939,266	3.95
TOTAL Handling and Transportation	238000 CY	19,514,990	780,600	3,044,338	1,867,194	25,207,122	105.91
11 Landfill Fees							
11.01 Landfill Fees - CECOS/Niagara F		9,074,300	362,972	1,415,591	868,229	11,721,092	
11.02 Landfill Fees-Wayne Dispoal,Mich		14,640,712	585,628	2,283,951	1,400,823	18,911,114	
11.06 Sampling Soil & Sediment	270.00 EA	523,051	20,922	81,596	50,046	675,615	2502.28
TOTAL Landfill Fees	238000 CY	24,238,063	969,523	3,781,138	2,319,098	31,307,821	131.55
12 Water Treatment							
12.09 Free Water Removal	16025000 GAL	419,446	16,778	65,434	40,133	541,790	0.03
TOTAL Water Treatment	16025000 GAL	419,446	16,778	65,434	40,133	541,790	0.03
13 Debris Handling	20.00 MON	76,383	3,055	11,916	7,308	98,662	4933.12
14 Debris Disposal	10000 TNS	1,298,511	51,940	202,568	124,242	1,677,261	167.73
15 Demob							
15.51 Removal of Temporary Facilities	1.00 EA	13,769	551	2,148	1,317	17,786	17785.71
15.52 Removal of Temporary Utilities	1.00 EA	1,680	67	262	161	2,171	2170.57
15.53 Demob of Construction Equip/Facl	1.00 EA	11,425	457	1,782	1,093	14,758	14757.75
15.61 Site Restoration		30,553	1,222	4,766	2,923	39,465	
15.71 Misc Personnel		76,383	3,055	11,916	7,308	98,662	
TOTAL Demob		133,811	5,352	20,875	12,803	172,841	
16 Project Closeout							
16.01 Project Closeout		30,553	1,222	4,766	2,923	39,465	
TOTAL Project Closeout		30,553	1,222	4,766	2,923	39,465	

** PROJECT INDIRECT SUMMARY - Contract **

		QUANTY	UOM	DIRECT	G&A	PROFIT	BOND	Design C	TOTAL COST	UNIT COST
01	General Conditions	1.00	EA	1,919,944	287,992	176,635	59,614	488,837	2,933,022	2933021.89
02	Mobilization	1.00	EA	102,311	15,347	9,413	3,177	26,049	156,296	156296.24
03	Site Preparation	1.00	EA	2,660,479	399,072	244,764	82,608	677,385	4,064,308	4064307.99
04	Unloading Facility - Dock	1.00	EA	3,200,000	480,000	294,400	99,360	814,752	4,888,512	4888512.00
05	Water Treatment Plant			200,000	30,000	18,400	6,210	50,922	305,532	
06	Mechanical Dredging	238000	CY	4,239,686	635,953	390,051	131,642	1,079,466	6,476,798	27.21
07	Testing/Monitoring - River			925,116	138,767	85,111	28,725	235,544	1,413,263	
08	Tug and Barges	238000	CY	2,472,784	370,918	227,496	76,780	629,596	3,777,574	15.87
09	Soil Stabilization	238000	CY	5,399,159	809,874	496,723	167,644	1,374,680	8,248,079	34.66
10	Handling and Transportation	238000	CY	12,774,433	1,916,165	1,175,248	396,646	3,252,498	19,514,990	82.00
11	Landfill Fees	238000	CY	15,866,137	2,379,921	1,459,685	492,644	4,039,677	24,238,063	101.84
12	Water Treatment	16025000	GAL	274,568	41,185	25,260	8,525	69,908	419,446	0.03
13	Debris Handling	20.00	MON	50,000	7,500	4,600	1,553	12,731	76,383	3819.15
14	Debris Disposal	10000	TNS	850,000	127,500	78,200	26,393	216,419	1,298,511	129.85
15	Demob			87,592	13,139	8,058	2,720	22,302	133,811	
16	Project Closeout			20,000	3,000	1,840	621	5,092	30,553	
	HUDSON RIVER PCB R/Rev 12/14/98	238000	CY	51,042,209	7,656,331	4,695,883	1,584,861	12995857	77,975,141	327.63
	Escalation								3,119,006	13.11
	SUBTOTAL								81,094,147	340.73
	Contingency								12,164,122	51.11
	SUBTOTAL								93,258,269	391.84
	SIOH								7,460,661	31.35
	TOTAL INCL OWNER COSTS								100,718,930	423.19

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTY UOM	DIRECT	G&A	PROFIT	BOND	Design C	TOTAL COST	UNIT COST
01 General Conditions								
01.01 Field Labor	24.00 MO	691,200	103,680	63,590	21,462	175,986	1,055,919	43996.61
01.02 Home Office Labor	24.00 MON	448,320	67,248	41,245	13,920	114,147	684,881	28536.69
01.05 Travel and Per Diem		236,000	35,400	21,712	7,328	60,088	360,528	
01.11 Equipment	24.00 MO	60,828	9,124	5,596	1,889	15,487	92,925	3871.87
01.12 Material	24.00 MO	9,160	1,374	843	284	2,332	13,993	583.06
01.13 Photos	20.00 MO	1,470	221	135	46	374	2,246	112.28
01.22 Plans	1.00 EA	56,870	8,531	5,232	1,766	14,480	86,878	86878.02
01.24 Pre-Construction Conference	1.00 EA	3,300	495	304	102	840	5,041	5041.28
01.41 Office Trailers	1.00 EA	38,650	5,798	3,556	1,200	9,841	59,044	59044.06
01.42 Storage Trailer	1.00 EA	5,300	795	488	165	1,349	8,097	8096.60
01.44 Electrical	24.00 MO	4,800	720	442	149	1,222	7,333	305.53
01.45 Telephone	24.00 MO	6,000	900	552	186	1,528	9,166	381.92
01.46 Toilets	1.00 EA	4,800	720	442	149	1,222	7,333	7332.77
01.51 Truck Scales	1.00 EA	14,400	2,160	1,325	447	3,666	21,998	21998.30
01.60 Health and Safety	1.00 EA	338,846	50,827	31,174	10,521	86,274	517,641	517641.36
TOTAL General Conditions	1.00 EA	1,919,944	287,992	176,635	59,614	488,837	2,933,022	2933021.89
Escalation							117,321	
SUBTOTAL							3,050,343	
Contingency							457,551	
SUBTOTAL							3,507,894	
SIOH							280,632	
TOTAL INCL OWNER COSTS							3,788,526	
02 Mobilization								
02.02 Equipment Rental-Mobilization	16.00 HR	3,958	594	364	123	1,008	6,046	377.89
02.21 Setup Trailers	1.00 EA	2,700	405	248	84	687	4,125	4124.68
02.29 Travel and Per Diem	1.00 EA	8,000	1,200	736	248	2,037	12,221	12221.28
02.31 Field Labor	2.00 MO	57,600	8,640	5,299	1,788	14,666	87,993	43996.61
02.32 Signs	2.00 EA	3,069	460	282	95	781	4,688	2344.05
02.34 Electrical Connection	1.00 EA	14,484	2,173	1,333	450	3,688	22,127	22127.01
02.35 Telephone Connection	1.00 EA	500	75	46	16	127	764	763.83
02.36 Water Distribution	800.00 LF	12,000	1,800	1,104	373	3,055	18,332	22.91
TOTAL Mobilization	1.00 EA	102,311	15,347	9,413	3,177	26,049	156,296	156296.24
Escalation							6,252	
SUBTOTAL							162,548	
Contingency							24,382	
SUBTOTAL							186,930	

	QUANTY	UOM	DIRECT	G&A	PROFIT	BOND	Design C	TOTAL COST	UNIT COST
SIOH								14,954	
TOTAL INCL OWNER COSTS								201,885	
03 Site Preparation									
03.11 Clearing and Grubbing	19.00	ACR	74,581	11,187	6,861	2,316	18,989	113,934	5996.54
03.12 Earth Shaping	10000	CY	50,427	7,564	4,639	1,566	12,839	77,036	7.70
03.13 Install/Remove Fence	1.00	EA	63,641	9,546	5,855	1,976	16,204	97,222	97221.50
03.15 Railroad Spur	1200.00	LF	290,942	43,641	26,767	9,034	74,077	444,461	370.38
03.41 Construct/Repair Road/Work Area	10000	SY	91,829	13,774	8,448	2,851	23,381	140,284	14.03
03.42 Mixing Sta. Containment Pad	1.00	EA	40,246	6,037	3,703	1,250	10,247	61,483	61482.71
03.44 Decontam Facil for Equi/Vehicle	1.00	EA	4,619	693	425	143	1,176	7,056	7055.79
03.55 Channel Dredging	11400	EA	1,971,744	295,762	181,400	61,223	502,026	3,012,154	264.22
03.56 Surveying	1.00	EA	72,450	10,868	6,665	2,250	18,446	110,679	110678.97
TOTAL Site Preparation	1.00	EA	2,660,479	399,072	244,764	82,608	677,385	4,064,308	4064307.99
Escalation								162,572	
SUBTOTAL								4,226,880	
Contingency								634,032	
SUBTOTAL								4,860,912	
SIOH								388,873	
TOTAL INCL OWNER COSTS								5,249,785	
04 Unloading Facility - Dock									
04.01 Unloading Facility - Dock	1.00	EA	3,200,000	480,000	294,400	99,360	814,752	4,888,512	4888512.00
TOTAL Unloading Facility - Dock	1.00	EA	3,200,000	480,000	294,400	99,360	814,752	4,888,512	4888512.00
Escalation								195,540	
SUBTOTAL								5,084,052	
Contingency								762,608	
SUBTOTAL								5,846,660	
SIOH								467,733	
TOTAL INCL OWNER COSTS								6,314,393	
05 Water Treatment Plant									
05.01 Water Clarification/Filtration			200,000	30,000	18,400	6,210	50,922	305,532	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTY UOM	DIRECT	G&A	PROFIT	BOND	Design C	TOTAL COST	UNIT COST
TOTAL Water Treatment Plant		200,000	30,000	18,400	6,210	50,922	305,532	
Escalation							12,221	
SUBTOTAL							317,753	
Contingency							47,663	
SUBTOTAL							365,416	
SIOH							29,233	
TOTAL INCL OWNER COSTS							394,650	
06 Mechanical Dredging								
06.01 Mob/Demob Dredge	4.00 EA	137,165	20,575	12,619	4,259	34,924	209,541	52385.29
06.02 Mechanical Dredging	238000 CY	2,920,577	438,087	268,693	90,684	743,608	4,461,649	18.75
06.03 Sediment Barrier Crew	20.00 MON	788,107	118,216	72,506	24,471	200,660	1,203,960	60198.00
06.04 Boat Rental/Testing Crew	20.00 MON	360,798	54,120	33,193	11,203	91,863	551,177	27558.85
06.05 River Water Sampling	1.00 EA	33,038	4,956	3,040	1,026	8,412	50,471	50471.23
TOTAL Mechanical Dredging	238000 CY	4,239,686	635,953	390,051	131,642	1,079,466	6,476,798	27.21
Escalation							259,072	1.09
SUBTOTAL							6,735,870	28.30
Contingency							1,010,381	4.25
SUBTOTAL							7,746,251	32.55
SIOH							619,700	2.60
TOTAL INCL OWNER COSTS							8,365,951	35.15
07 Testing/Monitoring - River								
07.03 Boat Rental/Test Crew	20.00 MON	285,216	42,782	26,240	8,856	72,619	435,713	21785.65
07.05 Sample Analysis	1.00 EA	639,900	95,985	58,871	19,869	162,925	977,550	977549.63
TOTAL Testing/Monitoring - River		925,116	138,767	85,111	28,725	235,544	1,413,263	
Escalation							56,531	
SUBTOTAL							1,469,793	
Contingency							220,469	
SUBTOTAL							1,690,262	
SIOH							135,221	
TOTAL INCL OWNER COSTS							1,825,483	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTY UOM	DIRECT	G&A	PROFIT	BOND	Design C	TOTAL COST	UNIT COST
08 Tug and Barges								
08.01 Mob/Demob - 4 @	200.00 HR	118,694	17,804	10,920	3,685	30,221	181,324	906.62
08.02 Tug and Barges-Rental/Operation	238000 CY	2,354,091	353,114	216,576	73,095	599,375	3,596,250	15.11
TOTAL Tug and Barges	238000 CY	2,472,784	370,918	227,496	76,780	629,596	3,777,574	15.87
Escalation							151,103	0.63
SUBTOTAL							3,928,676	16.51
Contingency							589,301	2.48
SUBTOTAL							4,517,978	18.98
SIOH							361,438	1.52
TOTAL INCL OWNER COSTS							4,879,416	20.50
09 Soil Stabilization								
09.04 Soil Stabilization	238000 CY	5,399,159	809,874	496,723	167,644	1,374,680	8,248,079	34.66
TOTAL Soil Stabilization	238000 CY	5,399,159	809,874	496,723	167,644	1,374,680	8,248,079	34.66
Escalation							329,923	1.39
SUBTOTAL							8,578,002	36.04
Contingency							1,286,700	5.41
SUBTOTAL							9,864,702	41.45
SIOH							789,176	3.32
TOTAL INCL OWNER COSTS							10,653,878	44.76
10 Handling and Transportation								
10.01 30 CY Containers		1,560,000	234,000	143,520	48,438	397,192	2,383,150	
10.02 Transport Cost	238000 CY	7,527,622	1,129,143	692,541	233,733	1,916,608	11,499,647	48.32
10.05 Rent RR Flat Cars	60.00 EA	858,000	128,700	78,936	26,641	218,455	1,310,732	21845.54
10.11 Mob/Demob Crane - 4@	4.00 EA	74,400	11,160	6,845	2,310	18,943	113,659	28414.65
10.12 Unload Barge with Crane	20.00 MON	720,006	108,001	66,241	22,356	183,321	1,099,924	54996.19
10.13 Load RR Car with Crane	20.00 MON	720,006	108,001	66,241	22,356	183,321	1,099,924	54996.19
10.14 Container Handling		838,399	125,760	77,133	26,032	213,465	1,280,789	
10.15 Unloading Fee	238000 CY	476,000	71,400	43,792	14,780	121,194	727,166	3.06
TOTAL Handling and Transportation	238000 CY	12,774,433	1,916,165	1,175,248	396,646	3,252,498	19,514,990	82.00
Escalation							780,600	3.28
SUBTOTAL							20,295,590	85.28

	QUANTY UOM	DIRECT	G&A	PROFIT	BOND	Design C	TOTAL COST	UNIT COST
Contingency							3,044,338	12.79
SUBTOTAL							23,339,928	98.07
SIOH							1,867,194	7.85
TOTAL INCL OWNER COSTS							25,207,122	105.91
11 Landfill Fees								
11.01 Landfill Fees - CECOS/Niagara F		5,940,000	891,000	546,480	184,437	1,512,383	9,074,300	
11.02 Landfill Fees-Wayne Dispoal,Mich		9,583,750	1,437,563	881,705	297,575	2,440,119	14,640,712	
11.06 Sampling Soil & Sediment	270.00 EA	342,387	51,358	31,500	10,631	87,175	523,051	1937.23
TOTAL Landfill Fees	238000 CY	15,866,137	2,379,921	1,459,685	492,644	4,039,677	24,238,063	101.84
Escalation							969,523	4.07
SUBTOTAL							25,207,586	105.91
Contingency							3,781,138	15.89
SUBTOTAL							28,988,723	121.80
SIOH							2,319,098	9.74
TOTAL INCL OWNER COSTS							31,307,821	131.55
12 Water Treatment								
12.09 Free Water Removal	16025000 GAL	274,568	41,185	25,260	8,525	69,908	419,446	0.03
TOTAL Water Treatment	16025000 GAL	274,568	41,185	25,260	8,525	69,908	419,446	0.03
Escalation							16,778	0.00
SUBTOTAL							436,224	0.03
Contingency							65,434	0.00
SUBTOTAL							501,658	0.03
SIOH							40,133	0.00
TOTAL INCL OWNER COSTS							541,790	0.03
13 Debris Handling	20.00 MON	50,000	7,500	4,600	1,553	12,731	76,383	3819.15
Escalation							3,055	152.77
SUBTOTAL							79,438	3971.92
Contingency							11,916	595.7
SUBTOTAL							91,354	4567.70
SIOH							7,308	365.42

	QUANTY UOM	DIRECT	G&A	PROFIT	BOND	Design C	TOTAL COST	UNIT COST
TOTAL INCL OWNER COSTS							98,662	4933.12
14 Debris Disposal	10000 TNS	850,000	127,500	78,200	26,393	216,419	1,298,511	129.85
Escalation							51,940	5.19
SUBTOTAL							1,350,451	135.05
Contingency							202,568	20.26
SUBTOTAL							1,553,019	155.30
SIOH							124,242	12.42
TOTAL INCL OWNER COSTS							1,677,261	167.73
15 Demob								
15.51 Removal of Temporary Facilities	1.00 EA	9,013	1,352	829	280	2,295	13,769	13769.44
15.52 Removal of Temporary Utilities	1.00 EA	1,100	165	101	34	280	1,680	1680.43
15.53 Demob of Construction Equip/Facl	1.00 EA	7,479	1,122	688	232	1,904	11,425	11425.24
15.61 Site Restoration		20,000	3,000	1,840	621	5,092	30,553	
15.71 Misc Personnel		50,000	7,500	4,600	1,553	12,731	76,383	
TOTAL Demob		87,592	13,139	8,058	2,720	22,302	133,811	
Escalation							5,352	
SUBTOTAL							139,164	
Contingency							20,875	
SUBTOTAL							160,038	
SIOH							12,803	
TOTAL INCL OWNER COSTS							172,841	
16 Project Closeout								
16.01 Project Closeout		20,000	3,000	1,840	621	5,092	30,553	
TOTAL Project Closeout		20,000	3,000	1,840	621	5,092	30,553	
Escalation							1,222	
SUBTOTAL							31,775	
Contingency							4,766	
SUBTOTAL							36,542	
SIOH							2,923	
TOTAL INCL OWNER COSTS							39,465	

HUDSON RIVER PCB R/Rev 12/14/98
Dredging of Hudson River to
Remove PCB Contaminated
Sediments

Designed By: Conceptual Idea Only - No Design
Estimated By: PE-C

Prepared By: RCM

Preparation Date: 09/21/98
Effective Date of Pricing: 01/01/98
Est Construction Time: 540 Days

Sales Tax: 0.00%

HUDSON RIVER PCB REMEDIATION

Contract Loading is as follows:

General conditions (site overhead and home office support) are itemized as a direct item.

G & A	=	15%
Profit	=	8%
Bond	=	2.5%
Design Contingency	=	20%
Escalation	=	4%
Reserve Contingecy	=	15%
SIOH	=	8%

The base for the estimate is judged to be current with midpoint of construction in two years.

** PROJECT OWNER SUMMARY - Contract **

		QUANTY	UOM	CONTRACT	ESCALATN	CONTINGN	SIOH	TOTAL COST	UNIT COST
01	General Conditions	1.00	EA	2,390,050	95,602	372,848	228,680	3,087,180	3087180.02
02	Mobilization	1.00	EA	152,172	6,087	23,739	14,560	196,557	196556.96
03	Site Preparation	1.00	EA	4,064,308	162,572	634,032	388,873	5,249,785	5249785.35
04	Unloading Facility - Dock	1.00	EA	4,888,512	195,540	762,608	467,733	6,314,393	6314393.18
05	Water Treatment Plant			305,532	12,221	47,663	29,233	394,650	
06	Mechanical Dredging	172000	CY	4,738,239	189,530	739,165	453,355	6,120,289	35.58
07	Testing/Monitoring - River	1.00	EA	1,060,520	42,421	165,441	101,471	1,369,852	1369852.35
08	Tug and Barges	172000	CY	2,734,963	109,399	426,654	261,681	3,532,697	20.54
09	Soil Stabilization	172000	CY	5,976,174	239,047	932,283	571,800	7,719,305	44.88
10	Handling and Transportation	172000	CY	14,857,856	594,314	2,317,826	1,421,600	19,191,596	111.58
11	Landfill Fees	172000	CY	16,060,826	642,433	2,505,489	1,536,700	20,745,448	120.61
12	Water Treatment	11600000	GAL	306,196	12,248	47,767	29,297	395,507	0.03
13	Debris Handling	15.00	MON	57,287	2,291	8,937	5,481	73,997	4933.12
14	Debris Disposal	7500.00	TNS	973,883	38,955	151,926	93,181	1,257,946	167.73
15	Demob			133,811	5,352	20,875	12,803	172,841	
16	Project Closeout			30,553	1,222	4,766	2,923	39,465	
20	Aquablok Bentonite Cap	811000	SF	5,514,951	220,598	860,332	527,671	7,123,552	8.78
TOTAL	HUDSON RIVER PCB R/Rev 12/14/98	172000	CY	64,245,835	2,569,833	10022350	6,147,041	82,985,060	482.47

	QUANTY	UOM	CONTRACT	ESCALATN	CONTINGN	SIOH	TOTAL COST	UNIT COST
01 General Conditions								
01.01 Field Labor	18.00	MO	791,939	31,678	123,542	75,773	1,022,932	56829.54
01.02 Home Office Labor	18.00	MON	513,660	20,546	80,131	49,147	663,485	36860.27
01.05 Travel and Per Diem	1.00	EA	332,724	13,309	51,905	31,835	429,773	429773.39
01.11 Equipment	18.00	MO	69,694	2,788	10,872	6,668	90,022	5001.22
01.12 Material	18.00	MO	12,160	486	1,897	1,163	15,707	872.61
01.13 Photos	15.00	MO	2,246	90	350	215	2,901	193.38
01.22 Plans	1.00	EA	86,878	3,475	13,553	8,312	112,219	112218.61
01.24 Pre-Construction Conference	1.00	EA	5,041	202	786	482	6,512	6511.72
01.41 Office Trailers	1.00	EA	53,178	2,127	8,296	5,088	68,689	68688.76
01.42 Storage Trailer	1.00	EA	6,263	251	977	599	8,090	8090.32
01.44 Electrical	24.00	MO	5,500	220	858	526	7,104	295.99
01.45 Telephone	24.00	MO	6,874	275	1,072	658	8,880	369.98
01.46 Toilets	1.00	EA	5,500	220	858	526	7,104	7103.69
01.51 Truck Scales	1.00	EA	21,998	880	3,432	2,105	28,415	28414.77
01.60 Health and Safety	1.00	EA	476,395	19,056	74,318	45,581	615,349	615349.30
TOTAL General Conditions	1.00	EA	2,390,050	95,602	372,848	228,680	3,087,180	3087180.02
02 Mobilization								
02.02 Equipment Rental-Mobilization	16.00	HR	6,046	242	943	579	7,810	488.11
02.21 Setup Trailers	1.00	EA	4,125	165	643	395	5,328	5327.77
02.29 Travel and Per Diem	1.00	EA	8,097	324	1,263	775	10,458	10458.21
02.31 Field Labor	2.00	MO	87,993	3,520	13,727	8,419	113,659	56829.54
02.32 Signs	2.00	EA	4,688	188	731	449	6,056	3027.76
02.34 Electrical Connection	1.00	EA	22,127	885	3,452	2,117	28,581	28581.02
02.35 Telephone Connection	1.00	EA	764	31	119	73	987	986.62
02.36 Water Distribution	800.00	LF	18,332	733	2,860	1,754	23,679	29.60
TOTAL Mobilization	1.00	EA	152,172	6,087	23,739	14,560	196,557	196556.96
03 Site Preparation								
03.11 Clearing and Grubbing	19.00	ACR	113,934	4,557	17,774	10,901	147,167	7745.61
03.12 Earth Shaping	10000	CY	77,036	3,081	12,018	7,371	99,505	9.95
03.13 Install/Remove Fence	1.00	EA	97,222	3,889	15,167	9,302	125,579	125579.07
03.15 Railroad spur	1200.00	LF	444,461	17,778	69,336	42,526	574,101	478.42
03.41 Construct/Repair Road/Work Area	10000	SY	140,284	5,611	21,884	13,422	181,202	18.12
03.42 Mixing Sta. Containment Pad	1.00	EA	61,483	2,459	9,591	5,883	79,416	79415.99
03.44 Decontam Facil for Equi/Vehicle	1.00	EA	7,056	282	1,101	675	9,114	9113.83
03.55 Channel Dredging	11400	EA	3,012,154	120,486	469,896	288,203	3,890,740	341.29
03.56 Surveying	1.00	EA	110,679	4,427	17,266	10,590	142,962	142961.81
TOTAL Site Preparation	1.00	EA	4,064,308	162,572	634,032	388,873	5,249,785	5249785.35

	QUANTY	UOM	CONTRACT	ESCALATN	CONTINGN	SIOH	TOTAL COST	UNIT COST
04 Unloading Facility - Dock								
04.01 Unloading Facility - Dock	1.00	EA	4,888,512	195,540	762,608	467,733	6,314,393	6314393.18
TOTAL Unloading Facility - Dock	1.00	EA	4,888,512	195,540	762,608	467,733	6,314,393	6314393.18
05 Water Treatment Plant								
05.01 Water Clarification/Filtration			305,532	12,221	47,663	29,233	394,650	
TOTAL Water Treatment Plant			305,532	12,221	47,663	29,233	394,650	
06 Mechanical Dredging								
06.01 Mob/Demob Dredge	3.00	EA	157,156	6,286	24,516	15,037	202,995	67665.03
06.02 Mechanical Dredging	172000	CY	3,224,385	128,975	503,004	308,509	4,164,873	24.21
06.03 Sediment Barrier Crew	15.00	MON	905,406	36,216	141,243	86,629	1,169,494	77966.30
06.04 Boat Rental/Testing Crew	15.00	MON	413,383	16,535	64,488	39,552	533,958	35597.22
06.05 River Water Sampling	1.00	EA	37,910	1,516	5,914	3,627	48,968	48967.64
TOTAL Mechanical Dredging	172000	CY	4,738,239	189,530	739,165	453,355	6,120,289	35.58
07 Testing/Monitoring - River								
07.03 Boat Rental/Test Crew	15.00	MON	326,785	13,071	50,978	31,267	422,101	28140.09
07.05 Sample Analysis	1.00	EA	733,735	29,349	114,463	70,204	947,751	947750.95
TOTAL Testing/Monitoring - River	1.00	EA	1,060,520	42,421	165,441	101,471	1,369,852	1369852.35
08 Tug and Barges								
08.01 Mob/Demob - 3@	150.00	HR	135,993	5,440	21,215	13,012	175,659	1171.06
08.02 Tug and Barges-Rental/Operation	172000	CY	2,598,971	103,959	405,439	248,670	3,357,038	19.52
TOTAL Tug and Barges	172000	CY	2,734,963	109,399	426,654	261,681	3,532,697	20.54
09 Soil Stabilization								
09.04 Soil Stabilization	172000	CY	5,976,174	239,047	932,283	571,800	7,719,305	44.88
TOTAL Soil Stabilization	172000	CY	5,976,174	239,047	932,283	571,800	7,719,305	44.88
10 Handling and Transportation								
10.01 30 CY Containers			2,383,150	95,326	371,771	228,020	3,078,267	

	QUANTY	UOM	CONTRACT	ESCALATN	CONTINGN	SIOH	TOTAL COST	UNIT COST
10.02 Transport Cost	172000	CY	8,270,421	330,817	1,290,186	791,314	10,682,738	62.11
10.05 Rent RR Flat Cars	60.00	EA	983,049	39,322	153,356	94,058	1,269,785	21163.08
10.11 Mob/Demob Crane - 3@	3.00	EA	85,244	3,410	13,298	8,156	110,108	36702.63
10.12 Unload Barge with Crane	15.00	MON	824,943	32,998	128,691	78,931	1,065,562	71037.48
10.13 Load RR Car with Crane	15.00	MON	824,943	32,998	128,691	78,931	1,065,562	71037.48
10.14 Container Handling			960,592	38,424	149,852	91,909	1,240,777	
10.15 Unloading Fee	172000	CY	525,515	21,021	81,980	50,281	678,797	3.95
TOTAL Handling and Transportation	172000	CY	14,857,856	594,314	2,317,826	1,421,600	19,191,596	111.58
11 Landfill Fees								
11.01 Landfill Fees - CECOS/Niagara F	206000	TNS	6,923,355	276,934	1,080,043	662,427	8,942,759	43.41
11.02 Landfill Fee-Wayne Disposal,Mich	52000	TNS	8,738,215	349,529	1,363,162	836,072	11,286,978	217.06
11.06 Sampling Soil & Sediment	206.00	EA	399,256	15,970	62,284	38,201	515,710	2503.45
TOTAL Landfill Fees	172000	CY	16,060,826	642,433	2,505,489	1,536,700	20,745,448	120.61
12 Water Treatment								
12.09 Free Water Removal	11600000	GAL	306,196	12,248	47,767	29,297	395,507	0.03
TOTAL Water Treatment	11600000	GAL	306,196	12,248	47,767	29,297	395,507	0.03
13 Debris Handling	15.00	MON	57,287	2,291	8,937	5,481	73,997	4933.12
14 Debris Disposal	7500.00	TNS	973,883	38,955	151,926	93,181	1,257,946	167.73
15 Demob								
15.51 Removal of Temporary Facilities	1.00	EA	13,769	551	2,148	1,317	17,786	17785.71
15.52 Removal of Temporary Utilities	1.00	EA	1,680	67	262	161	2,171	2170.57
15.53 Demob of Construction Equip/Facl	1.00	EA	11,425	457	1,782	1,093	14,758	14757.75
15.61 Site Restoration			30,553	1,222	4,766	2,923	39,465	
15.71 Misc Personnel			76,383	3,055	11,916	7,308	98,662	
TOTAL Demob			133,811	5,352	20,875	12,803	172,841	
16 Project Closeout								
16.01 Project Closeout			30,553	1,222	4,766	2,923	39,465	
TOTAL Project Closeout			30,553	1,222	4,766	2,923	39,465	
20 Aquablok Bentonite Cap								
20.01 Aquablok Bentonite Cap	811000	SF	3,925,653	157,026	612,402	375,607	5,070,688	6.25
20.03 Barging for Capping			1,419,899	56,796	221,504	135,856	1,834,055	

	QUANTY UOM	CONTRACT	ESCALATN	CONTINGN	SIOH	TOTAL COST	UNIT COST
20.04 Storage Silo		45,830	1,833	7,149	4,385	59,197	
20.05 Silt Retrieval Dredging	10000 CY	123,569	4,943	19,277	11,823	159,612	15.96
TOTAL Aquablok Bentonite Cap	811000 SF	5,514,951	220,598	860,332	527,671	7,123,552	8.78

** PROJECT INDIRECT SUMMARY - Contract **

		QUANTY UOM	DIRECT	G&A	PROFIT	BOND	Design C	TOTAL COST	UNIT COST
01	General Conditions	1.00 EA	1,564,517	234,678	143,936	48,578	398,342	2,390,050	2390050.19
02	Mobilization	1.00 EA	99,611	14,942	9,164	3,093	25,362	152,172	152171.56
03	Site Preparation	1.00 EA	2,660,479	399,072	244,764	82,608	677,385	4,064,308	4064307.99
04	Unloading Facility - Dock	1.00 EA	3,200,000	480,000	294,400	99,360	814,752	4,888,512	4888512.00
05	Water Treatment Plant		200,000	30,000	18,400	6,210	50,922	305,532	
06	Mechanical Dredging	172000 CY	3,101,632	465,245	285,350	96,306	789,707	4,738,239	27.55
07	Testing/Monitoring - River	1.00 EA	694,212	104,132	63,868	21,555	176,753	1,060,520	1060519.90
08	Tug and Barges	172000 CY	1,790,296	268,544	164,707	55,589	455,827	2,734,963	15.90
09	Soil Stabilization	172000 CY	3,911,979	586,797	359,902	121,467	996,029	5,976,174	34.75
10	Handling and Transportation	172000 CY	9,725,892	1,458,884	894,782	301,989	2,476,309	14,857,856	86.38
11	Landfill Fees	172000 CY	10,513,351	1,577,003	967,228	326,440	2,676,804	16,060,826	93.38
12	Water Treatment	11600000 GAL	200,434	30,065	18,440	6,223	51,033	306,196	0.03
13	Debris Handling	15.00 MON	37,500	5,625	3,450	1,164	9,548	57,287	3819.15
14	Debris Disposal	7500.00 TNS	637,500	95,625	58,650	19,794	162,314	973,883	129.85
15	Demob		87,592	13,139	8,058	2,720	22,302	133,811	
16	Project Closeout		20,000	3,000	1,840	621	5,092	30,553	
20	Aquablok Bentonite Cap	811000 SF	3,610,065	541,510	332,126	112,093	919,159	5,514,951	6.80
	HUDSON RIVER PCB R/Rev 12/14/98	172000 CY	42,055,061	6,308,259	3,869,066	1,305,810	10707639	64,245,835	373.52
	Escalation							2,569,833	14.94
	SUBTOTAL							66,815,668	388.46
	Contingency							10,022,350	58.27
	SUBTOTAL							76,838,018	446.73
	SIOH							6,147,041	35.74
	TOTAL INCL OWNER COSTS							82,985,060	482.47

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTY UOM	DIRECT	G&A	PROFIT	BOND	Design C	TOTAL COST	UNIT COST
01 General Conditions								
01.01 Field Labor	18.00 MO	518,400	77,760	47,693	16,096	131,990	791,939	43996.61
01.02 Home Office Labor	18.00 MON	336,240	50,436	30,934	10,440	85,610	513,660	28536.69
01.05 Travel and Per Diem	1.00 EA	217,800	32,670	20,038	6,763	55,454	332,724	332724.35
01.11 Equipment	18.00 MO	45,621	6,843	4,197	1,417	11,616	69,694	3871.87
01.12 Material	18.00 MO	7,960	1,194	732	247	2,027	12,160	675.57
01.13 Photos	15.00 MO	1,470	221	135	46	374	2,246	149.71
01.22 Plans	1.00 EA	56,870	8,531	5,232	1,766	14,480	86,878	86878.02
01.24 Pre-Construction Conference	1.00 EA	3,300	495	304	102	840	5,041	5041.28
01.41 Office Trailers	1.00 EA	34,810	5,222	3,203	1,081	8,863	53,178	53177.84
01.42 Storage Trailer	1.00 EA	4,100	615	377	127	1,044	6,263	6263.41
01.44 Electrical	24.00 MO	3,600	540	331	112	917	5,500	229.15
01.45 Telephone	24.00 MO	4,500	675	414	140	1,146	6,874	286.44
01.46 Toilets	1.00 EA	3,600	540	331	112	917	5,500	5499.58
01.51 Truck Scales	1.00 EA	14,400	2,160	1,325	447	3,666	21,998	21998.30
01.60 Health and Safety	1.00 EA	311,846	46,777	28,690	9,683	79,399	476,395	476394.54
TOTAL General Conditions	1.00 EA	1,564,517	234,678	143,936	48,578	398,342	2,390,050	2390050.19
Escalation							95,602	
SUBTOTAL							2,485,652	
Contingency							372,848	
SUBTOTAL							2,858,500	
SIOH							228,680	
TOTAL INCL OWNER COSTS							3,087,180	
02 Mobilization								
02.02 Equipment Rental-Mobilization	16.00 HR	3,958	594	364	123	1,008	6,046	377.89
02.21 Setup Trailers	1.00 EA	2,700	405	248	84	687	4,125	4124.68
02.29 Travel and Per Diem	1.00 EA	5,300	795	488	165	1,349	8,097	8096.60
02.31 Field Labor	2.00 MO	57,600	8,640	5,299	1,788	14,666	87,993	43996.61
02.32 Signs	2.00 EA	3,069	460	282	95	781	4,688	2344.05
02.34 Electrical Connection	1.00 EA	14,484	2,173	1,333	450	3,688	22,127	22127.01
02.35 Telephone Connection	1.00 EA	500	75	46	16	127	764	763.83
02.36 Water Distribution	800.00 LF	12,000	1,800	1,104	373	3,055	18,332	22.91
TOTAL Mobilization	1.00 EA	99,611	14,942	9,164	3,093	25,362	152,172	152171.56
Escalation							6,087	
SUBTOTAL							158,258	
Contingency							23,739	
SUBTOTAL							181,997	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTY	UOM	DIRECT	G&A	PROFIT	BOND	Design C	TOTAL COST	UNIT COST
SIOH								14,560	
TOTAL INCL OWNER COSTS								196,557	
03 Site Preparation									
03.11 Clearing and Grubbing	19.00	ACR	74,581	11,187	6,861	2,316	18,989	113,934	5996.54
03.12 Earth Shaping	10000	CY	50,427	7,564	4,639	1,566	12,839	77,036	7.70
03.13 Install/Remove Fence	1.00	EA	63,641	9,546	5,855	1,976	16,204	97,222	97221.50
03.15 Railroad spur	1200.00	LF	290,942	43,641	26,767	9,034	74,077	444,461	370.38
03.41 Construct/Repair Road/Work Area	10000	SY	91,829	13,774	8,448	2,851	23,381	140,284	14.03
03.42 Mixing Sta. Containment Pad	1.00	EA	40,246	6,037	3,703	1,250	10,247	61,483	61482.71
03.44 Decontam Facil for Equi/Vehicle	1.00	EA	4,619	693	425	143	1,176	7,056	7055.79
03.55 Channel Dredging	11400	EA	1,971,744	295,762	181,400	61,223	502,026	3,012,154	264.22
03.56 Surveying	1.00	EA	72,450	10,868	6,665	2,250	18,446	110,679	110678.97
TOTAL Site Preparation	1.00	EA	2,660,479	399,072	244,764	82,608	677,385	4,064,308	4064307.99
Escalation								162,572	
SUBTOTAL								4,226,880	
Contingency								634,032	
SUBTOTAL								4,860,912	
SIOH								388,873	
TOTAL INCL OWNER COSTS								5,249,785	
04 Unloading Facility - Dock									
04.01 Unloading Facility - Dock	1.00	EA	3,200,000	480,000	294,400	99,360	814,752	4,888,512	4888512.00
TOTAL Unloading Facility - Dock	1.00	EA	3,200,000	480,000	294,400	99,360	814,752	4,888,512	4888512.00
Escalation								195,540	
SUBTOTAL								5,084,052	
Contingency								762,608	
SUBTOTAL								5,846,660	
SIOH								467,733	
TOTAL INCL OWNER COSTS								6,314,393	
05 Water Treatment Plant									
05.01 Water Clarification/Filtration			200,000	30,000	18,400	6,210	50,922	305,532	

403203

	QUANTY UOM	DIRECT	G&A	PROFIT	BOND	Design C	TOTAL COST	UNIT COST
TOTAL Water Treatment Plant		200,000	30,000	18,400	6,210	50,922	305,532	
Escalation							12,221	
SUBTOTAL							317,753	
Contingency							47,663	
SUBTOTAL							365,416	
SIOH							29,233	
TOTAL INCL OWNER COSTS							394,650	
06 Mechanical Dredging								
06.01 Mob/Demob Dredge	3.00 EA	102,874	15,431	9,464	3,194	26,193	157,156	52385.29
06.02 Mechanical Dredging	172000 CY	2,110,669	316,600	194,182	65,536	537,397	3,224,385	18.75
06.03 Sediment Barrier Crew	15.00 MON	592,675	88,901	54,526	18,403	150,901	905,406	60360.38
06.04 Boat Rental/Testing Crew	15.00 MON	270,599	40,590	24,895	8,402	68,897	413,383	27558.85
06.05 River Water Sampling	1.00 EA	24,816	3,722	2,283	771	6,318	37,910	37910.04
TOTAL Mechanical Dredging	172000 CY	3,101,632	465,245	285,350	96,306	789,707	4,738,239	27.55
Escalation							189,530	1.10
SUBTOTAL							4,927,769	28.65
Contingency							739,165	4.30
SUBTOTAL							5,666,934	32.95
SIOH							453,355	2.64
TOTAL INCL OWNER COSTS							6,120,289	35.58
07 Testing/Monitoring - River								
07.03 Boat Rental/Test Crew	15.00 MON	213,912	32,087	19,680	6,642	54,464	326,785	21785.65
07.05 Sample Analysis	1.00 EA	480,300	72,045	44,188	14,913	122,289	733,735	733735.10
TOTAL Testing/Monitoring - River	1.00 EA	694,212	104,132	63,868	21,555	176,753	1,060,520	1060519.90
Escalation							42,421	
SUBTOTAL							1,102,941	
Contingency							165,441	
SUBTOTAL							1,268,382	
SIOH							101,471	
TOTAL INCL OWNER COSTS							1,369,852	

	QUANTY UOM	DIRECT	G&A	PROFIT	BOND	Design C	TOTAL COST	UNIT COST
08 Tug and Barges								
08.01 Mob/Demob - 3@	150.00 HR	89,020	13,353	8,190	2,764	22,665	135,993	906.62
08.02 Tug and Barges-Rental/Operation	172000 CY	1,701,276	255,191	156,517	52,825	433,162	2,598,971	15.11
TOTAL Tug and Barges	172000 CY	1,790,296	268,544	164,707	55,589	455,827	2,734,963	15.90
Escalation							109,399	0.64
SUBTOTAL							2,844,362	16.54
Contingency							426,654	2.48
SUBTOTAL							3,271,016	19.02
SIOH							261,681	1.52
TOTAL INCL OWNER COSTS							3,532,697	20.54
09 Soil Stabilization								
09.04 Soil Stabilization	172000 CY	3,911,979	586,797	359,902	121,467	996,029	5,976,174	34.75
TOTAL Soil Stabilization	172000 CY	3,911,979	586,797	359,902	121,467	996,029	5,976,174	34.75
Escalation							239,047	1.39
SUBTOTAL							6,215,221	36.14
Contingency							932,283	5.42
SUBTOTAL							7,147,504	41.56
SIOH							571,800	3.32
TOTAL INCL OWNER COSTS							7,719,305	44.88
10 Handling and Transportation								
10.01 30 CY Containers		1,560,000	234,000	143,520	48,438	397,192	2,383,150	
10.02 Transport Cost	172000 CY	5,413,784	812,068	498,068	168,098	1,378,404	8,270,421	48.08
10.05 Rent RR Flat Cars	60.00 EA	643,500	96,525	59,202	19,981	163,842	983,049	16384.15
10.11 Mob/Demob Crane - 3@	3.00 EA	55,800	8,370	5,134	1,733	14,207	85,244	28414.65
10.12 Unload Barge with Crane	15.00 MON	540,004	81,001	49,680	16,767	137,490	824,943	54996.19
10.13 Load RR Car with Crane	15.00 MON	540,004	81,001	49,680	16,767	137,490	824,943	54996.19
10.14 Container Handling		628,799	94,320	57,850	19,524	160,099	960,592	
10.15 Unloading Fee	172000 CY	344,000	51,600	31,648	10,681	87,586	525,515	3.06
TOTAL Handling and Transportation	172000 CY	9,725,892	1,458,884	894,782	301,989	2,476,309	14,857,856	86.38
Escalation							594,314	3.46
SUBTOTAL							15,452,171	89.84

	QUANTY UOM	DIRECT	G&A	PROFIT	BOND	Design C	TOTAL COST	UNIT COST
Contingency							2,317,826	13.48
SUBTOTAL							17,769,996	103.31
SIOH							1,421,600	8.27
TOTAL INCL OWNER COSTS							19,191,596	111.58
11 Landfill Fees								
11.01 Landfill Fees - CECOS/Niagara F	206000 TNS	4,532,000	679,800	416,944	140,719	1,153,893	6,923,355	33.61
11.02 Landfill Fee-Wayne Disposal,Mich	52000 TNS	5,720,000	858,000	526,240	177,606	1,456,369	8,738,215	168.04
11.06 Sampling Soil & Sediment	206.00 EA	261,351	39,203	24,044	8,115	66,543	399,256	1938.13
TOTAL Landfill Fees	172000 CY	10,513,351	1,577,003	967,228	326,440	2,676,804	16,060,826	93.38
Escalation							642,433	3.74
SUBTOTAL							16,703,259	97.11
Contingency							2,505,489	14.57
SUBTOTAL							19,208,748	111.68
SIOH							1,536,700	8.93
TOTAL INCL OWNER COSTS							20,745,448	120.61
12 Water Treatment								
12.09 Free Water Removal	11600000 GAL	200,434	30,065	18,440	6,223	51,033	306,196	0.03
TOTAL Water Treatment	11600000 GAL	200,434	30,065	18,440	6,223	51,033	306,196	0.03
Escalation							12,248	0.00
SUBTOTAL							318,444	0.03
Contingency							47,767	0.00
SUBTOTAL							366,210	0.03
SIOH							29,297	0.00
TOTAL INCL OWNER COSTS							395,507	0.03
13 Debris Handling	15.00 MON	37,500	5,625	3,450	1,164	9,548	57,287	3819.15
Escalation							2,291	152.77
SUBTOTAL							59,579	3971.92
Contingency							8,937	595.79
SUBTOTAL							68,516	4567.70
SIOH							5,481	365.42

	QUANTY UOM	DIRECT	G&A	PROFIT	BOND	Design C	TOTAL COST	UNIT COST
TOTAL INCL OWNER COSTS							73,997	4933.12
14 Debris Disposal	7500.00 TNS	637,500	95,625	58,650	19,794	162,314	973,883	129.85
Escalation							38,955	5.19
SUBTOTAL							1,012,839	135.05
Contingency							151,926	20.26
SUBTOTAL							1,164,764	155.30
SIOH							93,181	12.42
TOTAL INCL OWNER COSTS							1,257,946	167.73
15 Demob								
15.51 Removal of Temporary Facilities	1.00 EA	9,013	1,352	829	280	2,295	13,769	13769.44
15.52 Removal of Temporary Utilities	1.00 EA	1,100	165	101	34	280	1,680	1680.43
15.53 Demob of Construction Equip/Facl	1.00 EA	7,479	1,122	688	232	1,904	11,425	11425.24
15.61 Site Restoration		20,000	3,000	1,840	621	5,092	30,553	
15.71 Misc Personnel		50,000	7,500	4,600	1,553	12,731	76,383	
TOTAL Demob		87,592	13,139	8,058	2,720	22,302	133,811	
Escalation							5,352	
SUBTOTAL							139,164	
Contingency							20,875	
SUBTOTAL							160,038	
SIOH							12,803	
TOTAL INCL OWNER COSTS							172,841	
16 Project Closeout								
16.01 Project Closeout		20,000	3,000	1,840	621	5,092	30,553	
TOTAL Project Closeout		20,000	3,000	1,840	621	5,092	30,553	
Escalation							1,222	
SUBTOTAL							31,775	
Contingency							4,766	
SUBTOTAL							36,542	
SIOH							2,923	
TOTAL INCL OWNER COSTS							39,465	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTY UOM	DIRECT	G&A	PROFIT	BOND	Design C	TOTAL COST	UNIT COST
20 Aquablok Bentonite Cap								
20.01 Aquablok Bentonite Cap	811000 SF	2,569,717	385,457	236,414	79,790	654,276	3,925,653	4.84
20.03 Barging for Capping		929,460	139,419	85,510	28,860	236,650	1,419,899	
20.04 Storage Silo		30,000	4,500	2,760	932	7,638	45,830	
20.05 Silt Retrieval Dredging	10000 CY	80,888	12,133	7,442	2,512	20,595	123,569	12.36
TOTAL Aquablok Bentonite Cap	811000 SF	3,610,065	541,510	332,126	112,093	919,159	5,514,951	6.80
Escalation							220,598	0.27
SUBTOTAL							5,735,549	7.07
Contingency							860,332	1.06
SUBTOTAL							6,595,882	8.13
SIOH							527,671	0.65
TOTAL INCL OWNER COSTS							7,123,552	8.78

ITEM: Disposal at non-hazardous waste landfill

DESCRIPTION: Disposal of sediments w/ PCB concentration <50 ppm at CECOS landfill in Niagara Falls, NY (across from outlet mall). Landfill has direct rail access (CONRAIL). Landfill will only accept material w/ at least 20% solids concentration by weight (no standing liquid). Nick Morreal said that waste transporters will typically carry binding agents (cement, bentonite) that they can add to bind water that may become separated from the material during transport. If further stabilization is required prior to disposal, the landfill would hire an outside contractor to perform the stabilization and increase the disposal cost. The landfill will require sediments to be sampled and analyzed for TCLP metals, SVOCs, VOCs, Herbicides & Pesticides, and PCBs. Rate of sampling will be one sample per 1000 tons material.

INFORMATION SOURCE: Nick Morreal, CECOS landfill - phone: 716 614 3391, cell phone: 716 866 0289, pager: 716 629 4255

PRICE: Tipping fees: $22/ton for disposal (assuming disposal of total volume of 100,000 cy over two 6-month seasons). There are no taxes on disposal fees if the material to be disposed is delivered to the landfill. If the landfill is to provide transportation to the landfill, then a 7% tax is added to the transportation and disposal fees.

ITEM ITEM: Disposal at hazardous waste landfill

DESCRIPTION: Disposal of sediments w/ PCB concentration greater than 50 ppm at Environmental Quality (EQ) - Wayne Disposal landfill in Belleville, Michigan. The Wayne Disposal landfill currently does not have direct rail access. The closest rail access is 10 miles away at EQ Michigan Recovery facility. EQ can provide trucking service from the Michigan Recovery facility to the landfill for $15/ton. A new rail spur is being extended directly to the Wayne Disposal landfill by CONRAIL (Lee Fulton, CSX Transportation, 9/16/98). The new rail spur will be ready for operation by October 1999 (Barren 1998).

There is no specific solids concentration required for incoming material. However, no free standing liquid is allowed. Currently, the landfill does not have the capability to treat free liquids which may become separated from the waste material during transportation, EQ may have that capability in one year (Barren 9/16/98).

One sample analyzed for PCBs and one paint filter test is required from the landfill for disposal.

INFORMATION SOURCE: Environmental Quality/Wayne Disposal Landfill, Marc Barren 734 697 2200

PRICE: Tipping fees: $65-$75/ton
Landfill tax: $27.50/ton
State tax: $10/ton

Total: $102.50-$112.50/ton

ITEM: Water Treatment

DESCRIPTION: The water decanted during gravity settling of the dredged material and water from the mechanical dewatering process will be treated by settling in a clarifier and followed by gravity sand filtration. Provisions for addition of flocculating chemicals in the clarifier(s) will be included. An estimated volume of 100,000 gallons/day of water will require treatment. (The estimated volume was calculated assuming a total of 100,000 cubic yards of dredged material w/ in-place solids concentration of 50%, dredged solids concentration of 30%, and dewatered solids concentration of 70%, with a total of 200 days of operation). Information on a packaged plant for treating 150,000 gallons/day was also requested.

Water will be pumped from the dewatering process to the gravity clarifiers which will be 12' x 12' x 16.5' (width x length x height) hoppers. A box will be provided on the clarifiers to minimize turbulence in the entering pumped flow. A valve is provided at the bottom of the hopper for withdrawing sludge. Depending on the amount and type of flocculant used which will determine the rate of sludge formation, the valve can be automated to open on a timed schedule, mechanically opened as required, or left continuously open. Sludge is pumped out and returned to the dewatering process. Water decanted from the clarifier will be gravity fed to the filter. The sand filters (sized as appropriate for the design flow) will consist of a minimum of two cells. This will enable continuous operation during filter backwashing. Backwash water will return to the water treatment process.

During the winter between operating seasons, the treatment units and particularly all piping should be completely drained. The filter can be protected by covering up with a walkway grating with insulation slipped between the gratings. All pumps should also be insulated for protection.

The treatment units are sized for:
clarifier: 4 hour settling time
sand filter: 1 gpm/sf

For 100,000 gpd:
Two 12' x 12' x 16.5' hoppers
One 12' x 40' x 12' sand filter

For 150,000 gpd:
Three 12' x 12' x 16.5' hoppers
One 12' x 55' x 12' sand filter

INFORMATION SOURCE: Water Inc. - Jerry Serame: 615 264 0060

PRICE: will be provided by 9/25/98

ITEM: Capping technology - Aquablok bentonite cap

DESCRIPTION: This technology which is developed by New Waste Concepts involves applying a bentonite/gravel mix material to form a cap. The material are pellets consisting of gravel encapsulated in a clay/bentonite layer. The pellets can be manufactured on-site if the raw materials (gravel, clay, proprietary polymers) are available. The material can be applied from a barge, a conveyor, or even from a helicopter. As the material is released to water, it hydrates, expands and forms a continuous layer. A layer of pellets can expand to twice its initial thickness when hydration is achieved. In an inundated area, hydration of the cap is typically achieved in 1-2 days; thicker layers may take up to 7 days or more to hydrate. The material can withstand erosion in water with velocity up to 6 fps. The thickness of the layer depends on requirements for diffusion control, burrowing depth, and erosion control. Typical thicknesses for past applications range from 4" to 8". The permeability of the cap is approximate 10^{-9} to 10^{-8} cm/s. No preparation of subgrade, no cover material, and no anchoring are required for the bentonite layer.

Some resuspension of sediment will occur when the Aquablok material is applied. Extent of resuspension depends on depth of water, rate of application, and grain size of sediments. In environments with low velocity flows, some of the resuspended material will be incorporated into the cap as the Aquablok material hydrates. A layer of sand (~0.5 cm) can be placed on top of the sediments prior to applying Aquablok if resuspension is a particular concern.

The Aquablok material has been tested extensively in the laboratory. The material has been shown to withstand freeze-thaw cycles. Cracks that do develop during freezing typically rehydrate and reseal during thawing. The material is sensitive to dessication and cracking is a problem if the cap is exposed for extended of time.

This technology has been used in Alaska at Fort Richardson. A 1-acre area in an estuarine/wetland environment contaminated with white phosphorus was covered with the Aquablok material in 1994. A 4" layer was applied from a helicopter (because of concerns about live ordnance in the area) over a period of 3 days. The cap effectively sealed the area and made the white phosphorus unavailable to ducks living in the area which were getting sick from eating the white phosphorus.

A pilot study demonstration is currently being planned in the Ottawa River in Ohio. Three 1-acre areas will be capped with: 1) Aquablok, 2) Aquablok w/ geotextile, and 3) Aquablok w/ geotextile and layer of stones, respectively. The Aquablok will be applied using a barge, by helicopter, and a conveyor which spans the width of the river to assess the best method of application. The area to be capped is in 2' to 9' water.

INFORMATION SOURCE: Hull & Associates- John Hull and Joe Jersak: 419 385 2018; New Waste Concepts - Tom Nachtman: 800 359 2783, ext 110

PRICE: $150-200/ton of Aquablok material; for 6" layer: 9-10 lbs/sf, for 8" layer: 13-14 lbs/sf. Using $150/ton: $0.68-$0.75/sf for 6" layer, $0.98/sf-$1.05/sf for 8" layer

Using $200/ton: $0.90-$1.00/sf for 6" layer, $1.30/sf-$1.40/sf for 8" layer
Installation cost: $10,000/acre (or $0.23/sf). Rate of installation: estimated 2 acres/day from barge/conveyor (potentially higher if operating from land).
According to Tom Nachtman, quotes from John Hull for the material does cover the cost of bringing the product to the site; providing that there is a quarry not too far from the site where the raw material to manufacture Aquablok can be obtained.

ITEM: Transportation by rail

DESCRIPTION: Transportation of dredged material from dewatering/treatment facility (closest town is Fort Edward) to landfill by rail. The closest rail station (probably at Fort Edward) would provide freight rates for transport (by getting costs from all stations along route). The closest rail line to site may is a Delaware & Hudson line which has been bought out by Canadian Pacific (Fulton 1998).

Two modes of transport by rail: intermodal containers and gondola car. Each intermodal container holds ~20 tons of material. Four containers can go on a flat car, so that each flat car can hold ~80 tons of material. The containers can be transferred onto a truck flatbed for truck hauling if a landfill does not have direct rail access. A container can be unloaded through a backgate or if the equipment is available at a landfill, the container can be dumped by turning it upside down. A gondola car can hold ~90 tons of material. The gondola car would be covered by a tarp during transportation. A loader with clamshell bucket can be used to load and unload a gondola car. Another option for loading a gondola car, particularly at a site that does not have direct rail access, is to provide a ramp that can be hooked up to the gondola car to load truckloads of material onto the car (Fulton 1998).

For a round trip distance of approximately 700 miles (Fort Edward to Niagara Falls and back), 50 to 60 gondola cars should be leased to haul 500 cubic yards of dredged material per day. The number of cars required depends on the time it takes to make a round trip (Fort Edward to Niagara Falls and back). (Rich Hartzell of Canadian Pacific estimated 3 days travel from Fort Edward to Niagara Falls). The capacity of each car is 2,743 cubic feet (~100 cy). A loop of cars should be operating at any one time: one group of cars loading at the site, one group unloading at the landfill, one or more group(s) traveling from the site to the landfill, and one or more group(s) traveling from the landfill back to the site. The railroad would be notified when a group of cars is ready to be transported (Quinn 1998).

Flat cars used for transporting containers are not as available as gondola cars. Flat cars are typically leased for 5 years; so that leasing rates for shorter periods of time may be substantially higher. A 90-days notification is typically required to make containers and flat cars available. Availability of intermodal containers and flat cars may be a problem, particularly during summer months (Frazer 1998, Dyson 1998).

Rail transport is not highly dependent on distance, unlike truck hauling. So if a landfill farther away than the Niagara Falls area with rail access can be identified that will accept the dredged material for lower tipping fees, disposal there may be an option (Fulton 1998).

INFORMATION SOURCE:

Rail transportation -	Lee Fulton, CSX Transportation, 610 388 9639.
	Rich Hartzell, Canadian Pacific, 630 990 6993
Ramp to load gondola car -	Exodus Logistics: Ronny Knight 800 441 1153

Railcar/gondola car leasing - GATX: Paul Dyson 800 405 2555
DJ Joseph: Neil Quinn 513 621 8770
Herzog: Jim Frazer 816 233 9001

PRICE: $500/month to lease 1 gondola car (Quinn 1998)
$550/month to lease 1 flat car, based on a 5-year lease (Quinn 1998)
$435/month to lease 1 gondola car, plus $1.24/car/mile for transport from Missouri (where the cars are located) to site, plus insurance, taxes, and maintenance (Frazer 1998). Mr. Frazer suggested 2-year lease (or 1.5 year lease) may be more appropriate than two 6-month leases as it would assure that the cars would be available when needed. The cars may be leased out during the 6-month period when dredging is not conducted.

$1,722/gondola car per round trip from Fort Edward to Niagara Falls (3 days trip per way) (Hartzell 1998)

$12/container/day - short term lease of 25-cy container (Dyson 1998)
$300/container/month - 6-month lease of 25-cy container (Dyson 1998)
$1,000/flatcar/month - (4 containers/flatcar) (Dyson 1998)

Freight rates for a gondola car from Ft. Edward to Wayne Disposal in Michigan and freight rates for a flat car w/ containers from Ft. Edward to Buffalo, NY (for transfer to Model City) will be provided by CSX.

TAMS

INTEROFFICE CORRESPONDENCE

To	Bruce Fidler	Location		Date	Sep 16, 1998
From	Mark Moese	Location		Job No.	
Subject	Hudson Early Action Assessment- Draft Proposed Monitoring Plan	Reference			

This memo is a Draft monitoring plan which needs to be included in the development of the dredging/capping alternatives. This effort is exclusive of any monitoring of the land based sediment handling operations and health and safety monitoring.

PROPOSED MONITORING PLAN

- PCB/TAL Metals Water Sampling

Collect 24 hour composites at both the Thompson Island Dam and in Schuylerville for PCBs and TAL Metals in whole water and dissolved fractions. Sampling will be performed every other day with analysis turnaround in 24 hours. Estimated analytical costs are: $320.00(low level PCBs) and $270.00(TAL Metals) X 15 samples/month X 2 locations = $17,700.00/month.

- Fish Tissue Sampling

Collect samples once per month from the Thompson Island Pool and Schuylerville for PCB and TAL Metal whole body analysis. Three species of fish should be sampled with three samples per fish per location per event. The three suggested fish species are: yellow perch, large mouth bass, and pumpkinseed. PCB congener specific analysis is preferable. Estimated cost associated with these analyses is: 3 fish X 3 samples /event X 2 locations X $420.00/sample(PCB) + $370.00/sample (TAL Metals) = $14,220.00/month.

- Monitoring of Suspended Sediment

This effort will require daily monitoring 100 feet down river of the silt curtains or the dredge for total suspended sediments. This effort can be undertaken in an on-site laboratory with the purchase of $1,500.00 of capital equipment (drying oven, scale, buchner funnels etc.) and trailer rental.

It is anticipated that the sampling and analytical effort would require the presence of two laboratory/sampling technicians during the dredging activities.

TAMS Consultants, Inc.

300 Broadacres Drive 3rd Floor Bloomfield, NJ 07003
(973) 338-6680 Fax (973) 338-1052

SEP 28 '98 10:21 FR TAMS CONSULTANTS INC.212 697 6354 TO BLOOMFIELD P.02

TAMS

Job No. 5904-004

Project

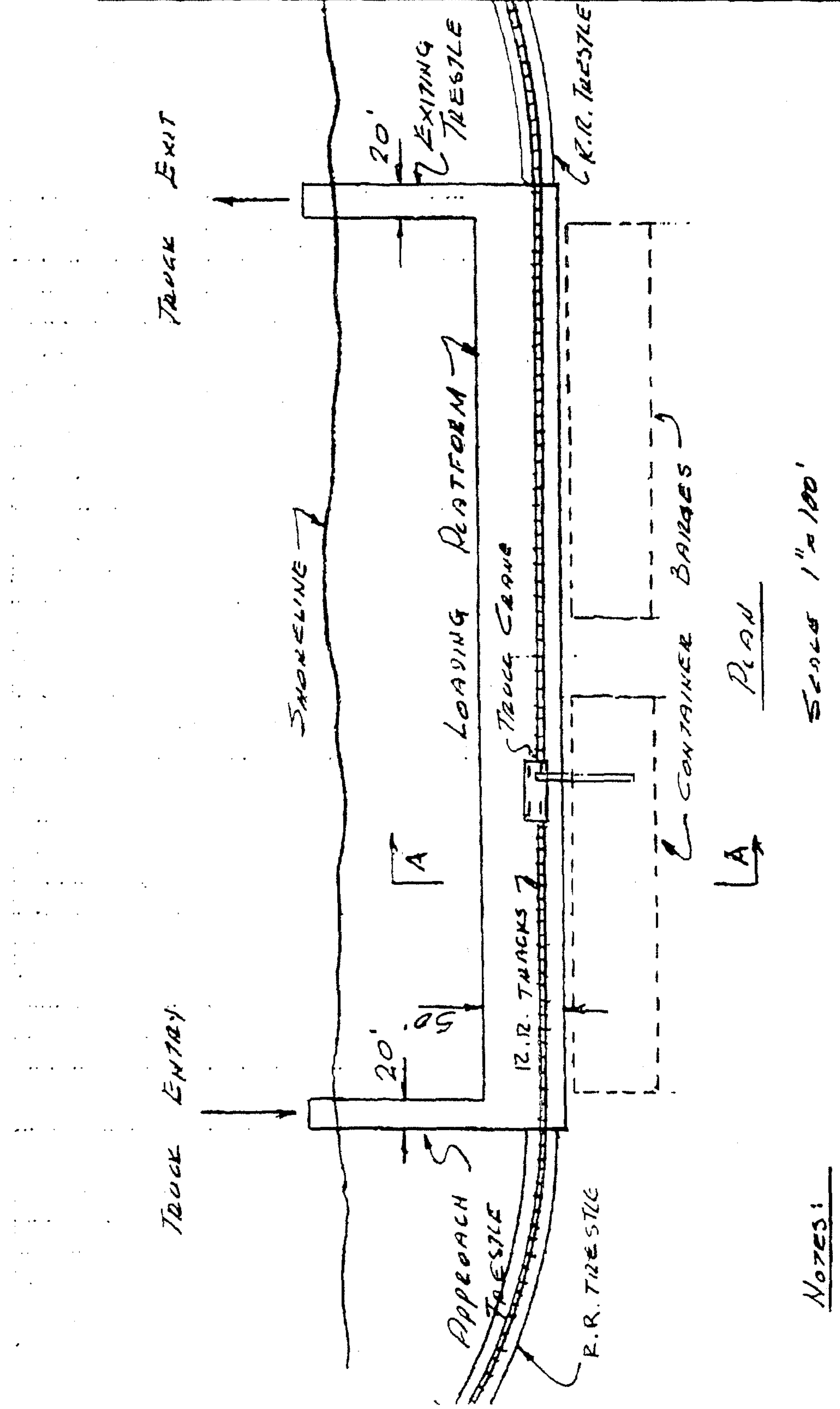
Subject Concept - Container Handling Facility

Sheet 1 of 3

Date 9-23-98

By B.

Ch'k. by



Notes:

1. Temporary Barge Unloading Facility
2. Container Loadings (from Barges) onto Truck Chassis or Flatbed R.R. Cars
3. Structures of Untreated Timber

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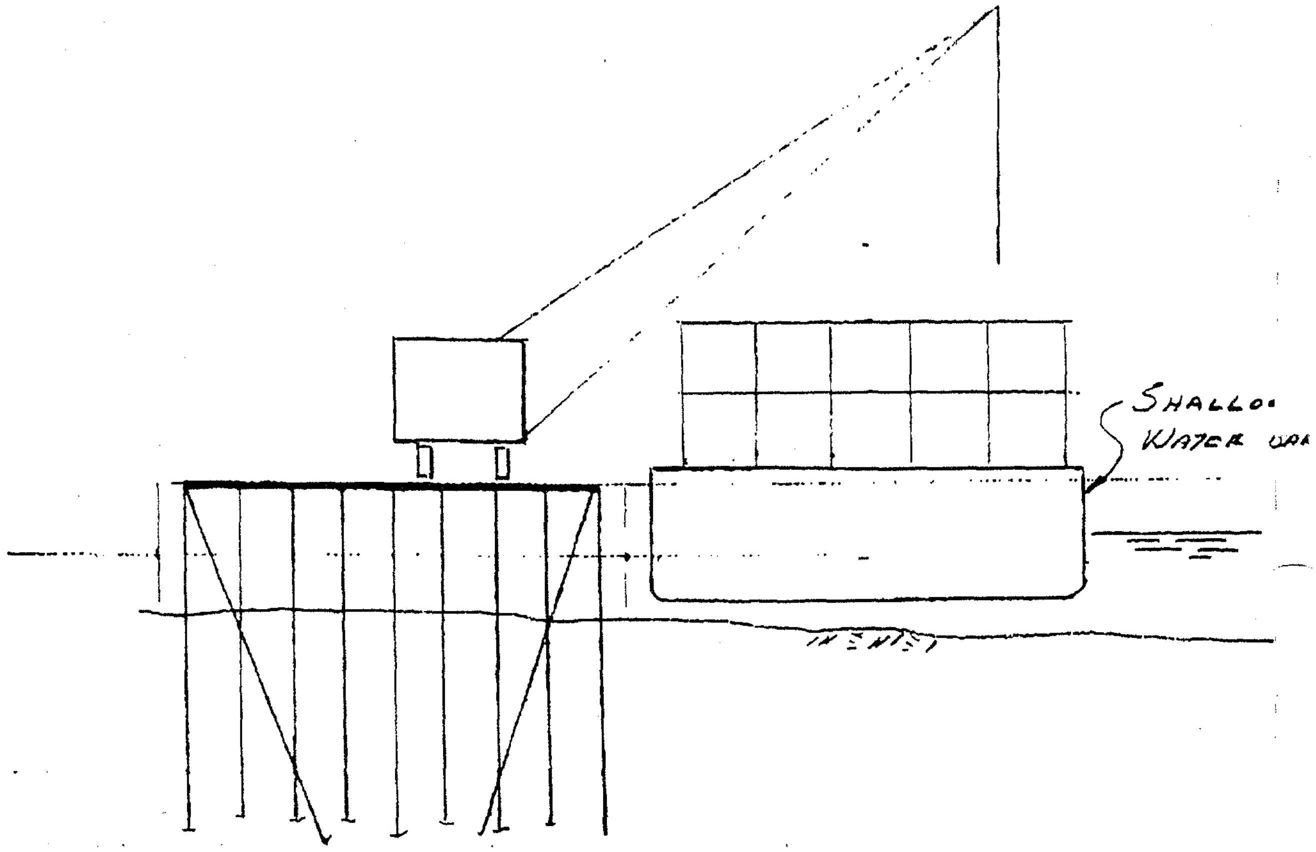
TAMS

Job No. 5504-004 | Sheet 2 of 3

Project CONCEPT - CONTAINER HANDLING FACILITY | Date 9-23-98

Subject | By [illegible]

Ch'k. by



SECTION A-A

SCALE 1" = 20

CONSTRUCTION COST

LOADING PLATFORM 50x600 = 30,000 SF

TRESTLES - 2 @ 20x100 = 4,000

TOTAL AREA = 34,000

34,000 @ $40/SF = $1.4 MILLION

(1) ESTIMATE APPLICABLE FOR TRUCK LOADING FACILITY ONLY

USE $1.5 MILLION (1)

TAMS

Job No. 5904-004
Project Concept - Container Handling Facility
Subject
Sheet 3 of 5
Date 9-28-98
By
Ch'k. by

CONSTRUCTION COST ESTIMATE

ITEM	SIZE	UNIT COST	COST
BASIC LOADING PLATFORM (TRUCKS ONLY)	30,000 SF	$40/SF	1,200,000
TRUCK TRESTLES	4,000 SF	$40/SF	160,000
CONVERT LP TO ACCOMMODATE R.R. CAR	600 LF.	$500/LF	300,000
R.R. TRESTLES	800 L.F.	1200/LF	960,000
			2,620,000
CONTINGENCIES - SAY 15%			393,000
			$3,013,000
		USE	$3,200,000 (2)

(2) ESTIMATE APPLICABLE FOR FACILITY THAT CAN ACCOMMODATE BOTH, TRUCK LOADINGS & R.R. CAR LOADINGS

TAMS

Job No. 5904

Project Hudson River

Subject Volume Dredged for Access Channel

Sheet 1 of 1

Date 10/1/98

By L Thai

Ch'k. by

Volume Dredged for Access Channel to Docking Facility

Want water depth in channel ~9'

Area 8' to 9' - or 8.5' depth avg - dredge 0.5' to 9'

$\frac{1}{2}(125 + 175') \times 50' \times 0.5' = 3750$ cf

Area 6' to 8' - or 7' depth avg - dredge 2' to 9'

$\frac{1}{2}(650' \times 120') \times 2' = 78{,}000$ cf

Area 4' to 6' - or 5' depth avg - dredge 4' to 9'

$650' \times 40' \times 4' = 104{,}000$ cf

Area 2' to 4' - or 3' depth avg - dredge 6' to 9'

$650' \times 20' \times 6' = 78{,}000$ cf

Area D

31,192 sf dredged 1' for contaminant removal

Avg depth 1' - Need to remove add'l 7' (after 1' removed for contam. rem.)

Area needed to be removed to 9' depth $= \frac{1}{2}(250' \times 50) \times 7' = 43{,}750$ cf

Total = 307,500 cf = 11,400 cy

TAMS

Job No. 5904

Sheet 1 of 1

Project Hudson River TIP Early Action

Date 9/98

Subject Quantities for Cost Estimates - Alt D-1

\# of Confirmation samples at dredged surface

By L Thai

Ch'k by

Confirmation Sampling

Field Screening - PCB Assays

Assume 1 sample every 5,000 sf plus 10% duplicates

Total surface area dredged = 3,243,133 sf

$$\# \text{ of field screen samples} = \frac{3,243,133 \text{ sf}}{5000 \text{ sf/sample}} * 1.1 = 714 \text{ samples}$$

Assume 10% are sent to laboratory

0.1 * 714 = 72 samples

TAMS

Job No. 5904

Sheet 1 of 1

Project Hudson River TIP Early Action

Date 9/98

Subject Number of containers and flat cars required for transport of sediment to landfill

By L. Thai

Ch'k. by

Dredging 60,000 cy / yr

⇒ 5 mos at 20 days/mo

⇒ 600 cy / day

if assume 1.5 T/cy

⇒ 600 x 1.5 = 900 T/d

if each container can hold ~ 35 Tons (according to Brian Larson)

⇒ $\frac{900}{35}$ = 26 containers per day

if assuming 2 containers per flat car

⇒ $\frac{26}{2}$ = 13 flat cars/day

⇒ 13 x 5 = 65 flat cars/week

Lease 65 flat cars for # of months doing dredging

assume 1 week round trip to land fill

need 26 $\frac{\text{containers}}{\text{day}}$ x 5 $\frac{\text{d}}{\text{wk}}$ x 2 wks = 260 containers

↑ 1 wk loading, 1 wk travelling

TAMS

Job No. 5904 | Sheet 1 of 1
Project Hudson River TIP Early Action | Date 9/98
Subject Volume of water for treatment - Alt D-1 | By L Thai
Ch'k. by

Total Volume of Sediments Dredged = 238,000 cy

If assume volume of water entrained is approx. 33% of volume of dredged sediments, (ie for each bucket removed, 75% of volume is sediment, 25% is water), and assuming decanting will remove all water entrained during dredging

Volume of water for treatment = 238,000 cy * 0.3333 * 202 gal/cy

= 16,023,730 gal

4. PREDICTION OF IMPACTS TO FISH

One of the major ecological issues involved with the proposed early action alternatives (*i.e.*, dredging and combined capping/dredging) is the potential increase in PCB water concentrations and subsequent bioaccumulation in and impact to fish in the TIP. This analysis is primarily based on the release of contaminants during dredging activities as a worst case example because resuspension of sediment during capping should be minimal. As noted in Chapter 3 above, the most important means of controlling sediment resuspension are the use of appropriate equipment and conducting the dredging operations in a controlled manner.

As the first part of this analysis we examined total PCB water concentrations versus fish tissue concentrations during previously performed consistent sampling series and coincidental sampling periods. These data are presented in the attached figures. Each point on the graph represents an arithmetic average of lipid normalized total PCB concentrations. Each point is labeled to show the location and year; *e.g.*, G1-88 indicates the TIP for 1988. While a trend may be evident, caution must be taken as to the true power of these relationships as a predictive tool. The relationship as originally presented in the Phase I Report (USEPA, 1991) is not as definitive when additional years of data are analyzed and the data are more consistently compared. Water column concentrations appropriate for each station were estimated from USGS observations at Stillwater, where TIP concentrations were adjusted up from the Stillwater data in accordance with the Preliminary Model Calibration Report (or PMCR, USEPA, 1996) procedure.

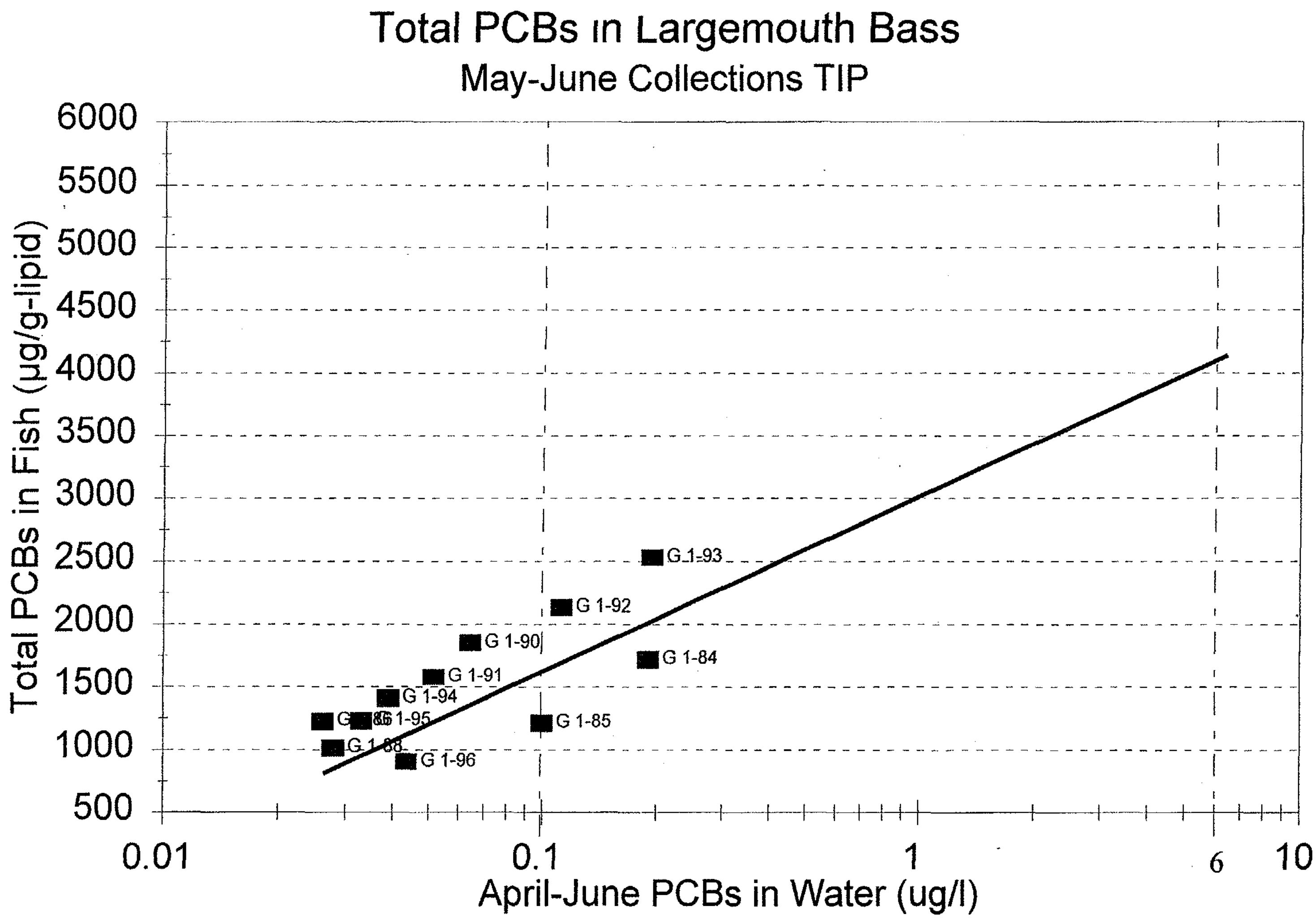
As a conservative estimate a simple trend analysis was undertaken to evaluate impacts at the dredge location for the pumpkinseed, brown bullhead, and largemouth bass. Based on a visual interpretation, a line was placed to estimate the potential trend in the data to predict what average concentration may occur in fish tissue if, based on the dredging impact analysis, the estimated maximum water concentration at the dredge increased to 6.0 ug/l total PCB during the dredging. (A description of the early action scenarios involving dredging is provided in Section 3.2.)

For the pumpkinseed, the database did not provide sufficient data in the TIP, so Stillwater data were included. The trend for the brown bullhead is less apparent due to the variability in the data. While for the largemouth bass the trend indicates that fish tissue concentrations may increase above the 1993 average which occurred during the May to June time frame, any projected increase in tissue concentration at the dredging location does not appear to be significant. Using an average lipid concentrations of 3.3% (pumpkinseed), 2.9% (brown bullhead), and 1.4% (largemouth bass) (USEPA, 1991), increases in tissue concentrations at the dredge were calculated (Figures 4-1 to 4-3). In the vicinity of the dredge, the largemouth bass tissue concentration may increase to 57 mg/kg, for the pumpkinseed, tissue levels may increase to 31 mg/kg, and brown bullhead concentrations may reach a maximum of 55 mg/kg.

For the second set of analyses, a simple calculation was performed to estimate the average daily mass loading which may occur in the TIP from the dredging activities assuming that dredging operations lose roughly two percent of the total sediment dredged (Tavolaro, 1984). This sediment loss coupled with the cumulative PCB mass removed, the estimated volume of sediment removed, the size of the bucket, and the number of buckets per day yields the potential total mass of PCBs released to the TIP on a daily basis. The results indicate that during the implementation of Alternative D-1 the average daily mass loading of PCBs during years 1, 2, 3, and 4 of the dredging operations would be 0.92, 0.71, 0.89 and 1.00 lbs of PCB per day to the TIP, respectively. For Alternative D-2, the first year of dredging would release an average of 1.14 lbs per day, while the expected average losses for the second year of dredging could be approximately 1.27 lbs of PCB per day. The calculated average daily mass loss of PCBs to the TIP for Alternative D-3 is 1.57 lbs per day. Therefore, depending on the actual final dredging sequence the estimated PCB loading to the TIP may range between 0.71 and 1.57 lbs per day. This incremental increase in PCB loading may increase the PCB water levels an additional 0.050 ug/l within the TIP. Using the 1996 data which indicate a water-column concentration of around 0.04 ug/l, the additional load from the dredging activities would result in a total water-column concentration of approximately 0.1 ug/l. This concentration is within the range of historical averages for the April to June time frame. In addition it is expected that the actual loss per bucket removed should be below the two percent estimated by Tavolaro (1984) for larger clamshell buckets, based on the use of a smaller environmental bucket and the projected slower dredging rate.

In conclusion, one can anticipate that there will be an increase in fish tissue PCB concentrations in the TIP and down-river of any action involving dredging. The magnitude of this increase may not be adequately forecasted by the trend analysis, since fish dietary exposure or other factors may play an important role in determining any increase in PCB tissue concentrations. Based on this analysis, however, it can be expected that the average fish tissue concentration increase at the dredge should not approach the levels found in the late 1970's except for the brown bullhead for which limited data exist for that time period (USEPA, 1991). This analysis is supported by previous investigations on the potential for contaminant impacts during dredging activities. Work by Peddicord and McFarland (1978) found that even in documented cases where tissue accumulation occurred, the resultant fish tissue concentrations were only a few times higher than in control organisms. While the levels of PCBs in fish may temporarily rise in the vicinity of a dredging operation, they will likely drop quickly back to pre-dredging levels. This is clearly illustrated by examining the increase and decrease in fish tissue PCB concentrations after the release at Allen Mill in the fall of 1991.

Figure 4-1

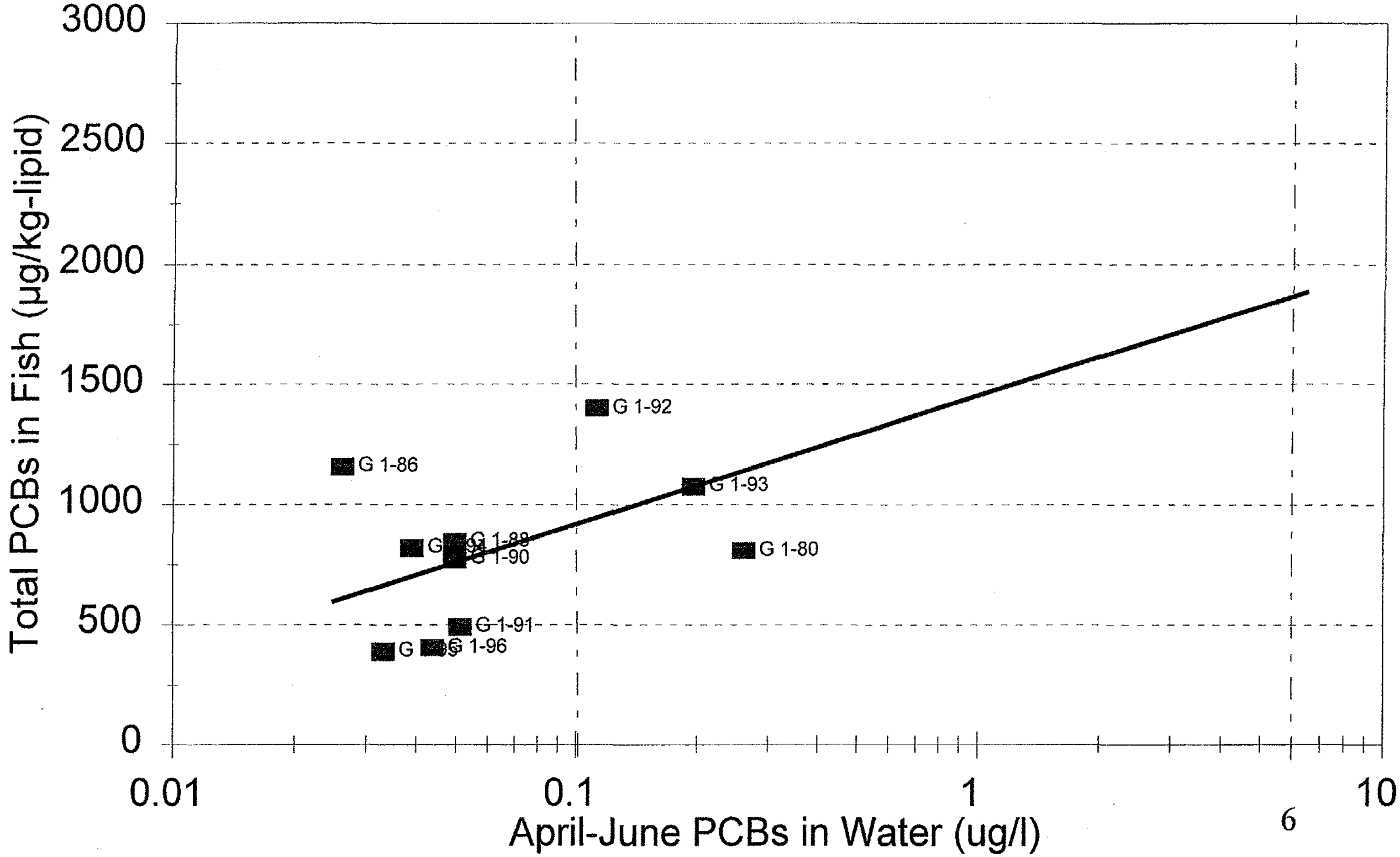


TAMS

Figure 4-2

Total PCBs in Brown Bullhead

May-June Collections TIP



TAMS

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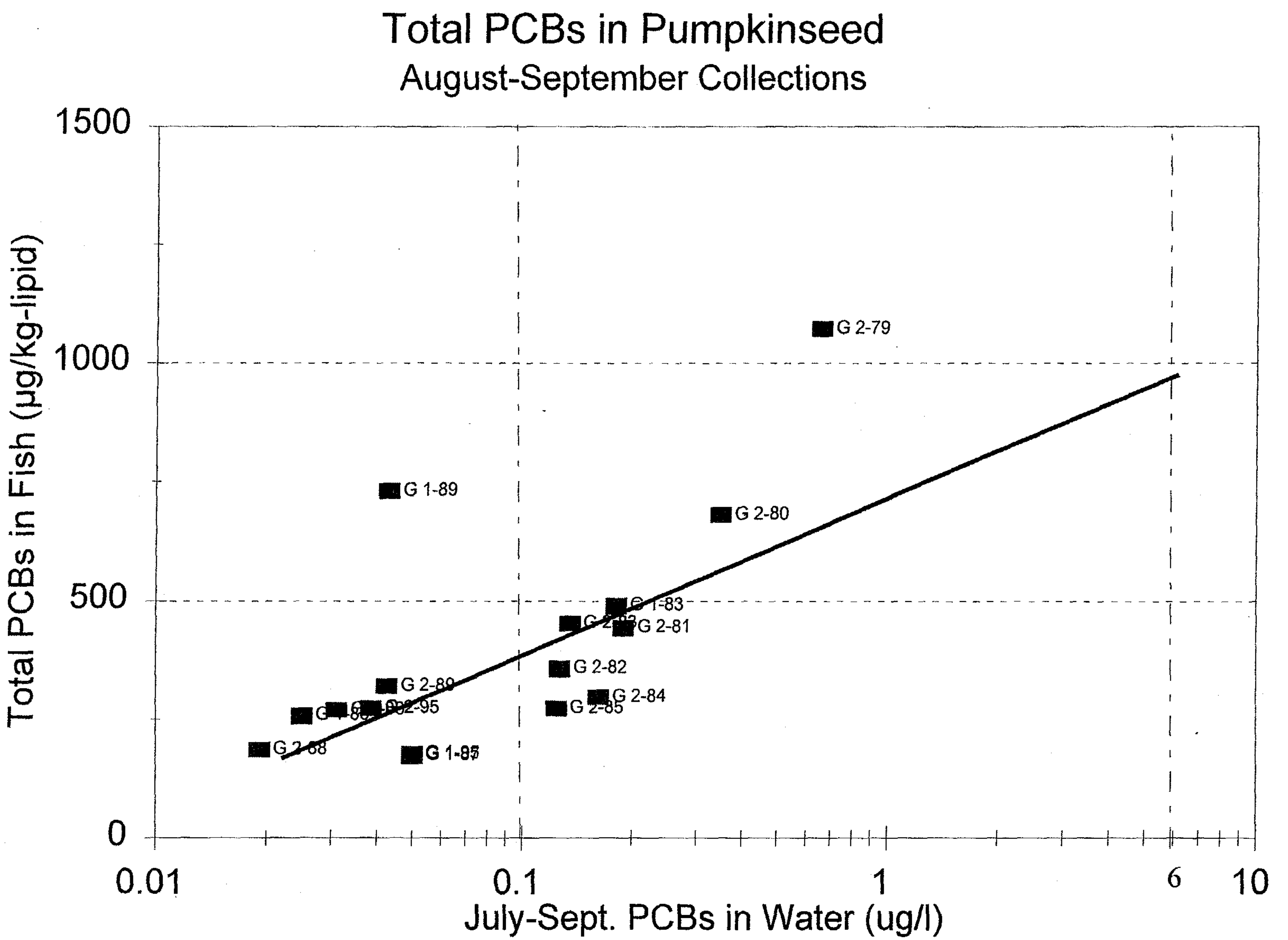
Figure 4-3



TAMS

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5. EVALUATION OF ECOLOGICAL IMPACTS OF ACTION ALTERNATIVES

5.1 Dredging Impact Analysis

Based on the technology selected for the dredging alternatives, an approximately 2 cu. yd. bucket with a closing lid, the following impact analysis is a conservative estimate of potential impacts because it is based on available information concerning dredging using a larger clamshell dredge. The use of a small bucket, a slow rate of dredging, and potential use of silt barriers will result in a loss rate of sediments that would be low. The vast majority of sediments that do escape are expected to resettle in the vicinity of the dredging site. In addition, potential impacts are expected to occur only during the dredging season, *i.e.*, May through November, thereby allowing some recovery to take place during the remaining months of the year.

The potential direct or indirect effects of dredging target areas in the TIP include:

- Physical disruption of the bottom;
- Changes in bottom topography;
- Suspension of sediment;
- Alteration of water quality; and
- Release of sediment-bound contaminants.

Dredging causes damage directly by the physical disturbance involved in removing sediment. The deepening of the water habitat can alter its stability by adjusting the bed geometry and hydraulic regime. This may reduce current velocity and accelerate sediment deposition (Kennish, 1992).

The principal effect of dredging on water quality relates to increases in turbidity, nutrients and contaminants. Most organisms are not seriously affected by suspended sediment conditions created in the water column by dredging operations. Organisms normally associated with muddy environments are highly tolerant of sediment suspensions. Dredging-induced turbidity may have effects on local community function such as photosynthesis but these effects are transitory. Laboratory experiments by O'Connor *et al.* (1977) on the sublethal effects of suspended sediments on estuarine fishes showed that white perch exposed to 0.65 g/L of Fuller's Earth for five days resulted in respiratory function impairment. O'Connor et al. (1977) also determined 24 hour LC_{50} concentrations of suspended sediment for several fish species including: killifish (38.18 g/L), mummichog (39 g/L), and white perch (less than 10 g/L). Hematological analysis on striped bass at exposure concentrations of 1.5 to 6 g/L of natural uncontaminated muds for six days caused no detectable impact. However, when exposed to suspended contaminated sediment striped bass (*Morone saxatillis*) survived only a few hours at 0.5 g/L suspended sediment, a condition representing a worst case of turbidity generation associated with a dredging operation. Such exposures are very unlikely to occur in the field where motile organisms may escape turbidity maxima, and where currents disperse sediments as they settle out of the water column.

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Dredging analyses performed by the USACE Waterways Experiment Station (WES) on clamshell buckets indicate that within 100 feet of the dredge the maximum water column suspended sediment concentration is approximately 0.3 g/L (WES 1986) with an average concentration of 0.1 g/L (Barnard, 1978). During dredging activities in Haverstraw Bay, using a bucket dredge with no suspended sediment engineering controls in place, WES (1989) analyzed total suspended sediment (TSS) concentrations near the dredge and at locations within the Bay at the surface, mid-depth, and bottom layers of the water column. They showed that at the surface and mid-depth, the average TSS value was 0.026 g/l while at the bottom the TSS value was 0.14 g/l. Bay-wide, the suspended sediment concentration during the dredging work resulted in a mean turbidity level of 8.4 NTU or slightly under the 0.026 g/l value at the dredge. This bay-wide suspended sediment level may be higher than what would be encountered in the TIP since Haverstraw Bay is subject to tidal cycles which would move the suspended sediment both up and down river, the dredge was not an environmental dredge, and no suspended sediment engineering controls were implemented during those dredging activities. Once dredging ceased however, turbidity increased due to fine grained materials on the disturbed bottom. This elevated turbidity can continue for a time after dredging until the bottom stabilizes. In the TIP, once dredging has ceased the increase in turbidity will be less of a concern due to the lower PCB concentrations expected in the destabilized sediment.

The resuspension of bottom sediment releases nutrients and remobilizes contaminants affecting water quality and water chemistry. The role of anthropogenic pollutants associated with dredged materials is difficult to assess because sediments containing high levels of pollutants do not necessarily release them into the water column during dredging (Kennish, 1992). Chemical analysis of sensitive species for metals, PCBs, and pesticides indicate uptake will occur but none were accumulated to levels which appeared to be sufficient to influence the survival of the exposed organisms (Peddicord and McFarland, 1978). Even in documented cases where tissue accumulation occurred, the concentrations were only a few times higher than in control organisms (Peddicord and McFarland 1978).

Potential impacts resulting from sedimentation during dredging operations is expected to be localized and temporary. The contaminants in the TIP sediments were deposited from chemical releases from upstream sources. Because there are no sources of chemicals at the dredging sites, dredging activity does not contribute any new quantities of contaminants to the aquatic environment. The disturbance and loss of small amounts of contaminants during dredging may result in a redistribution of these contaminants. Because there is widespread contamination in the Hudson River sediments, the redistribution of a small quantity of contaminants would not appreciably alter the exposure levels of benthic aquatic life to these contaminants. In 1989 USEPA performed extensive biomonitoring during the New Bedford Harbor Pilot Dredging Project. This monitoring program was developed to ease public concerns that dredging the PCB contaminated sediments would significantly affect aquatic plants and animals in the harbor. Several dredging technologies were tested coupled with an extensive biomonitoring field program to determine the potential impacts of dredging shallow water areas. After extensive testing no acute or chronic biological effects were observed from dredging the PCB contaminated sediment.

In 1977 during dredging activities near Fort Edward, monitoring data were collected by NYSDEC for PCB water content and suspended sediments (Brown, 1981). This report determined that during flow conditions averaging 1,240 cfs PCB levels at the dredge were found to be 0.29 ug/L resulting in a transport of 1.94 lbs/day. Assuming a maximum sediment concentration of 234 mg/kg in the

TIP sediments projected for removal under this action and a TSS value of 0.026 g/l, then the expected worst case incremental water concentration at the dredge could approximate 6.0 ug/l. Any potential water column concentrations will be highly dependent on how rapid the sediments settle out of the water column, and the amount of mixing that will occur based on river flow at the time of dredging.

The evaluation of mass loading which may occur in the TIP from the dredging alternatives was calculated assuming that dredge operations lose roughly two percent of the total sediment dredged (Tavolaro, 1984). The results indicate that during the implementation of Alternative D-1 the average daily mass loading of PCBs during years 1, 2, 3, and 4 of the dredging operations would be 0.92, 0.71, 0.89 and 1.00 lbs of PCB per day to the TIP, respectively. For Alternative D-2, the first year of dredging would release an average of 1.14 lbs per day while the expected average losses for the second year of the dredging could be approximately 1.27 lbs of PCB per day. The calculated average daily mass loss of PCBs to the TIP for Alternative D-3 is 1.57 lbs per day. Therefore, depending on the actual final dredging alternative and sequence, the estimated PCB loading may range between 0.71 and 1.57 lbs per day, which may incrementally increase the water levels by approximately 0.05 ug/L, depending on the total river flow at the time of dredging.

Ecological recovery of the dredged locations in the TIP may occur slowly with opportunistic pioneering species initially recolonizing the site and later being supplanted by organisms in a successional pattern. The life cycle activity of the benthic fauna present within the project area is generally limited to the top several centimeters of bottom sediment. Dredging will result in temporary loss of benthic habitat, therefore bottom feeding predators would suffer a temporary loss of prey until the area is repopulated. This recovery process may require one to two years since many benthic species have distinct peaks of reproduction and recruitment, and benthic recovery is temporally and spatially variable. Lateral migration of organisms and larval recruitment from upriver areas will play important roles in recolonizing dredged locations in the TIP. Dredging will be performed in small sections over a one- to four-year period, depending on the alternative chosen, instead of one large area. This approach will promote recovery time and minimize potential impacts to the system.

It will be ecologically advantageous in areas where dredging may only remove the top one to two feet of contaminated material that no backfilling take place using clean material so that natural sediments remain for the biota to recolonize. In areas where more than two feet of contaminated material is being removed and it is determined that a hydrologic requirement for recontouring must be undertaken, then fine natural sand/silt should be used in those areas. Any effects in these areas due to the change in sediment grain size should be minimal. WES (1996) showed that based on a 10 day bioassay using benthic organisms that survival of the amphipod *Hyalella azteca*, survival, reproduction and growth of the oligochaete *Lumbriculus variegatus* and survival of the midge *Chironomus tentans* were unaffected by sediment grain size. This review also stated that chironomids may perform better in sandy sediments and that grain size effects on habitat selection may actually be the result of hydrodynamic forces not the result of changes in grain size. It will also be important to recreate a varied benthic habitat once dredging is completed to promote greater species diversity. In addition to the placement of sand/silt during any recontouring requirement and the areas where natural sediment will be exposed, any rock above six inches in diameter should be replaced in the dredged hot spot as a type of gravel/rock bar habitat to promote habitat diversity.

It is fully recognized that bioaccumulation of PCBs may occur in fish downstream of the dredging operation due to increases in water column concentrations. They are however, anticipated to decrease following cessation of dredging much like the trend in fish tissue concentrations associated with the release of PCBs from the Hudson Falls GE facility in the early 1990's. Based on an estimated total PCB maximum concentration of 6.0 ug/l in the TIP at the dredge as a worst case, the largemouth bass tissue concentrations may increase to an average of 57 ug/kg, pumpkinseed tissue levels may increase to 31 mg/kg, and brown bullhead concentrations may reach a maximum of 55 mg/kg. (Figures 4-1 to 4-3).

As indicated by the mass loading calculation, the water concentrations are expected to increase incrementally by approximately 0.05 ug/l, which would keep the total PCB concentrations within historical averages. Based on this analysis, concentrations in the largemouth bass and pumpkinseed will not exceed the historical averages in the TIP, whereas tissue concentrations in the brown bullhead may exceed historic levels in the TIP (USEPA, 1991). Any increase in PCB fish body burden may incrementally increase impacts on the health of both aquatic and terrestrial piscivorous species over what is currently occurring. However, once dredging is completed, the resultant decrease in PCB exposure will reduce PCB effects on the aquatic and terrestrial receptors that inhabit the site area. The ecological effects of suspended sediment conditions in the water column typically created by dredging operations are minimal, transient and do not cause irreversible ecological impacts (Stern and Stickle, 1978).

In addition, since dredging will occur along the river shoreline, the potential exists for requiring the implementation of shoreline stabilization measures. If shoreline stabilization is required, bioengineering controls should be implemented. Examples include stone, rock, or log revetments for toe protection, coupled with brush mattressing or brush layering for shoreline stabilization.

At the present time no seasonal restrictions to dredging are anticipated as they relate to environmental concerns. In order to minimize the potential dredging impacts the following items should be included in the dredging operation:

- Dredge used, if a mechanical type, should employ an enclosed bucket with well-controlled movements to reduce sediment resuspension;
- No barge overflow should be permitted, as this contributes to increased suspended sediment concentrations;
- Suspended sediment 100 ft down-river of the dredge should not exceed 0.5 grams per liter;
- Dredging schedule should be from the northernmost (*i.e.*, farthest upstream) target area to the southernmost (*i.e.*, farthest downstream) target area for any scenario;
- Silt barriers should be deployed as a secondary measure where feasible to further reduce total PCB water concentrations;
- No backfill is required if only dredging one to two feet in depth, since maintenance of natural sediment is preferred to sand;

403232

- For dredging depths greater than two feet, recontouring with fine sand may be conducted if hydraulically necessary;

- Large rocks (*i.e.*, greater than six inches in diameter) removed from target areas must be returned when dredging is completed to enhance fish habitat; and

- Bioengineering controls should be implemented for shoreline protection.

5.2 Capping and Dredging Alternative Impact Analysis

This analysis will be confined solely to addressing the impacts from capping contaminated sediments. The impacts associated with dredging, which would also apply to the combined capping and dredging alternatives, are discussed in detail above in Section 5.1.

Capping may be defined as the process where by a layer of clean material is deposited atop contaminated sediments so as to reduce the loss of contaminants to the water column and to isolate the contaminated deposits from biota.

Considerations in the evaluation of the feasibility of capping include water depth, bottom topography, currents and capping material characteristics. Capping has been successfully implemented to isolate contaminated material as a means of offsetting the potential harm of contaminated material.

The potential direct and indirect environmental effects of capping are similar to dredging impacts:

- Physical disruption of the bottom - burial of organisms or communities, alteration of habitat;

- Bottom topography effects - changed hydraulics, changed sedimentation patterns;

- Suspension of sediments - lethal or sublethal effects due to smothering;

- Alteration of water quality - effects on dissolved oxygen; and

- Release of contaminants - expected to be minimal due to low incidence of bottom disturbance.

Based on the type and thickness of the cap proposed it can be assumed that all organisms below the cap will be lost during implementation of the action. Changes in or loss of habitat may be significant since the loss of habitat results in loss of benthic organisms, which further results in loss of bottom-feeding predators. A significant determinant of the potential impacts will be the percent of the shallow water habitat which is lost. Based on the estimated area to be capped vs. the total fine-grained sediment area in the TIP as a whole and the area below NYSDEC *Hot Spot* 9, the percentage of near-shore habitat lost will amount to 12.8 and 17.8 percent respectively. Changes in hydraulics due to the addition of approximately 20 inches of capping material may directly impact recruitment of new populations to repopulate both the cap and areas around the cap as well as sedimentation rates. This loss of this shallow water habitat may require mitigation measures to be implemented.

Water column turbidity created by capping operations is seldom an ecological problem since minimal contaminated sediment is resuspended and the capping material settles quickly. This is however contingent on the means and speed by which the cap is placed over the contaminated sediment. All capping operations must be performed in such a manner that resuspension of sediments is kept to a minimum. The use of equipment or placement rates that might result in capping material displacing or mixing with the contaminated material must be avoided. During the capping operation best management practices should be employed to minimize the resuspension of contaminated sediment. Resulting resuspension and release of contaminants is expected to be minimal and should not impact local biota.

In conclusion, the primary environmental impact with the capping portion of these alternatives will be the burial of sediment dwelling organisms, and loss of shallow water habitat. Some overall benefit from the capping and dredging alternatives will occur due to the reduction in exposure and resultant impacts associated with PCB-contaminated sediments. In order to minimize any impacts, compensation for loss of benthic habitat may be required by the U.S. Fish and Wildlife Service based on their Mitigation Policy 501 FW 2 established in accordance with the Fish and Wildlife Act of 1956 (16 U.S.C. 742(a) -754), the Fish and Wildlife Coordination Act (16 U.S.C. 661-667(e)), the Watershed Protection and Flood Prevention Act (16 U.S.C. 1001-1009), and the National Environmental Policy Act (42 U.S.C. 4321-4347).

6. ALTERNATE WATER TREATMENT COST ANALYSIS

Monthly averages of flow rate data from a USGS gage located at Fort Edward on the Hudson River were used to obtain flow rates at Thompson Island Dam (TID). Based on historical data, a factor of 1.05 was applied to flows from Fort Edward to represent the increase in flows due to the two main tributaries between Fort Edward and TID. The resulting flows for Thompson Island Dam were plotted as averages for the years 1995 through 1997. PCB water concentration (1996 - 1997 data) and total suspended solids (TSS) concentration at TID (1991 - 1997 data) are presented on the same plots (Figures 6-1 and 6-2).

From the plots, base flow and average PCB and TSS concentrations in the water were estimated for use in the water treatment plant design and cost estimating purposes. A base flow of approximately 3,090 cfs or 2,000 MGD was selected as the design plant flow rate to represent the minimum plant size required; for purposes of this analysis, it was assumed that excess water during periods of higher flow would be allowed to pass over the dam without treatment. The average PCB concentration in the water at TID is historically less than the MCL, so this is not a feasible reference point for treatment effectiveness. Because most of the PCBs in the water are associated with suspended matter, the plant concept was developed to remove TSS in order to remove the PCBs.

A conventional water treatment process which includes coagulation with alum, flocculation, sedimentation, and filtration was selected as the most appropriate process for TSS removal. This treatment scheme is similar to that used at the Waterford Water Works (WWW) treatment plant, except for a rapid mix process which precedes flocculation at the WWW. The Waterford treatment plant is the nearest public water system on the Hudson River downstream of the TID which uses the Hudson River as the source water.

For the development of the water treatment plant concept, it was assumed the Thompson Island Dam would be raised three feet to capture the water for treatment. This is the approximate head on the top of the dam during base flow conditions. During periods of higher flow, excess water would be allowed to simply flow over the dam without treatment. The plant would operate primarily by gravity flow. Sludge produced from treatment processes was assumed to be dewatered using belt filter presses and disposed offsite at a non-hazardous waste landfill. Treatment units were sized based on typical design criteria (JMM, 1985). The land requirement for the treatment plant is estimated to be approximately 75 to 80 acres.

Construction and annual O&M costs were estimated for the major treatment plant processes. The estimated construction costs shown on Table 6-1 include material and equipment purchase and installation, and subcontractor's overhead and profit. The estimated construction costs do not include: special site work; general contractor overhead and profit; engineering; land; legal, fiscal, and administrative costs; and interest during construction. If these costs were included, the estimated construction costs could increase by as much as a factor of two. The estimated O&M costs shown on Table 6-2 include energy requirements, labor, and maintenance materials.

Two possible discounted present values were calculated for the project's construction and O&M costs. The calculations are shown on Table 6-3. The two values were calculated for a 30-year design life using: 1) an interest rate of 6% (fixed over 30 years), an inflation rate of 3%, a discount

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rate of 5%, and, 2) an interest rate of 7% (fixed over 30 years), an inflation rate of 3%, a discount rate of 4.5%.

Completion time for the project, excluding site selection but including engineering design, permitting and licensing, and construction of the plant is estimated to be five years. The concept developed would produce water of essentially potable quality. As a frame of reference, assuming a typical generalized water supply requirement of 150 gallons per person per day, the plant would produce sufficient potable water for a population of over 13 million people. The site selected for such a treatment plant must be located at or adjacent to the southern end of the TIP in order to serve its purpose. Given its location, Thompson Island would be an obvious choice. However, at approximately 47 acres, it has only about half of the land area needed to contain the plant. Any site proposed will contend with many of the same issues as a site for long-term disposal of dredge spoils, as well as being subject to the possibility of flooding during high flow conditions.

TABLE 6-1
WATER TREATMENT PLANT ESTIMATED CONSTRUCTION COSTS

ITEM	EST. CONSTRUCTION COSTS[1]
Dam Raise and Headworks	$5M
Flocculation Basins	$35M
Clarifiers	$85M
Filters	$170M
Belt Filter Presses	$28M
Buildings, Misc. Tanks, Small Structures, Electrical, etc.	$200M
Total Estimated Construction Costs	**$523M**

NOTE:

(1) Est. construction costs do not include: special sitework; general contractor overhead & profit; engineering; land; legal, fiscal, and administrative costs; and interest during construction.

TABLE 6-2
WATER TREATMENT PLANT ESTIMATED ANNUAL O&M COSTS

ITEM	EST. ANNUAL O&M COSTS[1]
Flocculation Basins	$1.5M
Clarifiers	$1.2M
Filters	$10.4M
Sludge Dewatering	$2.3M
Sludge Disposal	$4.8M
Total Estimated Annual O&M Costs	**$20.2M**

NOTE:

(1) Estimated O&M costs include energy requirements, labor, and maintenance materials.

TABLE 6-3

Water Treatment Plant
Present Value Calculation (in $MM)

Capital Cost	$ 523	MM
Annual O&M	$ 20	MM

Scenario 1
Financing Cost of 6%/Yr fixed 30 years
O&M inflating @ 3% /Yr
PV discount rate of 5%

Yr	Interest	O&M	Total	Discounted PV
1	$31.38	$20.20	$51.58	$51.58
2	$31.38	$20.81	$52.19	$49.70
3	$31.38	$21.43	$52.81	$47.90
4	$31.38	$22.07	$53.45	$46.17
5	$31.38	$22.74	$54.12	$44.52
6	$31.38	$23.42	$54.80	$42.94
7	$31.38	$24.12	$55.50	$41.41
8	$31.38	$24.84	$56.22	$39.96
9	$31.38	$25.59	$56.97	$38.56
10	$31.38	$26.36	$57.74	$37.22
11	$31.38	$27.15	$58.53	$35.93
12	$31.38	$27.96	$59.34	$34.70
13	$31.38	$28.80	$60.18	$33.51
14	$31.38	$29.66	$61.04	$32.37
15	$31.38	$30.55	$61.93	$31.28
16	$31.38	$31.47	$62.85	$30.23
17	$31.38	$32.42	$63.80	$29.23
18	$31.38	$33.39	$64.77	$28.26
19	$31.38	$34.39	$65.77	$27.33
20	$31.38	$35.42	$66.80	$26.44
21	$31.38	$36.48	$67.86	$25.58
22	$31.38	$37.58	$68.96	$24.75
23	$31.38	$38.71	$70.09	$23.96
24	$31.38	$39.87	$71.25	$23.20
25	$31.38	$41.06	$72.44	$22.46
26	$31.38	$42.29	$73.67	$21.76
27	$31.38	$43.56	$74.94	$21.08
28	$31.38	$44.87	$76.25	$20.42
29	$31.38	$46.22	$77.60	$19.79
30	$31.38	$47.60	$78.98	$19.19
Sum	$941.40	$961.02	$1,902.42	$971.42
Capital Cost	$523.00		PV	$121.02
			Total PV	**$1,092.44**

Scenario 2
Financing Cost of 7%/Yr fixed 30 years
O&M inflating @ 3% /Yr
PV discount rate of 4.5%

Yr	Interest	O&M	Total	Discounted PV
1	$36.61	$20.20	$56.81	$56.81
2	$36.61	$20.81	$57.42	$54.94
3	$36.61	$21.43	$58.04	$53.15
4	$36.61	$22.07	$58.68	$51.42
5	$36.61	$22.74	$59.35	$49.76
6	$36.61	$23.42	$60.03	$48.17
7	$36.61	$24.12	$60.73	$46.63
8	$36.61	$24.84	$61.45	$45.16
9	$36.61	$25.59	$62.20	$43.74
10	$36.61	$26.36	$62.97	$42.37
11	$36.61	$27.15	$63.76	$41.05
12	$36.61	$27.96	$64.57	$39.79
13	$36.61	$28.80	$65.41	$38.57
14	$36.61	$29.66	$66.27	$37.40
15	$36.61	$30.55	$67.16	$36.27
16	$36.61	$31.47	$68.08	$35.18
17	$36.61	$32.42	$69.03	$34.13
18	$36.61	$33.39	$70.00	$33.12
19	$36.61	$34.39	$71.00	$32.15
20	$36.61	$35.42	$72.03	$31.21
21	$36.61	$36.48	$73.09	$30.31
22	$36.61	$37.58	$74.19	$29.44
23	$36.61	$38.71	$75.32	$28.60
24	$36.61	$39.87	$76.48	$27.79
25	$36.61	$41.06	$77.67	$27.01
26	$36.61	$42.29	$78.90	$26.25
27	$36.61	$43.56	$80.17	$25.53
28	$36.61	$44.87	$81.48	$24.83
29	$36.61	$46.22	$82.83	$24.15
30	$36.61	$47.60	$84.21	$23.50
Sum	$1,098.30	$961.02	$2,059.32	$1,118.42
Capital Cost	$523.00		PV	$139.64
			Total PV	**$1,258.06**

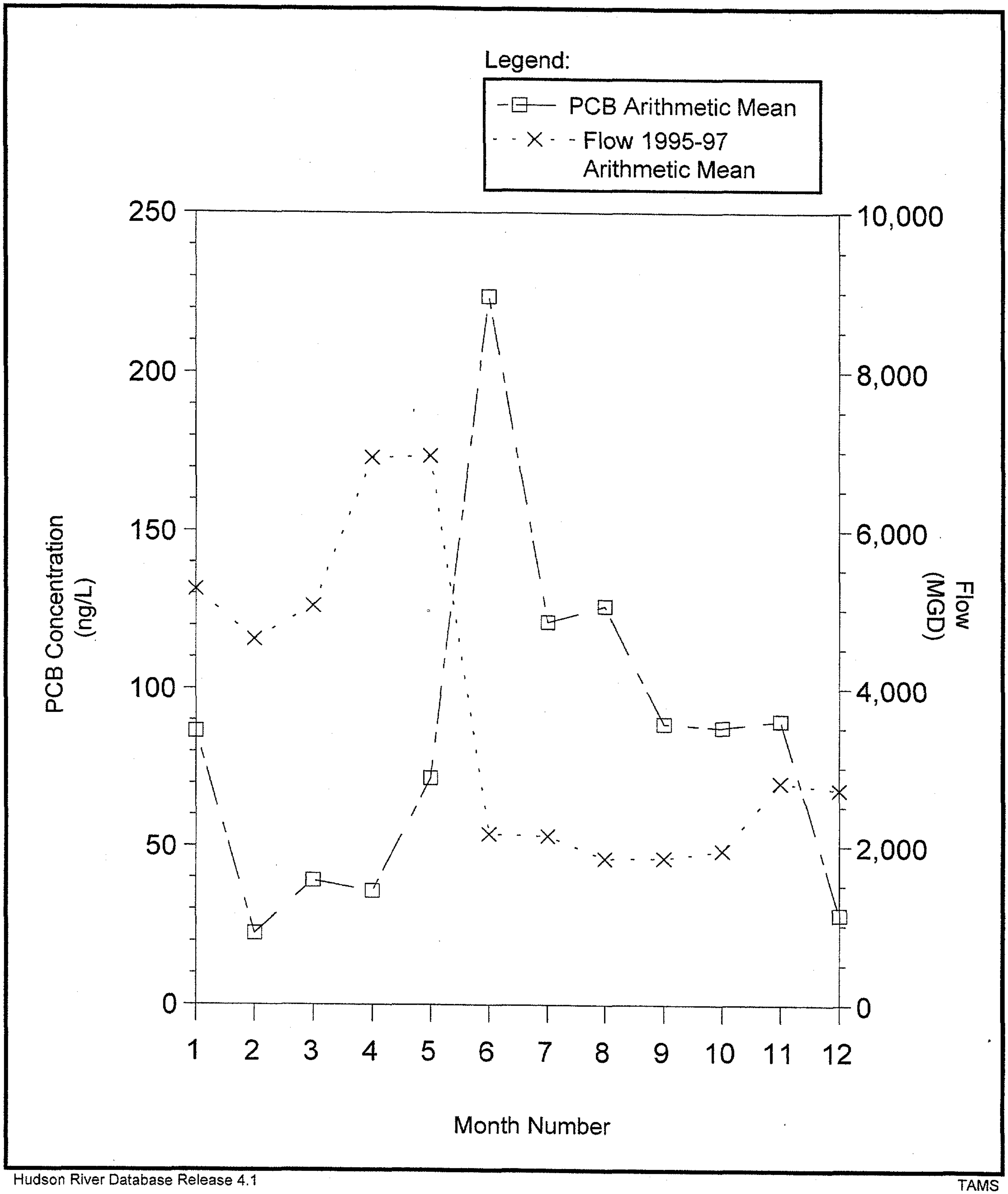
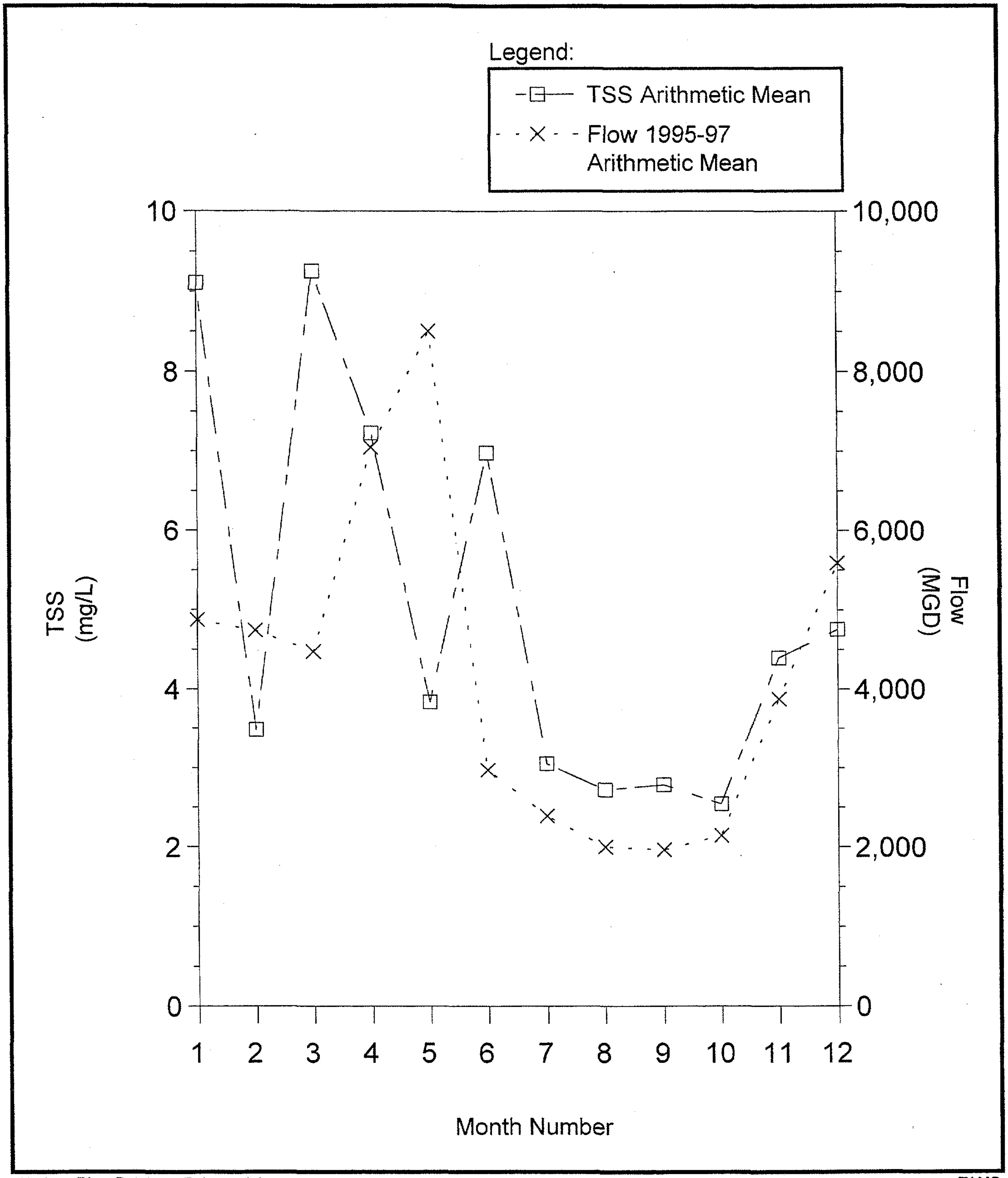


Figure 6-1
PCBs (1996-97 GE data) and Flow (1995-97 USGS)
at Thompson Island Dam



Hudson River Database Release 4.1

TAMS

Figure 6-2
TSS (1991-97 GE data) and Flow (1995-97 USGS)
at Thompson Island Dam

TAMS

Job No. 5904
Project Hudson River
Subject Water Treatment Cost – Clarifier

Sheet 1 of 7
Date 9/22/98
By L Thai
Ch'k. by MP 9/30/98

2000 MGD

2,000,000,000 gal/day = 1,389,000 gal/min

All Tables & Figures from EPA's Estimating Water Treatment Cost EPA 600/2-79-162b Aug. 1979, except where specified JMM which is Water Trmt by James M. Montgomery 1985 ed.

Clarifier –

Surface loading rate = 1 gpm/ft²

Area required = 1,389,000 ft²

Circular tanks 200 ft diam.
31,416 sf area

need 1,389,000 sf / 31,416 sf/tank = 45 clarifiers

Construction cost per clarifier (10/78 estimate) = $900,000 (Table 44)

Using ENR construction Cost Index (CCI)
10/78 CCI = 2851
9/98 CCI = 5963

Const. cost per clarifier (9/98 estimate) = $900,000 × 5963/2851 (2.09) = $1,882,400

Const cost for 45 Clarifiers (9/98 est.) = **$84.7 M**

Surface area req'd = 200 × 200 × 45 = 1,800,000 sf = 41.3 acres
Allowing room between clarifiers = 220 × 220 × 45 = 50 acres

O & M cost – per 200 ft diam. clarifier (Table 45)

energy requirement (ferric-alum sludge) = 11,100 kw-hr/yr
labor = 500 hr/yr
maintenance Material = $4,100 × 2.09 = $8600/yr (9/98 est.)

for 45 clarifiers –

energy req = 45 × 11,100 kw hr/yr = 499,500 kw hr/yr at $0.08/kw hr = $39,960

labor = 45 × 500 hr/yr = 22,500 hrs at assumed $35/hr rate = $787,500/yr

maintenance mat'l = 45 × $8600 = $387,000/yr

Sed. tanks Total O & M/yr = $39,960 + $787,500 + $387,000 = **$1,214,460**

TAMS

Job No. 5904　　Sheet 2 of 7
Project Hudson River　　Date 9/22/98
Subject Flocculator　　By L Thai
Ch'k. by MP 9/30/98

Flocculation Facility

Assume 20 minutes mixing time * 2 stages

Volume required = 1,389,000 gal/min × 40 min = 55,560,000 gal

55,560,000 gal * 1 cf / 7.48 gal = 7,427,260 cf

Need 8 - 1,000,000 cf basins

Const. cost per 1,000,000 cf basin, horiz. paddle system (10/78 est.) G = 50

= $2,077,750 (Table 40)

Const. cost for 8 basins (9/98 est.)

= $2,077,750 * 8 * 2.09 = $34.7 M

O & M cost per 1,000,000 cf basin (Table 43)

energy req = 1,188,300 kw-hr/yr
Labor = 990 hr/yr
Maint. mat'l = $28,860 * 2.09 = $60,300/yr (9/98 est.)

for 8 - 1,000,000 cf basins
energy req = 8 × 1,188,300 kw hr/yr = 9,506,400 kw hr/yr at $0.08/kw hr = $760,512
labor = 8 * 990 hr/yr at $35/hr = $277,200/yr
maint. mat'l = 8 * $60,300/yr = $482,400/yr

Flocculation Total O & M = $760,512 + $277,200/yr + $482,400/yr
= $1,520,112/yr

TAMS

Job No. 5904
Project Hudson River
Subject Filter

Sheet 3 of 7
Date 9/22/98
By L Thai
Ch'k. by MP 9/30/98

Gravity Filtration

From Table 52

Plant flow = 200 mgd
Total filter Area = 28,000 sf
22 filters at 1,275 sf for each dual-celled filter

Construction cost (10/78 est.) for 28,000 sf of filters = $5,602,030 (Table...

So for plant flow = 2000 mgd
Total filter area = 280,000 sf
220 filters at 1,275 sf each dual-celled filter

Construction cost (10/78 est.) = $56,020,300

Const. Cost (9/98 est.) = $56,020,030 (2.09) = $117,082,400

≃ $117.1M

Housing requirement ≃ 40,000 sf for 22 - 1275 sf filters
Area req'd = 440,000 sf = 10.1 acres

O & M cost - per 28,000 sf filter area (Table 54)
Bldg energy req = 4,123,490 kw-hr/yr
Labor = 18,000 hr/yr
Maintenance mat'l = $36,700 * 2.09 = $76,700 (9/98 est.)

for 280,000 sf filter area
energy req. = 10 * 4,123,490 kw-hr/yr = 41,234,900 kw hr/yr at $0.08/kw
= $3,298,792
labor = 10 * 18,000 hr/yr = 180,000 hrs. at $35/hr = $6.3M
maint. mat'l = 10 * $76,700 = $767,000/yr

Filtration Total O & M = $3,298,792 + $6,300,000/yr + $767,000/yr
= $10,365,792/yr

TAMS

Job No. 5904 Sheet 4 of 7
Project Hudson River Date 9/22/99
Subject Filter (cont') By [illegible]
Ch'k. by N[illegible] 9/30/99

Filtration media

Assume dual media filter (coal-sand)

Construction cost for 28,000 sf bed area (200 mgd) (10/78 est)
= $431,280

Const. cost for 280,000 sf bed area (2000 mgd) (10/78 est)
= $4,312,800

Const. cost for 280,000 sf bed area (2000 mgd) (9/98 est.)
= $4,312,800 * 2.09 = $9.0 M ← Filtration media

Backwash pumping facilities

Assume max. design rate for backwash = 15 gpm/sf (Table 21-12) (TMM)

Pumping capacity req'd = 15 gpm/sf * 280,000 sf * 0.5
= 2,100,000 gpm
Assume half of filters are backwashed at one time

Const. cost for 22,950 gpm backwash pumping facility (10/78 est.)
= $214,440

Number of backwashing facility req'd =
2,100,000 gpm / 22,950 gpm = 92

Const. cost (9/98 est) for 92 backwash facilities
= $214,410 * 92 * 2.09 = $41.2 M

403244

TAMS

Job No. 5904 | Sheet 5 of 7
Project Hudson River Water Treatment | Date 9/29/98
Subject Sludge Dewatering & Disposal | By [illegible]
Ch'k. by M[illegible] 09/30/98

Estimate of total sludge produced
Flow = 2000 MGD
Suspended solids conc.: 5 mg/L
Assume add alum at 20 mg/L
(from JMM Water Trmt - p. 237 → 0.33 lb sludge on dry solids basis produced per pound alum)

Total sludge = Sludge from susp. solids + Sludge from alum

$= (5 \text{ mg/L} * 8.34 \frac{lb}{gal} * 2000 \text{ mgd}) + (20 \text{ mg/L} * 8.34 \frac{lb}{gal} * 2000 \text{ mgd} * 0.33)$

$= 83{,}400 + 110{,}088 \text{ lb/d} = 193{,}488 \text{ lb/d}$

↙Typ. Solids conc. for Alum Coag. (JMM Table 13-4)

Assume specific gravity of 1% solids sludge is 1.0, volume of 1% solids sludge is $= \frac{193{,}488 \text{ lb/d}}{(0.01 \times 1.0 \times 62.4 \text{ lb/ft}^3)} = 310{,}077 \frac{ft^3}{d} = 2{,}319{,}375 \frac{gal}{d}$

$= 1610 \frac{gal}{min}$

From EPA Water Trmt Cost Document - Table 160

Assume will need 4 installed machine capacities of 450 gpm where each installed machine capacity of 450 gpm includes 12 units w/ belt width of 3 m

Construction cost for each installed machine capacity of 450 gpm
= \$3,290,150 (1978 costs)
Construction costs for 4 installed machine capacities of 450 gpm in 1998
= \$3,290,150 * 4 * 2.09 = (\$27.5 M)

From Table 162 - O&M costs per year
Energy Requirement = 4 * 2,711,000 kw hr/yr * \$0.08/kw hr. = \$867,520
Labor Requirement = 4 * 12,000 hrs * \$35/hr = \$1,680,000
Maintenance Mat'l = 4 * \$30,000/yr * 2.09 = \$250,800

Total, O&M for Belt Filter Press Annual = \$867,520 + \$1,680,000 + \$250,800
= \$2,286,320

403245

TAMS

Job No. 5904
Project Hudson River
Subject Sludge Disposal

Sheet 6 of 7
Date 9/20/98
By L Tu
Ch'k. by MT 09/30/98

Volume of Sludge Produced after dewatering

- Assume solids conc. by wt of dewatered material is 30% (p.297 JMM)

weight of sludge for disposal

$$= \frac{193,488 \text{ lb/d}}{0.30} = 644,960 \frac{\text{lb}}{\text{day}} = 232,185,600 \frac{\text{lbs}}{\text{yr}}$$

$$= 116,093 \text{ Ton/yr}$$

Assume disposal at Non-haz waste Landfill (CECOS, Niagara Falls, NY)

Disposal Fee = \$22 / Ton

Transportation Fee \$1722 / gondola car per trip
where each gondola car can hold ~ 90 Tons

⇒ Total Cost for Offsite Transport & Disposal per year

$$= 116,093 \frac{T}{yr} * \frac{\$22}{Ton} + 116,093 \frac{T}{yr} * \frac{1 \text{ car}}{90T} * \frac{\$1722}{car}$$

$$= \$2,554,046 + \$2,221,246 = \boxed{\$4,775,300}$$

*This cost does not include material handling costs (ie loading & unloading rail cars)

TAMS

Job No. 5904 | Sheet 7 of 7
Project Hudson Riv. | Date 9/29/98
Subject | By Twoi
Ch'k. by MG 9/30/98

See attached Table 25-1 (JNM)

Head Works		$5 M	~ 1%
Flocculation	$34.7 M	$119.4 M	~ 22% of total Const. cost
Clarifiers	$84.7 M		
Filters	$117.1 M	$167.3 M	~ 32% of total Const. cost
Filt Media	$9.0 M		
Filt Backwash	$41.2 M		
Belt Filter	$27.5	$27.5 M	~ 5% of total Const. Cost
Operations & Admin Bldgs			assume remaining 40% of construction co ~$200 M
Electrical & telemetry			
Misc. tanks, small structures			

These costs are not included
- Special Sitework
- General contractor overhead & profit
- Engineering
- Land
- legal, fiscal, & administrative costs
- interest during construction

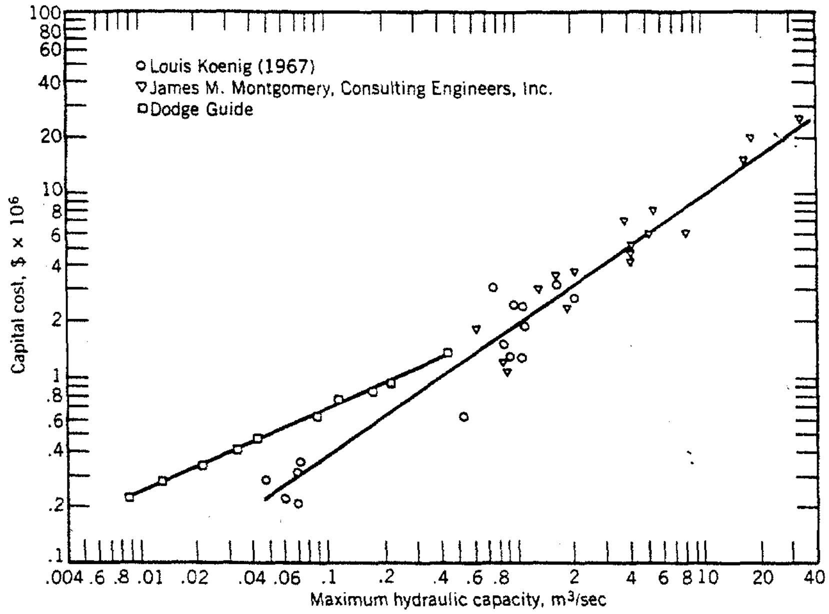


FIGURE 25-4. Conventional water treatment plant cost (adjusted to ENR CCI of 1000).

Component Cost Approach

Separation of a water treatment project into its major component parts enables the estimator to accumulate cost data for the components actually involved in a specific project. Some degree of variability remains in the basic data due to such things as the imperfect methods of adjusting historic data to other places and times or due to difference in construction methods and efficiencies. However, it is usually possible to obtain reliable average volume for construction costs for various processes that would be incurred under average conditions. Table 25-1 presents a breakdown of percentages of total capital cost that might be expected in major components of a water treatment plant. Several items normally included in a project were not included because of their highly variable costs. These items were general site and civil work such as excavation, paving, and yard piping, low and high service pumping facilities, and the finished water storage reservoir.

It is essential for the estimator to review the derivation of any unit of cost estimates he might use to avoid mistakes in application of data. A number of the components discussed below may or may not be included in the basic unit process cost data obtained from any particular reference.

Water Treatment Processes. Data for construction costs of specific water treatment components are normally obtained from one of two sources: either a series of typical detailed designs is made and detailed cost estimates are prepared for each design or historic data for actual construction of project components are adjusted to obtain comparable values. Each method in general will produce values satisfactory for most preliminary estimating needs.

A series of typical construction cost curves for eight representative water treatment unit operations

TABLE 25-1. Percent of Total Cost Attributed to Components

Water Treatment Plant Components	Percent of Total Construction Cost	
Flocculation and sedimentation basins	20–40	assume 25%
Filters and appurtenances, backwash water storage and pumping, washwater reclamation	20–40	assume 35%
Operations and administration building	10–30	assume 40% (bracketed with the two rows below)
Electrical and telemetry	10–20	
Miscellaneous chemical tanks, small structures	10–20	

SOURCE: James M. Montgomery, Consulting Engineers, Inc.

TAMS

Job No. 5904 | Sheet 1 of 1

Project Hudson River - Water Trmt | Date 9/22/98

Subject Land Area Requirement for Treating Water Pumped from Hudson River | By L Thai

Ch'k. by

From Table 25.2 - JMM Water Trmt Text

Assume Area required for Conventional treatment (which includes: Coagulation, flocculation, sedimentation, filtration).

for 570 MGD : land required = 16 acres

If we have 2000 MGD - assume ~ 4 times land required = 60 acres plus associated buildings, roads, parking etc assume 75-80 acres of administrative and other treatment plant buildings are generally obtained by determining space requirements and applying unit building costs. Administration building costs can cover a wide range depending on the intended use by the owner. It is not uncommon among water utilities to find operations buildings that are impressive or even majestic, an expensive manifestation of community pride. While structures of that stature are rarely built today, water plants are popular destinations for school field trips and civic organizations, and the administration or operations building should be a model of efficiency and cleanliness. Unit costs for various classes of buildings are readily obtained

... Some consideration must also be given to the shape and slope of land since arrangement of treatment process units can influence other project costs. The data in Table 25-2 were obtained from measurements of land areas occupied by structures of actual operating water treatment plants.

Site Work. While most cost curves for treatment components include costs of site preparation for the individual units, it is sometimes necessary to add a separate estimate for an assortment of items constructed at the site as part of the overall project. This group would consist of such things as general site clearing, grading, intercomponent piping, and

TABLE 25-2. Approximate Minimum Water Treatment Plant Land Requirements

	Maximum Hydraulic Capacity													
Process	ML/d 45	mgd 11	ML/d 90	mgd 22	ML/d 180	mgd 45	ML/d 360	mgd 90	ML/d 900	mgd 230	ML/d 1700	mgd 460	ML/d 2000	mgd 570
Conventional treatment[a]														
Hectares	0.6	—	0.8	—	1.2	—	1.9	—	3.2	—	5.0	—	6.5	—
Acres	—	1.5	—	2.0	—	3.0	—	4.7	—	7.9	—	12.4	—	16.0
Direct filtration[b]														
Hectares	0.4	—	0.6	—	0.8	—	1.2	—	2.0	—	3.2	—	4.0	—
Acres	—	1.0	—	1.5	—	2.0	—	3.0	—	5.0	—	7.9	—	10.0
Conventional treatment with sludge-drying beds														
Hectares	0.9	—	1.9	—	3.7	—	7.7	—						
Acres	—	2.2	—	4.7	—	9.1	—	19.0						
Direct filtration with sludge-drying beds														
Hectares	0.8	—	1.5	—	3.0	—	6.5	—						
Acres	—	2.0	—	3.7	—	7.4	—	16.0						

[a] Coagulation, flocculation, sedimentation, filtration, disinfection.
[b] Chemical conditioning, filtration, disinfection.
SOURCE: James M. Montgomery, Consulting Engineers, Inc.

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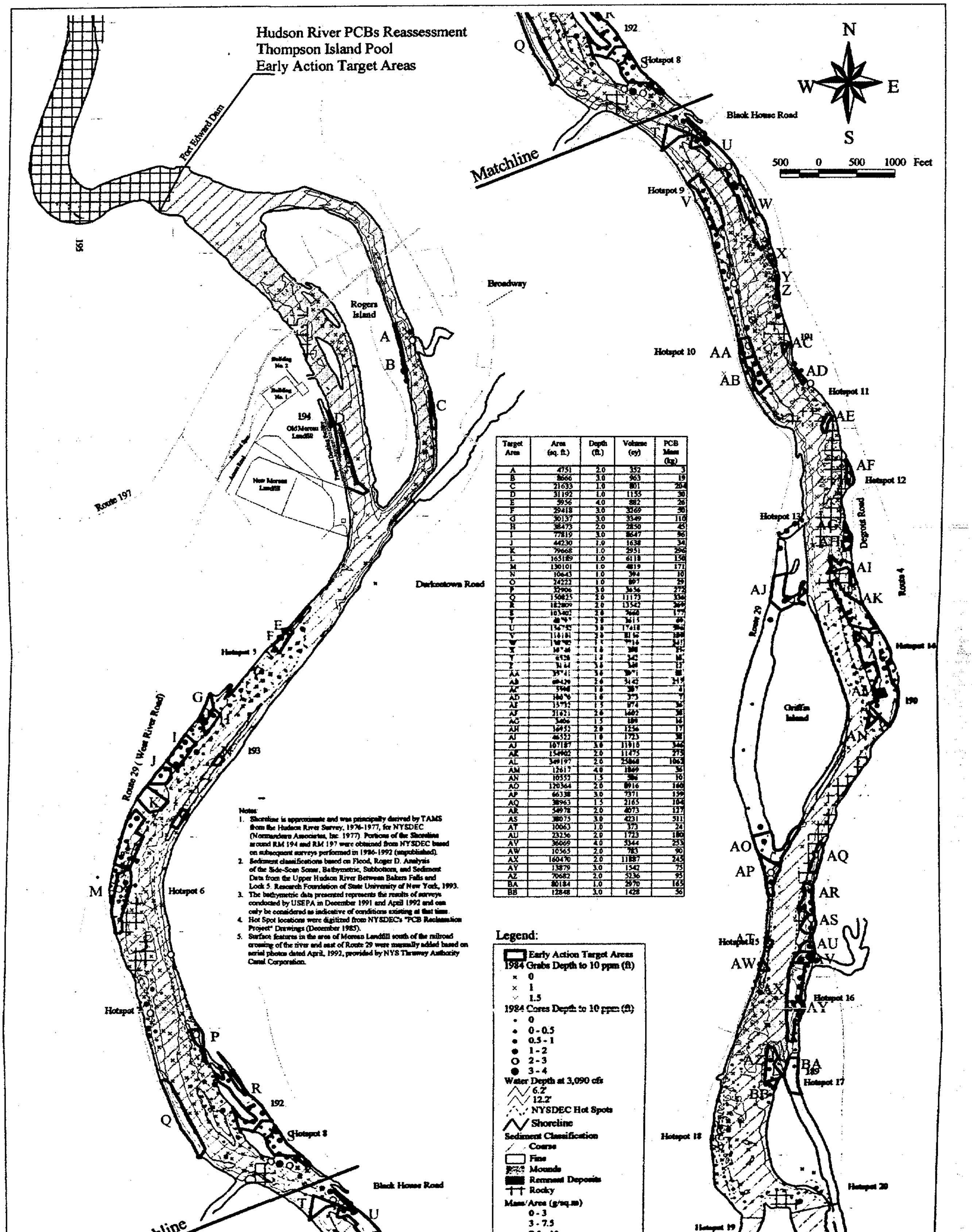
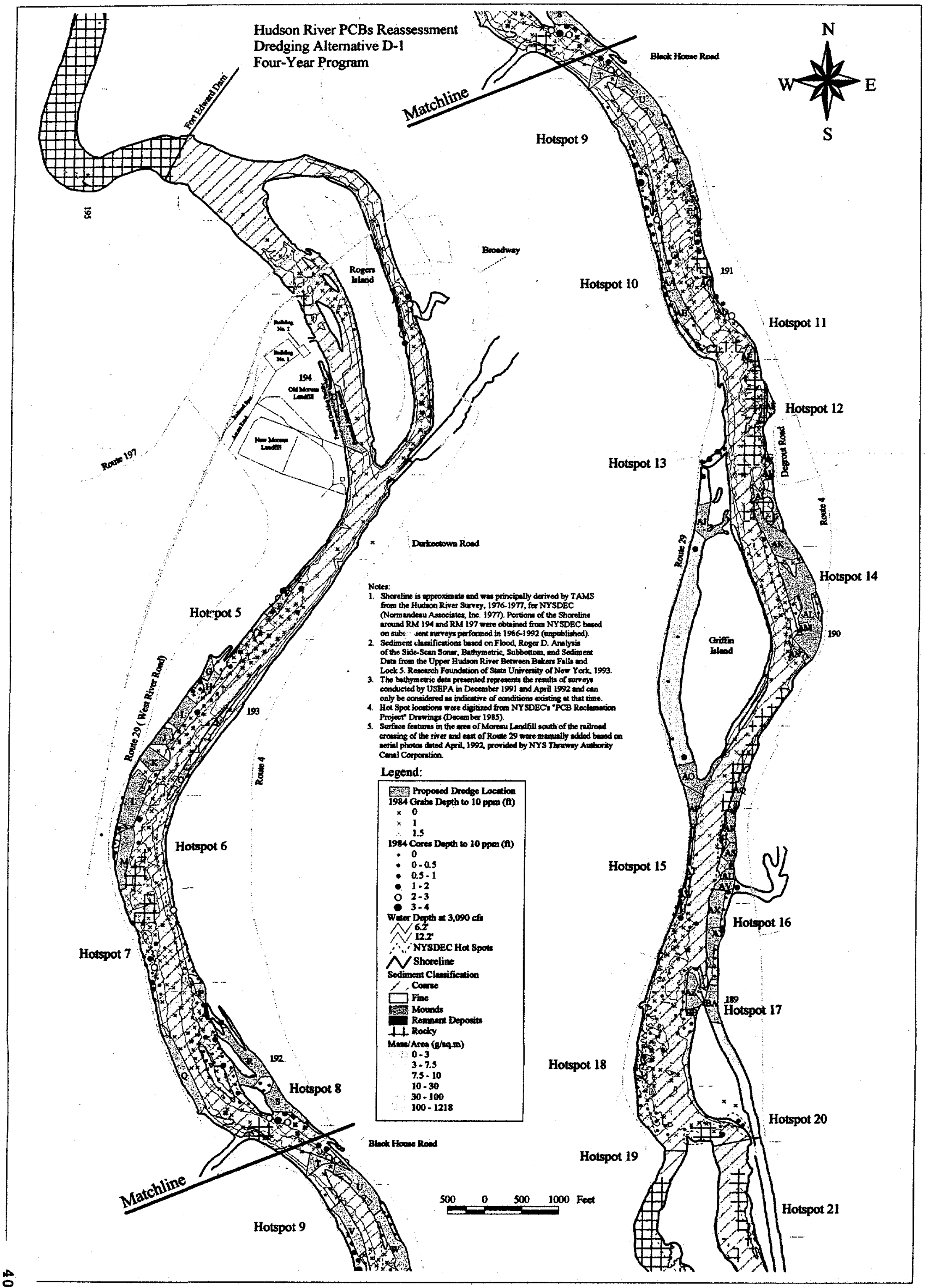
Hudson River PCBs Reassessment
Thompson Island Pool
Early Action Target Areas



Target Area	Area (sq. ft.)	Depth (ft.)	Volume (cy)	PCB Mass (kg)
A	4751	2.0	352	3
B	8666	3.0	963	19
C	21633	1.0	801	204
D	31192	1.0	1155	30
E	5956	4.0	882	26
F	29418	3.0	3269	30
G	30137	3.0	3349	110
H	38473	2.0	2850	45
I	77819	3.0	8647	96
J	44230	1.0	1638	34
K	79668	1.0	2951	296
L	165189	1.0	6118	150
M	130101	1.0	4819	171
N	10643	1.0	394	10
O	24222	1.0	897	29
P	32906	3.0	3656	272
Q	150825	2.0	11173	336
R	182809	2.0	13542	[illegible]
S	103402	2.0	7660	177
T	[illegible]	[illegible]	3615	[illegible]
U	[illegible]	3.0	17418	[illegible]
V	116181	2.0	[illegible]	[illegible]
W	[illegible]	[illegible]	[illegible]	[illegible]
X	[illegible]	1.0	[illegible]	[illegible]
Y	6528	1.0	242	[illegible]
Z	[illegible]	2.0	[illegible]	[illegible]
AA	[illegible]	3.0	[illegible]	[illegible]
AB	[illegible]	2.0	[illegible]	[illegible]
AC	[illegible]	1.0	[illegible]	4
AD	[illegible]	1.0	373	7
AE	15735	1.5	874	[illegible]
AF	21621	2.0	1602	[illegible]
AG	3406	1.5	[illegible]	16
AH	16955	2.0	1256	17
AI	46522	1.0	1723	[illegible]
AJ	107187	3.0	11910	346
AK	154902	2.0	11475	275
AL	349197	2.0	25866	1062
AM	12617	4.0	1869	36
AN	10555	1.5	586	10
AO	120364	2.0	8916	160
AP	66338	3.0	7371	159
AQ	38963	1.5	2165	104
AR	54978	2.0	4073	127
AS	38075	3.0	4231	511
AT	10063	1.0	373	24
AU	23256	2.0	1723	180
AV	36069	4.0	5344	253
AW	10565	2.0	783	90
AX	160470	2.0	11887	245
AY	13879	3.0	1542	75
AZ	70682	2.0	5236	95
BA	80184	1.0	2970	165
BB	12848	3.0	1428	56

Notes:
1. Shoreline is approximate and was principally derived by TAMS from the Hudson River Survey, 1976-1977, for NYSDEC (Normandeau Associates, Inc. 1977). Portions of the Shoreline around RM 194 and RM 197 were obtained from NYSDEC based on subsequent surveys performed in 1986-1992 (unpublished).
2. Sediment classifications based on Flood, Roger D. Analysis of the Side-Scan Sonar, Bathymetric, Subbottom, and Sediment Data from the Upper Hudson River Between Bakers Falls and Lock 5. Research Foundation of State University of New York, 1993.
3. The bathymetric data presented represents the results of surveys conducted by USEPA in December 1991 and April 1992 and can only be considered as indicative of conditions existing at that time.
4. Hot Spot locations were digitized from NYSDEC's "PCB Reclamation Project" Drawings (December 1985).
5. Surface features in the area of Moreau Landfill south of the railroad crossing of the river and east of Route 29 were manually added based on aerial photos dated April, 1992, provided by NYS Thruway Authority Canal Corporation.


Hudson River PCBs Reassessment
Dredging Alternative D-1
Four-Year Program
N
W
E
S
Fort Edward Dam
Matchline
Black House Road
Hotspot 9
195
Broadway
Rogers Island
Building No. 2
Building No. 1
194
Old Moreau Landfill
New Moreau Landfill
Route 197
Hotspot 10
191
Hotspot 11
Hotspot 12
Degroot Road
Hotspot 13
Route 4
Durkeetown Road
Route 29
Hotspot 14
Hotspot 5
190
Griffin Island
Route 29 (West River Road)
193
Route 4
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Legend:
Proposed Dredge Location
1984 Grabs Depth to 10 ppm (ft)
0
1
1.5
1984 Cores Depth to 10 ppm (ft)
0
0 - 0.5
0.5 - 1
1 - 2
2 - 3
3 - 4
Water Depth at 3,090 cfs
6.2'
12.2'
NYSDEC Hot Spots
Shoreline
Sediment Classification
Coarse
Fine
Mounds
Remnant Deposits
Rocky
Mass/Area (g/sq.m)
0 - 3
3 - 7.5
7.5 - 10
10 - 30
30 - 100
100 - 1218
Hotspot 6
Hotspot 15
Hotspot 16
Hotspot 7
189
Hotspot 17
Hotspot 18
192
Hotspot 8
Hotspot 20
Black House Road
Hotspot 19
Matchline
500
0
500
1000
Feet
Hotspot 21
Hotspot 9

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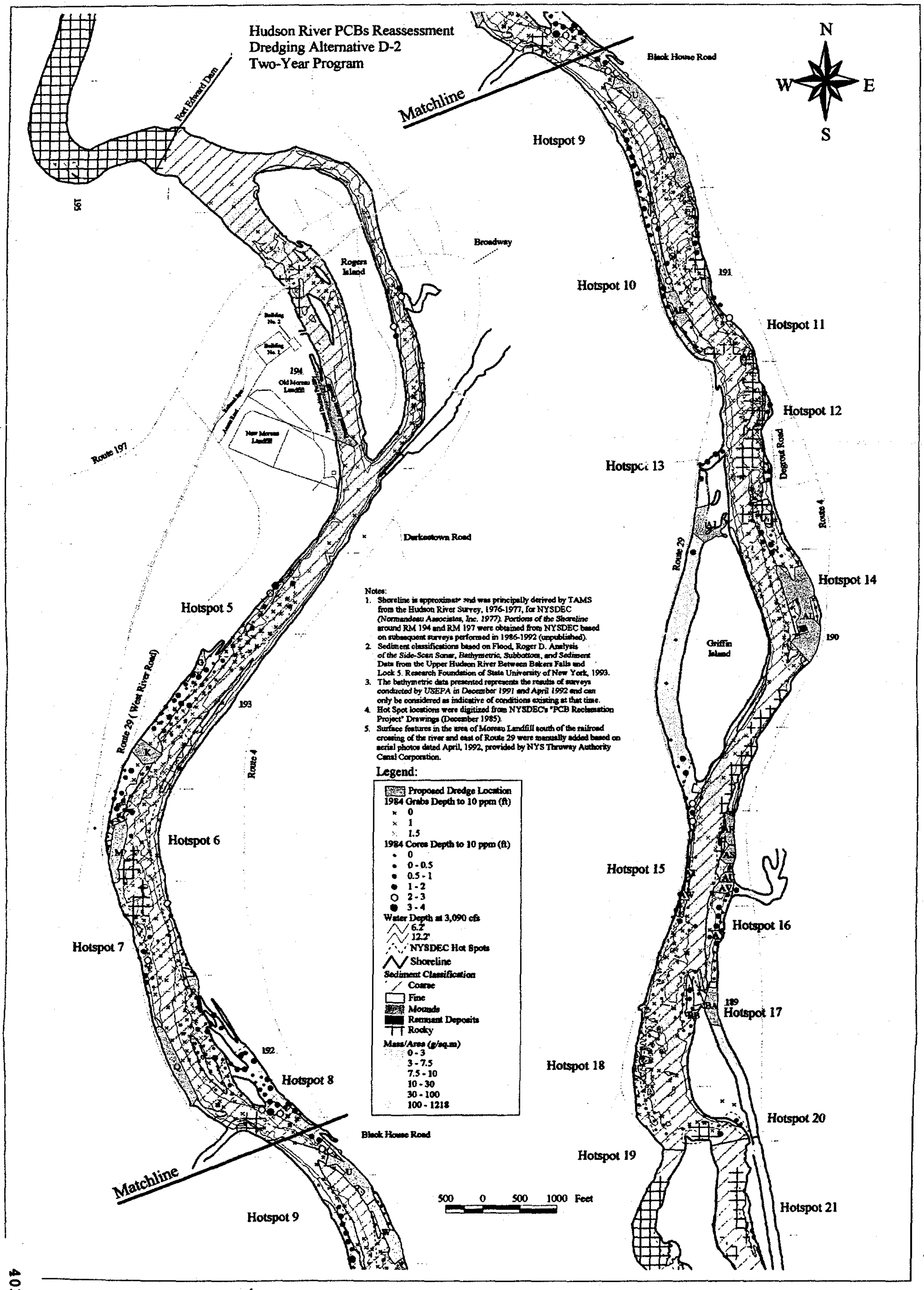
Hudson River PCBs Reassessment
Dredging Alternative D-2
Two-Year Program
Fort Edward Dam
195
Rogers Island
Broadway
Building No. 2
Building No. 1
194
Old Moreau Landfill
New Moreau Landfill
Route 197
Darkeetown Road
Hotspot 5
Route 29 (West River Road)
193
Route 4
Hotspot 6
Hotspot 7
192
Hotspot 8
Black House Road
Matchline
Hotspot 9
N
W
E
S
Black House Road
Matchline
Hotspot 9
191
Hotspot 10
Hotspot 11
Hotspot 12
Hotspot 13
Degroot Road
Route 4
Route 29
Hotspot 14
Griffin Island
190
Hotspot 15
Hotspot 16
189
Hotspot 17
Hotspot 18
Hotspot 19
Hotspot 20
Hotspot 21
500 0 500 1000 Feet
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0
1
1.5
1984 Cores Depth to 10 ppm (ft)
0
0 - 0.5
0.5 - 1
1 - 2
2 - 3
3 - 4
Water Depth at 3,090 cfs
6.2'
12.2'
NYSDEC Hot Spots
Shoreline
Sediment Classification
Coarse
Fine
Mounds
Remnant Deposits
Rocky
Mass/Area (g/sq.m)
0 - 3
3 - 7.5
7.5 - 10
10 - 30
30 - 100
100 - 1218

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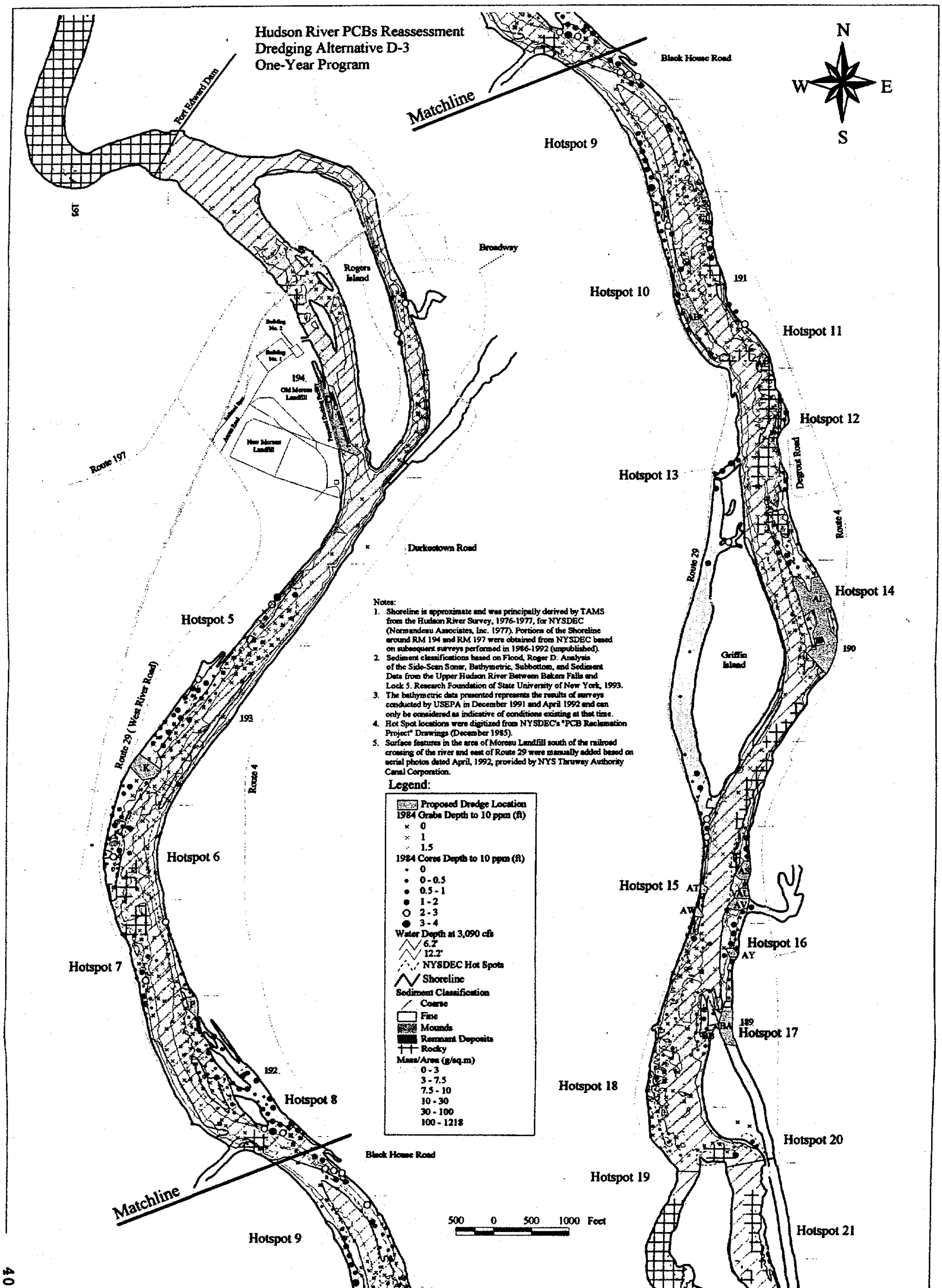
Hudson River PCBs Reassessment
Dredging Alternative D-3
One-Year Program
N
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S
Fort Edward Dam
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Broadway
Building No. 2
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Old Moreau Landfill
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Route 4
Hotspot 6
Hotspot 7
192
Hotspot 8
Black House Road
Matchline
Hotspot 9
Black House Road
Matchline
Hotspot 9
191
Hotspot 10
Hotspot 11
Hotspot 12
Degraff Road
Hotspot 13
Route 4
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Griffin Island
Hotspot 15
Hotspot 16
189
Hotspot 17
Hotspot 18
Hotspot 20
Hotspot 19
Hotspot 21
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Legend:
Proposed Dredge Location
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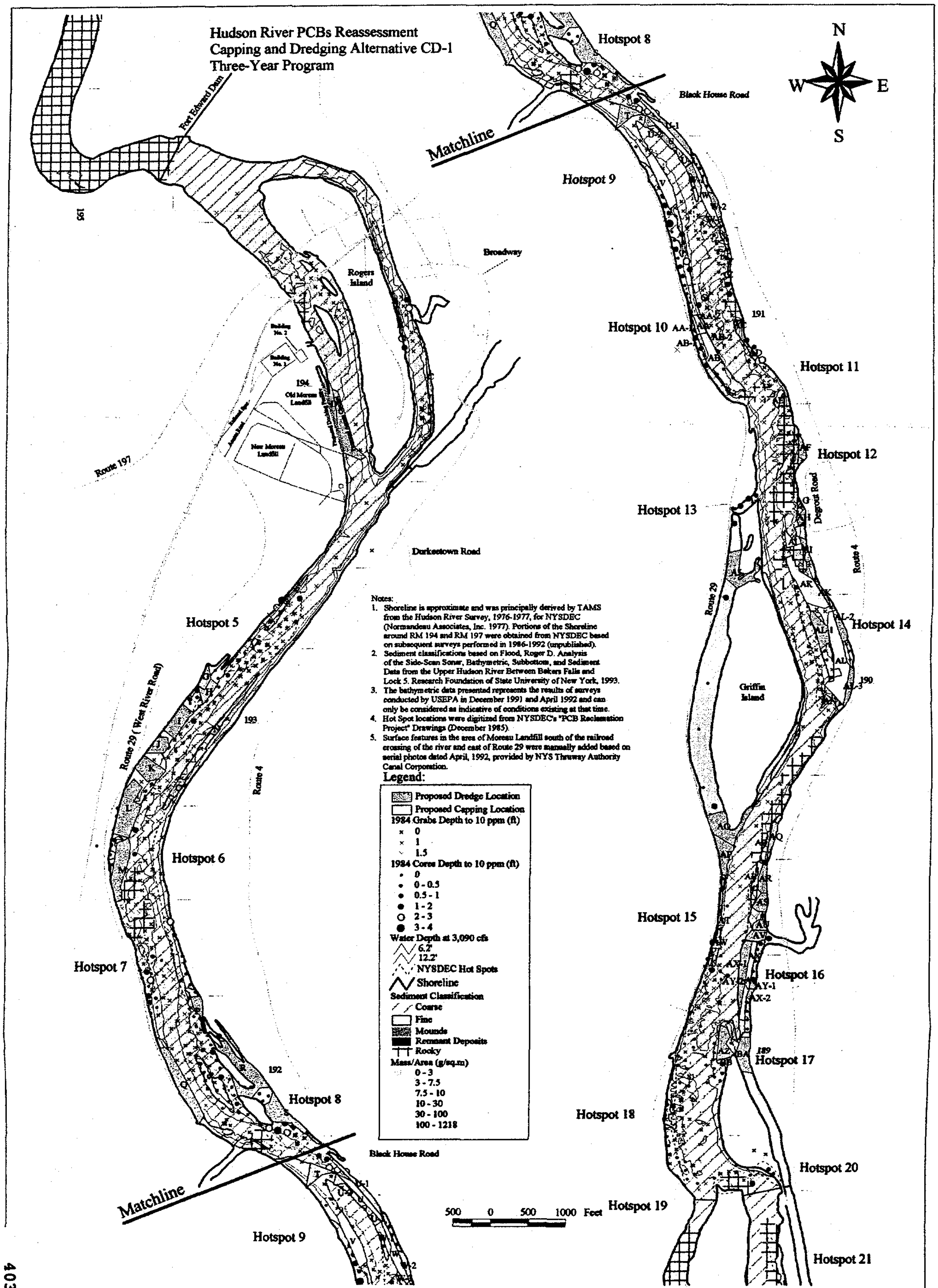
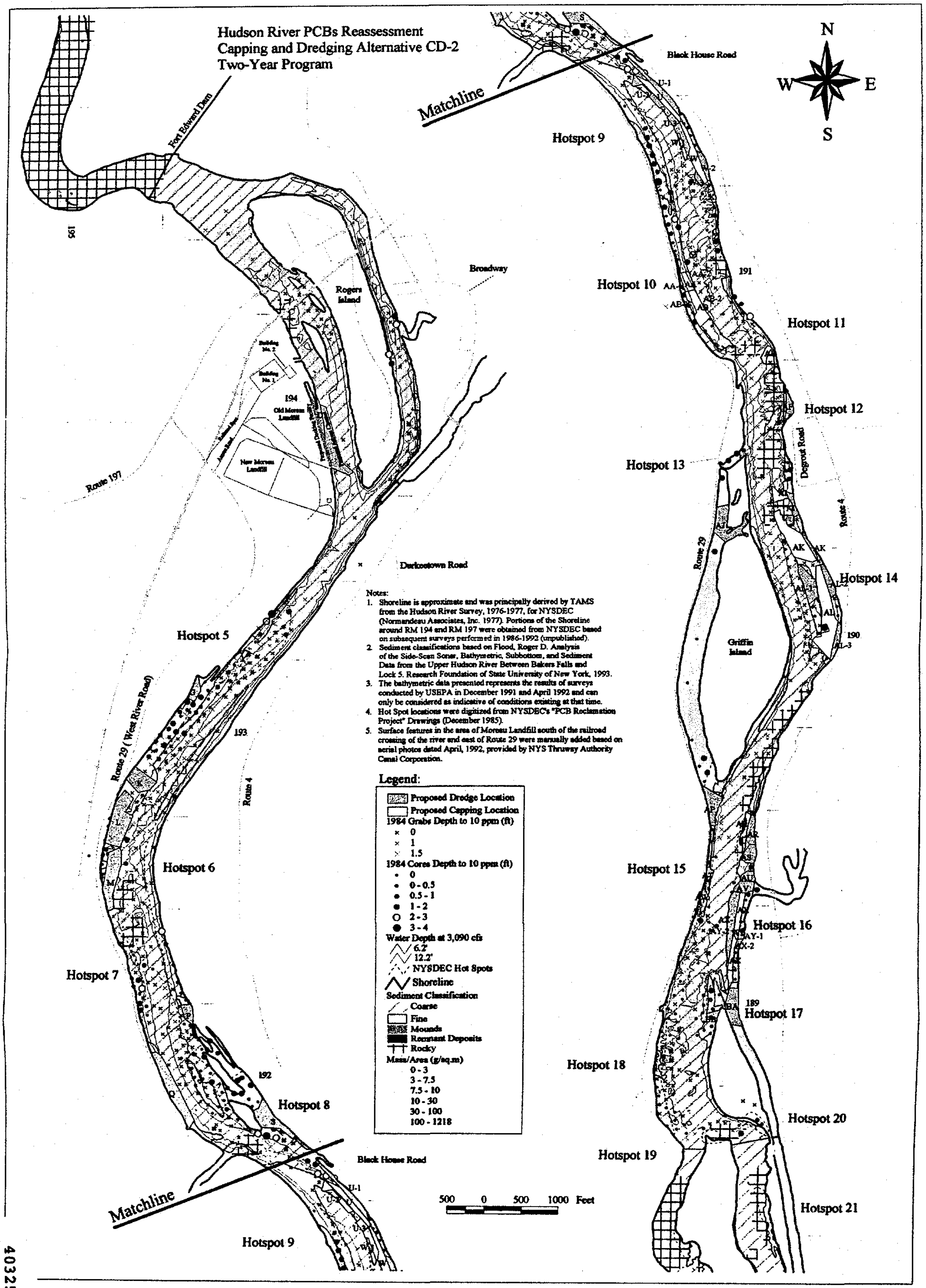
0
1
1.5
1984 Cores Depth to 10 ppm (ft)
0
0 - 0.5
0.5 - 1
1 - 2
2 - 3
3 - 4
Water Depth at 3,090 cfs
6.2'
12.2'
NYSDEC Hot Spots
Shoreline
Sediment Classification
Coarse
Fine
Mounds
Remnant Deposits
Rocky
Mass/Area (g/sq.m)
0 - 3
3 - 7.5
7.5 - 10
10 - 30
30 - 100
100 - 1218
500 0 500 1000 Feet

403256


Hudson River PCBs Reassessment
Capping and Dredging Alternative CD-1
Three-Year Program
N
W
E
S
Fort Edward Dam
Rogers Island
Broadway
Route 197
Darkeetown Road
Hotspot 5
Hotspot 6
Hotspot 7
Hotspot 8
Hotspot 9
Hotspot 10
Hotspot 11
Hotspot 12
Hotspot 13
Hotspot 14
Hotspot 15
Hotspot 16
Hotspot 17
Hotspot 18
Hotspot 19
Hotspot 20
Hotspot 21
Route 29 (West River Road)
Route 4
Route 29
Degraut Road
Griffin Island
Black House Road
Matchline
Notes:
1. Shoreline is approximate and was principally derived by TAMS from the Hudson River Survey, 1976-1977, for NYSDEC (Normandeau Associates, Inc. 1977). Portions of the Shoreline around RM 194 and RM 197 were obtained from NYSDEC based on subsequent surveys performed in 1986-1992 (unpublished).
2. Sediment classifications based on Flood, Roger D. Analysis of the Side-Scan Sonar, Bathymetric, Subbottom, and Sediment Data from the Upper Hudson River Between Bakers Falls and Lock 5. Research Foundation of State University of New York, 1993.
3. The bathymetric data presented represents the results of surveys conducted by USEPA in December 1991 and April 1992 and can only be considered as indicative of conditions existing at that time.
4. Hot Spot locations were digitized from NYSDEC's "PCB Reclamation Project" Drawings (December 1985).
5. Surface features in the area of Moreau Landfill south of the railroad crossing of the river and east of Route 29 were manually added based on aerial photos dated April, 1992, provided by NYS Thruway Authority Canal Corporation.
Legend:
Proposed Dredge Location
Proposed Capping Location
1984 Grabs Depth to 10 ppm (ft)
0
1
1.5
1984 Cores Depth to 10 ppm (ft)
0
0 - 0.5
0.5 - 1
1 - 2
2 - 3
3 - 4
Water Depth at 3,090 cfs
6.2'
12.2'
NYSDEC Hot Spots
Shoreline
Sediment Classification
Coarse
Fine
Mounds
Remnant Deposits
Rocky
Mass/Area (g/sq.m)
0 - 3
3 - 7.5
7.5 - 10
10 - 30
30 - 100
100 - 1218
500 0 500 1000 Feet

403257



Hudson River PCBs Reassessment
Capping and Dredging Alternative CD-2
Two-Year Program
N
W
E
S
Fort Edward Dam
Rogers Island
Broadway
Building No. 2
Building No. 1
194
Old Moreau Landfill
New Moreau Landfill
Route 197
195
Darkeetown Road
Hotspot 5
Route 29 (West River Road)
193
Route 4
Hotspot 6
Hotspot 7
192
Hotspot 8
Black House Road
Matchline
Hotspot 9
Hotspot 10
191
Hotspot 11
Hotspot 12
Degroot Road
Hotspot 13
Route 29
Route 4
Hotspot 14
190
Griffin Island
Hotspot 15
Hotspot 16
189
Hotspot 17
Hotspot 18
Hotspot 19
Hotspot 20
Hotspot 21
500 0 500 1000 Feet
Notes:
1. Shoreline is approximate and was principally derived by TAMS from the Hudson River Survey, 1976-1977, for NYSDEC (Normandeau Associates, Inc. 1977). Portions of the Shoreline around RM 194 and RM 197 were obtained from NYSDEC based on subsequent surveys performed in 1986-1992 (unpublished).
2. Sediment classifications based on Flood, Roger D. Analysis of the Side-Scan Sonar, Bathymetric, Subbottom, and Sediment Data from the Upper Hudson River Between Bakers Falls and Lock 5. Research Foundation of State University of New York, 1993.
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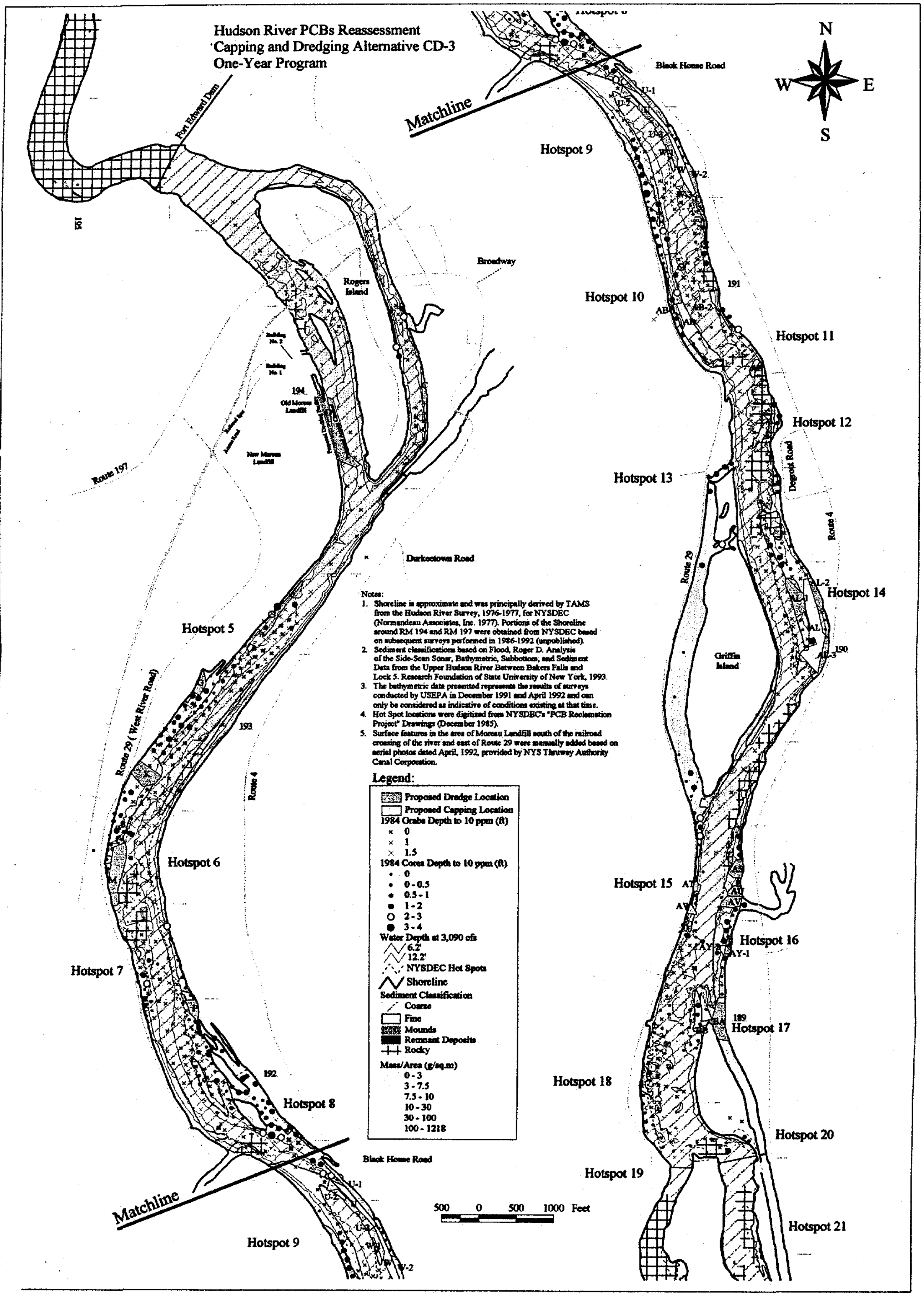
Legend:
Proposed Dredge Location
Proposed Capping Location
1984 Grabs Depth to 10 ppm (ft)
0
1
1.5
1984 Cores Depth to 10 ppm (ft)
0
0 - 0.5
0.5 - 1
1 - 2
2 - 3
3 - 4
Water Depth at 3,090 cfs
6.2'
12.2'
NYSDEC Hot Spots
Shoreline
Sediment Classification
Coarse
Fine
Mounds
Remnant Deposits
Rocky
Mass/Area (g/sq.m)
0 - 3
3 - 7.5
7.5 - 10
10 - 30
30 - 100
100 - 1218


Hudson River PCBs Reassessment
Capping and Dredging Alternative CD-3
One-Year Program
N
W
E
S
Fort Edward Dam
Matchline
Black House Road
Hotspot 9
Broadway
Rogers Island
194
Route 197
Darkeetown Road
Hotspot 5
Route 29 (West River Road)
193
Route 4
Hotspot 6
Hotspot 7
192
Hotspot 8
Hotspot 10
191
Hotspot 11
Hotspot 12
Hotspot 13
Degarmo Road
Route 4
Route 29
Hotspot 14
Griffin Island
190
Hotspot 15
Hotspot 16
Hotspot 17
189
Hotspot 18
Hotspot 19
Hotspot 20
Hotspot 21
Notes:
1. Shoreline is approximate and was principally derived by TAMS from the Hudson River Survey, 1976-1977, for NYSDEC (Normandeau Associates, Inc. 1977). Portions of the Shoreline around RM 194 and RM 197 were obtained from NYSDEC based on subsequent surveys performed in 1986-1992 (unpublished).
2. Sediment classifications based on Flood, Roger D. Analysis of the Side-Scan Sonar, Bathymetric, Subbottom, and Sediment Data from the Upper Hudson River Between Bakers Falls and Lock 5. Research Foundation of State University of New York, 1993.
3. The bathymetric data presented represents the results of surveys conducted by USEPA in December 1991 and April 1992 and can only be considered as indicative of conditions existing at that time.
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Legend:
Proposed Dredge Location
Proposed Capping Location
1984 Grabs Depth to 10 ppm (ft)
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1
1.5
1984 Cores Depth to 10 ppm (ft)
0
0 - 0.5
0.5 - 1
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2 - 3
3 - 4
Water Depth at 3,090 cfs
6.2'
12.2'
NYSDEC Hot Spots
Shoreline
Sediment Classification
Coarse
Fine
Mounds
Remnant Deposits
Rocky
Mass/Area (g/sq.m)
0 - 3
3 - 7.5
7.5 - 10
10 - 30
30 - 100
100 - 1218
500 0 500 1000 Feet

403259