Lower Fox River Operable Unit 1 Remedial Action

2006 Remedial Summary Report

Prepared for

GW Partners, LLC

May 2007

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Acronyms and Abbreviations

AOC	Administrative Order on Consent
BMP	Best Management Practice
CD	Consent Decree
CQAPP	Construction Quality Assurance Project Plan
cy	cubic yards
DMU	Dredge Management Unit
ESD	Explanation of Significant Differences
ft	feet
HPR	Former Huber Property
IDW	inverse distance weighted
lb	pound
LFR	Lower Fox River
LLBdM	Little Lake Butte des Morts
LLC	limited liability corporation
MG	million gallons
NTU	nephelometric turbidity units
O&M	Operation and Maintenance
OU	Operable Unit
PCB	polychlorinated biphenyl
ppm	parts per million
QA	quality assurance
QC	quality control
RA	Remedial Action
RAL	Remedial Action Level
RAWP	Remedial Action Work Plan
RD	Remedial Design
ROD	Record of Decision

SOW	Statement of Work
SWAC	Surface Weighted Average Concentration
TSS	total suspended solids
UCS	Unconfirmed Compressive Strength
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
WDNR	Wisconsin Department of Natural Resources
WTP	water treatment plant

SECTION 1

Introduction

J.F.Brennan, CH2M HILL, Foth Infrastructure & Environment, LLC (Foth), and STS Consultants, Ltd. (STS) prepared this Lower Fox River (LFR) Operable Unit 1 (OU1) 2006 Remedial Action (RA) Summary Report on behalf of GW Partners, LLC, (GW Partners) as part of the LFR OU1 RA. GW Partners is a limited liability company formed by WTM I Company and the P.H. Glatfelter Company to jointly perform the RA.

The 2006 RA Summary Report is a deliverable required by the 2006 RA Work Plan, dated June 2006. The RA Work Plan was a requirement of the Consent Decree (CD) for the LFR OU1 RA, which was entered into by WTM I Company and the P.H. Glatfelter Company; the U.S. Environmental Protection Agency (USEPA); and the State of Wisconsin, through the Wisconsin Department of Natural Resources (WDNR). The U.S. District Court for the Eastern District of Wisconsin entered the CD on April 12, 2004.

1.1 Project Background

The LFR, defined as the 39-mile portion of the Fox River beginning at the outlet of Lake Winnebago and terminating at the river's mouth into the bay of Green Bay, is the most industrialized river in Wisconsin. The LFR has experienced water quality problems since the early 1900s. Polychlorinated biphenyls (PCBs) were discovered in the LFR in the 1970s.

The LFR's most southerly section, from the outlet of Lake Winnebago to the Upper Appleton Dam, is Little Lake Butte des Morts (LLBdM), also known as OU1. USEPA and WDNR signed a Record of Decision (ROD) encompassing OU1 in December 2002. The ROD established a Remedial Action Level (RAL) of 1-ppm PCBs for the cleanup effort in OU1, and estimated that the removal of 784,200 cubic yards (cy) of sediment containing 3,770 pounds (lbs) of PCBs would be required to achieve this RAL. The ROD provides that pre-remediation sampling and characterization efforts will define a spatial footprint of sediment containing PCB concentrations greater than 1-ppm. This footprint was targeted for removal by dredging. If sampling shows that the 1-ppm PCB RAL is not achieved after completing sediment removal (dredging) for OU1, the ROD allows for a surface weighted average concentration (SWAC) of 0.25-ppm PCBs to be used to assess the effectiveness of PCB removal at LLBdM. If the SWAC is not achieved, then the ROD provides for either further dredging or the placement of a sand cover over dredged areas.

1.2 LFR OU1 2006 Remedial Action

The remedy selected in the LFR OU1 Record of Decision (ROD) specifies the removal and landfill disposal of PCB-impacted sediment exceeding the RAL of 1-ppm PCBs. The 2006 RA continued with removal of PCB-impacted sediment by dredging, sediment dewatering, water treatment and sediment landfilling as necessary to meet the requirements of the ROD.

The marine support area, sediment dewatering area, and water treatment occurred in the same location as the 2005 RA—the former Huber property (HPR; Lots 1 and 2 CSM 5305) located in the Town of Menasha in Winnebago County, Wisconsin.

Consistent with the objectives presented in the 2006 RA Final Design Report, 2006 remedial activities included the following:

- Installed screening and thickener unit operations to increase the percent solids in the sediment slurry fed to the geotextile tubes.
- Dredged Sub-areas C/D2S North (remaining portion of Sub-areas C and D2S – meaning the portion north of the gas pipeline), POG2, POG3 South, a portion of POG3 North (adjacent to POG2), POG4 South, and E1 South (which is essentially a northern extension of POG2) and dewatered thickened sediment slurry in geotextile tubes.
- Optimized dredging operations to minimize turbidity, over dredging, and residual polychlorinated biphenyl (PCB) concentrations.
- Installed and tested bag filters downstream of the Krofta sand float and upstream of the granular activated carbon units. However, bag filters were found not to be effective and operation was discontinued.
- Optimized dewatering and water treatment operations to maximize dewatered percent solids while minimizing operations costs and meeting environmental standards.
- Disposed of non-TSCA dewatered sediment at the Veolia Environmental Services Hickory Meadows Landfill Facility in the Town of Chilton, Wisconsin, and disposed of TSCA dewatered sediment at the EQ Wayne Disposal Landfill site in Belleville, Michigan.
- Monitored RA activities and their impacts (sediment removal verification, water treatment effluent, surface water quality, and air quality).

SECTION 2

2006 Remedial Action Project Team

2.1 Project Organization, Responsibility and Authority

J.F. Brennan Co., Inc. (Brennan) was the Supervising Contractor managing the implementation of the LFR OU1 2006 RA on behalf of GW Partners. Figure 2-1, the organization chart, presents the project team structure. The RA project responsibilities and authorities for various organizations and project team members are outlined in the following subsections. Additional information regarding project responsibilities and authorities is provided in the Construction Quality Assurance Project Plan (CQAPP) included in Appendix B of the 2006 Remedial Action Work Plan.

2.2 GW Partners, LLC

GW Partners is a limited liability company formed by WTM I Company and P. H. Glatfelter Company, which have entered into a Consent Decree to perform the LFR OU1 RA.

2.2.1 GW Partners' 2006 RA Project Coordinator/RD Project Coordinator –Mike Jury, CH2M-HILL

Mike Jury, GW Partners' 2006 RA Project Coordinator/RD Project Coordinator, for the LFR OU1 2006, performed the following tasks during the 2006 RA:

- Monitored overall progress and compliance with the 2006 Remedial Design and evaluated the need to perform design changes, as necessary, during the 2006 remedial activities;
- Informed the representatives of GW Partners regarding significant issues during the 2006 remedial activities and worked with GW Partners, GW Partners' Project Manager, and Contractors to resolve these issues;
- Communicated with USEPA and WDNR on an ongoing basis regarding significant issues during the 2006 RA Work and responded to Agency concerns (after consultation with GW Partners' Project Manager and with GW Partners when needed).
- Prepared and submitted the RA Monthly Progress Reports required by the Consent Decree with the assistance of Bill Hartman, Vic Buhr, and others as needed;
- Assisted in preparing quarterly reports required by the Consent Decree;
- Made recommendations to GW Partners regarding proposed changes in the implementation of the design and means to reduce costs and/or make the project more effective; and,
- Assisted with public and government affairs as needed.

2.2.2 GW Partners' Project Manager/2006 RA Alternate Project Coordinator—Bill Hartman, Glatfelter

Bill Hartman, GW Partners' Project Manager/2006 RA Alternate Project Coordinator, for the LFR OU1 2006 RA, performed the following tasks during the 2006 RA:

- Monitored progress of the 2006 RA project activities and provided oversight of daily operations during the 2006 RA project activities;
- Informed representatives of GW Partners of project progress and any significant issues, and worked with GW Partners, the Project Coordinator and Contractors to resolve significant issues;
- Communicated with USEPA and WDNR on an ongoing basis regarding day to day operations during the 2006 remedial activities and responded to Agency concerns (after consultation with GW Partners' Project Coordinator and with GW Partners when needed).
- Notified USEPA and WDNR of releases or threatened releases when required by the Consent Decree and served as a point of contact for Agency officials and contractors regarding actions to address the release or threatened release.
- Provided necessary project-related approvals as authorized by GW Partners;
- Reviewed and approved monthly RA progress reports prepared by the Project Coordinator, as required by the Consent Decree;
- Assisted in preparing quarterly reports required by the Consent Decree;
- Reviewed and approved invoices directed to GW Partners, subject to authority granted by GW Partners;
- Coordinated RA activities between the Supervising Contractor (Brennan) and other GW Partners' contractors (Frederickson, Veolia Environmental Services, and EQ Wayne Disposal);
- Monitored Construction Quality Assurance (CQA) Officer activities;
- Assisted with public and government affairs as appropriate, including acting as a spokesman and community liaison for GW Partners; and
- Contributed to the 2006 RA Summary Report.

2.2.3 GW Partners' Engineer— Foth Infrastructure and Environment, LLC.

In 2005, Foth &Van Dyke and Associates, Inc., predecessor to Foth Infrastructure and Environment, LLC (Foth) served as the Quality Assurance/Quality Control (QA/QC) Engineer and STS Consultants, Ltd. served as the Construction Management and Contract Administration (CM/CA) Engineer. In 2006, GW Partners decided to combine these two engineering roles and retained Foth to serve as the "Engineer."

Foth performed the following activities during the 2006 RA:

- Responsible for implementation of the Construction Quality Assurance Project plan (CQAPP) and the Quality Assurance Project Plan for Operation and Maintenance, including providing the CQA Officer;
- Performed environmental monitoring, including surface water (turbidity), air quality, and sediment removal verification sampling;
- Coordinated on-site sampling activities in accordance with Appendices D and E of the 2006 RA Work Plan;
- Maintained laboratory test data and results;
- Provided technical support to GW Partners; 2006 project contract administration, including review and initial approval of Contractor's invoices, change orders, estimates of cost to complete, and pay requests.
- Reported directly to GW Partners' Project Manager and communicated and coordinated their activities with Brennan's Project and/or Site Manager;
- Assisted GW Partners in ongoing communication with USEPA and WDNR regarding project performance and other issues as requested; and,
- Contributed to the 2006 RA Summary Report.

Quality Assurance Bathymetric Survey

In addition to the activities described above, Foth was also responsible for the Quality Assurance Bathymetric Survey to verify attainment of the modeled 1-ppm PCB RAL elevation. A baseline existing conditions or pre-dredge QA bathymetric survey was conducted prior to dredging by Brennan with direct oversight by Foth in areas anticipated for dredging in 2006. This survey was the basis for all volume computations for the 2006 dredging work.

Following completion of dredging in sub-areas or DMUs, a QA bathymetric survey of the sediment surface was performed by Brennan with direct oversight by Foth for confirmation that the design target elevations were achieved. This survey was also used by Foth to document the post-dredge sediment bed elevation and, in conjunction with the baseline existing conditions survey, used to calculate the sediment volumes removed during dredging.

QA Bathymetric surveys were performed following the general procedures described by Engineering and Design – Hydrographic Surveying (USACE Manual No. 1110-2-1003, 2004), and were integrated with Brennan's dredging process.

2.2.4 GW Partners' Geotechnical Disposal Support – STS Consultants, Ltd.

STS Consultants, Ltd. performed the following tasks during the 2006 RA:

- Provided technical support and assistance in geotechnical sampling and coordination related to the geotextile tubes;
- Provided technical assistance in coordinating disposal of non-TSCA sediment at the Veolia Environmental Services Hickory Meadows Landfill, including sediment placement at the landfill;

- Assisted GW Partners in coordinating disposal of TSCA sediments, and,.
- Contributed to the 2006 RA Summary Report.

2.2.5 GW Partners' Subcontractors

2.2.5.1 Frederickson Trucking

Frederickson Trucking, as a direct contractor to GW Partners, provided trucks for non-TSCA sediment hauling to the Veolia Environmental Services Hickory Meadows Landfill Facility in the Town of Chilton, Wisconsin, for disposal.

2.2.5.2 Veolia Environmental Services Hickory Meadows Landfill, LLC.

Veolia Environmental Services Hickory Meadows Landfill, LLC, as a direct contractor to GW Partners, provided for non-TSCA sediment disposal at its Veolia Environmental Services Hickory Meadows Landfill Facility in the Town of Chilton, Wisconsin.

2.2.5.3 EQ Wayne Disposal

EQ Wayne Disposal, as a direct contractor to GW Partners, provided transportation and disposal services for TSCA sediment at the EQ Wayne Disposal Landfill site in Belleville, Michigan.

2.3 J.F. Brennan

J.F. Brennan was the Supervising Contractor for the LFR OU1 2006 RA. As such, Brennan managed on-site activities and performed the LFR OU1 2006 RA on behalf of GW Partners. The following subsections summarize the responsibilities of key J. F. Brennan personnel who performed the RA.

2.3.1 Brennan Project Manager-Vic Buhr

Vic Buhr, Brennan's Project Manager, performed the following tasks during the 2006 RA:

- Provided overall direction and management of 2006 RA project activities on site (except transport and disposal of dewatered sediment which is outside the scope of the Brennan contract);
- Communicated to GW Partners' Project Coordinator and Project Manager regarding project progress and issues needing their involvement for resolution;
- Prepared and implemented contingency plans for health and safety emergencies;
- Prepared and implemented contingency plans for emergencies involving a potential release of waste materials as described in the Consent Decree;
- Managed Brennan's subcontractors' work;
- Performed administrative and decision-making activities;
- Implemented health and safety plans;
- Assisted in preparing monthly RA progress reports;
- Maintained updates to the construction schedule;
- Prepared and submitted monthly invoices to GW Partners;
- Prepared and submitted monthly cost-to-complete estimates;

- Assisted GW Partners, as requested, with communication with the public and press;
- Assisted GW Partners, as requested, with coordination of ongoing activities with neighbors and addressed neighbor concerns;
- Facilitated RA coordination between Brennan and external organizations, such as subcontractors and regulatory agencies;
- Coordinated with the CQA Officer;
- Monitored geotextile tube, WTP, and dredging optimization; and,
- Assisted GW Partners in ongoing communication with USEPA and WDNR regarding project status and technical issues, as requested.

2.3.2 Brennan Site Manager - Matt Binsfeld

Matt Binsfeld, Brennan's Site Manager, performed the following tasks during the 2006 RA:

- Managed RA on-site activities;
- Instructed and coordinated activities with field staff;
- Coordinated subcontractor and J. F. Brennan schedules;
- Ensured that field activities were conducted in accordance with the 2006 RA Work Plan;
- Ensured that field staff were properly trained to perform field activities in accordance with the RA Work Plan, possessed proper certification (e.g., current Hazardous Waste Operations and Emergency Response [HAZWOPER] training), and complied with medical monitoring requirements;
- Inspected and accepted supplies and equipment;
- Communicated construction and operations issues to the project team;
- Performed oversight of subcontractor activities; and,
- Notified Engineer when QA bathymetric surveys were required.

2.3.3 Brennan Operations Manager – Kevin Zenke

Kevin Zenke, Brennan's Operational Manager, performed the following tasks during the 2006 RA:

- Managed RA operational activities on site;
- Coordinated subcontractor work;
- Performed oversight of all operations on site with regards to safety and quality; and,
- Interacted with GW Partners and the Agencies to ensure that all parties are properly briefed on operations.

2.3.4 J. F. Brennan Subcontractors

The main Brennan subcontractors were as follows:

- **Ciba Specialty Chemicals Corporation** provided chemicals and associated consulting services for dewatering and water treatment processes.
- **Miratech** provided the geotextile tubes.
- **Earth Tech** operated the Water Treatment Plant**.**

- **STS Consultants, Ltd.** assisted Brennan in preparing the 2006 RA Work Plan and the 2006 RA Summary Report.

2.4 U.S. Environmental Protection Agency

2.4.1 USEPA Project Coordinator—Jim Hahnenberg

Jim Hahnenberg performed the following tasks during the 2006 RA:

- Reviewed all project deliverables and plans and/or approved project strategies;
- Reviewed and approved the RA Work Plan;
- Provided technical assistance to GW Partners Project Coordinators;
- Reviewed progress reports detailing work accomplished;
- Reviewed and provided comments on all reports in draft version prior to their finalization; and,
- Provided USEPA approval of final reports.

2.4.2 USEPA Quality Assurance Reviewer—Richard Byvik

Richard Byvik reviewed the O&M QAPP.

2.5 Wisconsin Department of Natural Resources

2.5.1 WDNR Project Coordinator—Greg Hill

Greg Hill performed the following tasks during the 2006 RA:

- Reviewed all project deliverables and plans and/or approved project strategies;
- Directed RA Work Plan review and approval ;
- Provided technical assistance to USEPA and GW Partners' Project Coordinators;
- Reviewed progress reports detailing work accomplished;
- Reviewed and provided comments on all reports in draft version prior to their finalization; and,
- Provided WDNR approval of final reports.

2.5.2 WDNR's Oversight Contractor

Boldt Construction and its subcontractors (Boldt Oversight Team) is WDNR's designated oversight contractor. They provided technical assistance to the WDNR during the 2006 remedial action.

2.6 Communications

2.6.1 Monthly Progress Reports

As required by the Consent Decree, the Project Coordinator provided written progress reports to USEPA and WDNR by the 10th day of every month.

2.6.2 Quarterly Reports

As required by the Consent Decree, GW Partners provided written quarterly reports to USEPA and WDNR according to the schedule listed in the Consent Decree. Quarterly reports were submitted as follows: the first quarter report by May 1, 2006, the second quarter report by August 1, 2006, the third quarter report by November 1, 2006, and the fourth quarter report by February 1, 2007.

2.6.3 Meetings

2.6.3.1 Management Meetings

The Project Coordinators held progress report meetings/telephone conferences at least monthly.

Project management meetings were held at the site weekly or according to a schedule agreed to by GW Partners' representatives, Brennan's Project Manager, and the WDNR and USEPA Project Coordinators. At a minimum, Brennan's Project Manager and Site Manager; GW Partners' Project Manager, GW Partners' Project Coordinator, Foth and representatives from USEPA, WDNR, and/or its oversight contractor attended the meetings. The purpose of the project management meetings was to:

- Provide a brief summary of weekly coordination meetings, as needed.
- Identify significant issues during the 2006 remedial activities, such as issues with significant cost implications (greater than $10,000), circumstances that may require a change in the 2006 Final Design or 2006 RA Work Plan, or that impact the schedule, or issues that affect the work anticipated for 2007 and beyond.
- Discuss a framework and schedule for resolving significant issues.
- Discuss any communications issues or concerns with reporting to the Agencies/oversight contractor and potential solutions.

2.6.3.2 Weekly Status Meetings

Weekly coordination meetings were held at the site and included representatives of Brennan, Foth, GW Partners, and regulatory agencies. GW Partners was responsible for recording and distributing meeting minutes.

The purpose of coordination meetings was to:

- Review the current activities and accomplishments;
- Review environmental monitoring;
- Discuss existing or potential problems and solutions; and,
- Review plans for the upcoming period.

2.6.3.3 Daily Meetings

Daily progress meetings were held at the Project Site and included representatives of Brennan, Foth, and GW Partners. In addition to representatives of GW Partners, Foth, and Brennan, each subcontractor, supplier, or other entity concerned with current progress or involved in planning, coordination, or performance of future activities were represented at these meetings. Brennan provided meeting agendas, recorded meeting minutes, and distributed the minutes to parties involved.

SECTION 3

2006 RA Project Schedule

The proposed 2006 RA Schedule is depicted on Figure 3-1. Key schedule milestone dates were as follows:

- April 10, 2006 – Initiate mobilization
- May 1, 2006 – Initiate dredging
- July 10, 2006 - Initiate dewatered sediment load out
- October 19, 2006 - Complete dredging
- December – Complete dewatered sediment load out for the year (note: some sediment remains on the pad to increase dewatering. Hauling in 2007 will provide for the pad to be emptied in time for the start of 2007 dewatering operations).

The 2006 RA Schedule key schedule milestone dates were achieved as follows:

- The 2006 RA Dredging was initiated on May 1, 2006, with one dredge in Sub-area C/D2S North and the other dredge in Sub-area POG3 South. A booster pump system was utilized while dredging C/D2S North. Sediment removal in Sub-area C/D2S North was completed by June 7, 2006.
- After Sub-Area C/D2S operations concluded on June 7, 2006, the dredge was moved to POG3 South, joining the first dredge. On July 18, 2006, one dredge was moved to the TSCA area scheduled for removal in 2006, and began dredging the TSCA area, with completion of the area on July 22, 2006.
- Dredging continued in Sub-area POG3 South, with dredging completed on November 16, 2006.
- Dredge operations moved to POG4 South on July 24, 2006, where dredging continued until August 25, 2006.
- Dredge operations moved to POG2/E1 South on August 25, 2006, and were completed on October 27, 2006.
- Beginning on June 26, 2006, and continuing through November 16, 2006, dredge work proceeded in POG3 North (20-foot wide buffer next to POG2 and the POG3 North area exceeding 50 ppm PCB's plus a 20-foot allowance).
- Sediment haul-out began on August 14, 2006, and is planned to continue until the end of February 2007. Dewatered sediments will be removed from the pad in advance of any preparation work that needs to be accomplished prior to dredging during the 2007 season.

The water treatment plant (WTP) will be operated until the flow from the geotextile tubes ceases. The WTP will be available to treat stormwater that accumulates on the dewatering pad during winter, as necessary.

A photo log containing photographs of 2006 field activities is provided as Appendix A.

SECTION 4

Dredging

4.1 Dredge Areas

Six sub-areas within LLBdM were selected for sediment removal in 2006: Sub-areas C/D2S North (north of the gas pipeline), POG2, POG3 South, a portion of POG3 North, POG4 South, and E1 South. The planned removal limits for 2006 are shown on Figure 4-1 and the actual removal limits are shown on Figure 4-2. These sub-areas were selected based on LLBdM's existing sediment PCB data and its hydrodynamic and bathymetric properties. Sub-area POG3 contained the highest average PCB concentration in OU-1, while Sub-areas C and POG2 contained the third and fourth highest average PCB concentrations in OU-1, respectively. The portion of Sub-area POG3 North designated for dredging in 2006 was a PCB hot spot located adjacent to POG2. All sub-areas designated for dredging in 2006 were located upstream of all undredged sub-areas.

The surface areas and associated sediment removal volumes for the six sub-areas were estimated based upon approved methodologies presented in the 2005 Basis of Design Report (BODR). The modeling performed to generate the OU1 dredge prisms, including the 2006 dredge areas, was fully described in the January, 2005 Foth White Paper titled, *Development of Sediment Prisms in Lower Fox River OU1* (Appendix D, March 2005 OU1 BODR). The nature of the modeling process results in conservative estimates of the 1.0 ppm PCB RAL dredge limits as confirmed in the July 19, 2006, joint WDNR Oversight Contractor/Foth memorandum re: *Clarification on Defining Dredge Neat Line Using GMS.* This memorandum is included as Attachment B-3 in Appendix B.

These estimates along with the actual 2006 dredge volumes are summarized in Table 4-1. Table 4-2 provides a more detailed accounting of the dredge areas and volumes by dredge management unit (DMU).

Table 4-1
2006 Dredge Removal Areas and Volumes

Sub-area	2006 RAWP Planned Surface Area of 1ppm PCB Target (acres)	2006 RAWP Planned Volume to 1ppm PCB Target (cy)	Revised Final Design Surface Area to 1ppm PCB Target (acres)	Final Design Volume to 1ppm Target (cy)	Final Design Planned 4" Overcut Volume (cy)	Final Design Planned Total Volume (cy)	Actual Surface Area Dredged (acres)	Actual Dredged Volume (cy)
C/D2S North	7.42	7,141	7.44	7,031	3,940	10,971	7.33	11,136
E1 South	1.16	3,066	1.16	3,066	623	3,689	1.16	3,427
POG2	11.48	63,160	11.30	56,584	6,000	62,584	11.16	51,696
POG3 South	32.46	29,909	32.32	29,851	17,356	42,207	32.27	11,521
POG3 North	2.28	4,755	7.68	10,189	4,127	14,316	7.67	9,921
POG4 South	5.76	19,726	5.03	16,161	2,586	18,747	4.81	10,353
Total	60.56	127,757	74.93	122,882	34,632	157,514	64.40	98,054
Subtotal Re-dredge Area	--	--	--	--	--	--	--	3,969
Total 2006 Dredge Volume	--	--	--	--	--	--	--	102,023
Subtototal TSCA Area*	1.08	--	--	1,068	--	--	1.08	464

*Included in POG3 South Area and Volumes.

Prepared by: SVF
Checked by: TAG

The difference between the actual and the planned dredge volume was 55,491 cy. This can be attributed to two factors:

- Native red clay or other dense native material (high subgrade) was encountered at depths shallower than the 1.0 ppm modeled dredge cut. High subgrade was not dredged after it was confirmed.
- In some areas where high subgrade was not present, the dredge operators were able to make a cut to the 1.0 ppm PCB target elevation with less than the anticipated 4 inch overcut.

Table 4-2
OU-1 2006 Remedial Action Dredging Summary

	Last QA Survey Date	[1, 2] DMU Volume (Cubic Yards from `06 RAWP)	[1] DMU Area (Acres)	Area Dredged At or Below Target Elevation (Acres)	Confirmed High Sub-Grade Area (Acres)	[3] Percent of DMU at or Below Target Elevation	DMU Volume of 4" Planned Overcut (Cubic Yards)	Volume of Planned Overcut Dredged (Cubic Yards)	Volume of Sediment Removed Below Planned 4" Overcut (Cubic Yards)	Volume Between 2006 Existing Conditions Survey and GMS 1 ppm Model (Cubic Yards)		Amount of Sediment Dredged to Target Elevation (Cubic Yards)	Amount of Material Remaining above Target Elevation (Cubic Yards)	[4] Total Amount of Sediment Removed (Cubic Yards)
A	B	D	E	F	G	H	I	J	K	M		N	O	P
						(F+G)/E	(((E*43560) * 0.33)/27)						(M−N)	(J+K+N)
POG3 South														
DMU-1	5/24/2006	1,113	1.086	0.212	0.874	100.0%	584	49	9	967	*	633	334	691
DMU-2	5/24/2006	871	0.881	0.403	0.478	100.0%	474	38	2	685		477	208	517
DMU-3	5/24/2006	914	0.936	0.478	0.458	100.0%	503	115	10	602		467	135	592
DMU-4	6/20/2006	1,140	1.227	0.329	0.898	100.0%	660	105	14	754		229	525	348
DMU-5	6/7/2006	1,158	1.243	0.277	0.966	100.0%	668	80	11	1,239		725	514	816
DMU-6	6/20/2006	1,138	1.183	0.110	1.073	100.0%	636	21	0	1,234		545	689	566
DMU-7	6/22/2006	1,137	1.195	0.531	0.664	100.0%	643	228	112	679		137	542	477
DMU-8	7/12/2006	1,258	1.175	0.054	1.121	100.0%	632	13	1	796		105	691	119
DMU-9	7/11/2006	1,231	1.204	0.392	0.812	100.0%	647	116	11	1,160		746	414	873
DMU-10	8/3/2006	1,090	1.198	0.634	0.552	98.7%	645	202	14	1,087		833	254	1,049
DMU-11	7/31/2006	1,530	1.221	0.000	1.221	100.0%	657	0	0	1,360		168	1,192	168
DMU-12	8/22/2006	427	0.755	0.312	0.443	100.0%	406	25	6	121		122	-1	153
DMU-13	7/28/2006	1,719	1.226	0.009	1.217	100.0%	659	1	0	1,262		113	1,149	114
DMU-14	8/3/2006	1,290	1.285	0.401	0.854	97.7%	691	105	13	1,281		842	439	960
DMU-15	8/30/2006	1,275	1.180	0.122	1.038	98.3%	635	31	12	1,347		644	703	687
DMU-16	8/30/2006	1,379	1.138	0.017	1.121	100.0%	612	5	2	1,311		194	1,117	201
DMU-17	7/19/2006	1,169	1.181	0.002	1.179	100.0%	635	0	0	926		50	876	50
DMU-18	8/25/2006	760	1.438	0.146	1.292	100.0%	773	57	18	712		120	592	195
DMU-19	7/26/2006	784	1.315	0.085	1.230	100.0%	707	39	3	611		279	332	321
DMU-20	7/26/2006	735	1.329	0.225	1.080	98.8%	715	46	1	934		594	340	641
DMU-2[5]	9/27/2006	815	1.281	0.012	1.269	100.0%	689	2	0	986		172	814	174
DMU-22[5] (TSCA)	7/24/2006	1,068	1.084	0.009	1.075	100.0%	583	2	0	1,202		462	740	464

Table 4-2
OU-1 2006 Remedial Action Dredging Summary

	Last QA Survey Date	[1, 2] DMU Volume (Cubic Yards from `06 RAWP)	[1] DMU Area (Acres)	Area Dredged At or Below Target Elevation (Acres)	Confirmed High Sub-Grade Area (Acres)	[3] Percent of DMU at or Below Target Elevation	DMU Volume of 4" Planned Overcut (Cubic Yards)	Volume of Planned Overcut Dredged (Cubic Yards)	Volume of Sediment Removed Below Planned 4" Overcut (Cubic Yards)	Volume Between 2006 Existing Conditions Survey and GMS 1 ppm Model (Cubic Yards)		Amount of Sediment Dredged to Target Elevation (Cubic Yards)	Amount of Material Remaining above Target Elevation (Cubic Yards)	[4] Total Amount of Sediment Removed (Cubic Yards)
A	B	D	E	F	G	H	I	J	K	M		N	O	P
						(F+G)/E	(((E*43560) * 0.33)/27)						(M−N)	(J+K+N)
DMU-23[5]	9/27/2006	822	1.562	0.080	1.482	100.0%	840	15	0	1,135		323	812	338
DMU-24	9/5/2006	1,413	1.522	0.052	1.438	97.9%	819	14	1	1,527		336	1,191	351
DMU-25	8/30/2006	1,557	1.588	0.179	1.332	95.2%	854	54	10	1,588		523	1,065	587
DMU-26	6/30/2006	856	0.906	0.023	0.883	100.0%	487	3	0	916		45	871	48
DMU-27	7/10/2006	1,202	0.932	0.002	0.930	100.0%	501	1	0	1,223		20	1,203	21
Sub-area Total		**29,851**	**32.271**	**5.096**	**26.980**	**99.4%**	**17,356**	**1,367**	**250**	**27,645**		**9,904**	**17,741**	**11,521**
POG3 North														
DMU-28	6/30/2006	2,475	1.144	0.082	1.062	100.0%	615	24	5	2,806		1,538	1,268	1,567
DMU-29	10/18/2006	2,294	1.132	0.943	0.157	97.2%	609	447	345	2,456		2,259	197	3,051
Sub Total		4,769	2.276	1.025	1.219	98.6%	1,224	471	350	5,262		3,797	1,465	4,618
DMU-30[6]	10/18/2006	1,033	1.109	0.602	0.490	98.5%	596	276	233	1,285		943	342	1,452
DMU-31[6]	10/18/2006	885	1.082	0.442	0.634	99.4%	582	194	187	1,244		718	526	1,099
DMU-32[6]	10/18/2006	938	1.067	0.368	0.660	96.3%	574	116	31	1,083		720	363	867
DMU-33[6]	11/6/2006	1,220	1.062	0.187	0.825	95.2%	571	62	16	1,426		759	667	837
DMU-34[6]	11/16/2006	1,344	1.079	0.415	0.650	98.7%	580	177	203	1,613		668	945	1,048
Sub Total		5,420	5.399	2.014	3.259	97.7%	2,903	825	670	6,651		3,808	2,843	5,303
Sub-area Total		**10,189**	**7.675**	**3.039**	**4.478**	**97.9%**	**4,127**	**1,296**	**1,020**	**11,913**		**7,605**	**4,308**	**9,921**
POG4 South														
DMU-1	8/23/2006	1,848	0.484	0.052	0.410	95.5%	260	20	9	1,953	*	1,204	749	1,233
DMU-2	9/5/2006	2,849	0.878	0.014	0.864	100.0%	472	4	0	2,729	*	1,468	1,261	1,472
DMU-3	8/22/2006	3,832	1.098	0.106	0.948	96.0%	591	30	5	3,613	*	2,216	1,397	2,251

Table 4-2
OU-1 2006 Remedial Action Dredging Summary

	Last QA Survey Date	[1, 2] DMU Volume (Cubic Yards from `06 RAWP)	[1] DMU Area (Acres)	Area Dredged At or Below Target Elevation (Acres)	Confirmed High Sub-Grade Area (Acres)	[3] Percent of DMU at or Below Target Elevation	DMU Volume of 4" Planned Overcut (Cubic Yards)	Volume of Planned Overcut Dredged (Cubic Yards)	Volume of Sediment Removed Below Planned 4" Overcut (Cubic Yards)	Volume Between 2006 Existing Conditions Survey and GMS 1 ppm Model (Cubic Yards)		Amount of Sediment Dredged to Target Elevation (Cubic Yards)	Amount of Material Remaining above Target Elevation (Cubic Yards)	[4] Total Amount of Sediment Removed (Cubic Yards)
A	B	D	E	F	G	H	I	J	K	M		N	O	P
						(F+G)/E	(((E*43560) * 0.33)/27)						(M−N)	(J+K+N)
DMU-4	8/17/2006	3,875	1.199	0.347	0.799	95.6%	645	150	64	3,559	*	2,184	1,375	2,398
DMU-5	9/5/2006	3,757	1.149	0.525	0.624	100.0%	618	234	194	3,530	*	2,571	959	2,999
Sub-area Total		**16,161**	**4.808**	**1.044**	**3.645**	**97.5%**	**2,586**	**438**	**272**	**15,384**		**9,643**	**5,741**	**10,353**
C/D2S North														
DMU-3D2S	5/19/2006	394	0.645	0.615	0.000	95.4%	347	291	279	499		490	9	1,060
DMU-4D2S	5/19/2006	800	0.961	0.952	0.000	99.1%	517	501	695	810		806	4	2,002
DMU-5D2S	5/19/2006	1,083	0.980	0.973	0.000	99.3%	527	505	769	1,090		1,086	4	2,360
DMU-6D2S	5/19/2006	802	0.847	0.827	0.000	97.7%	455	384	273	725		718	7	1,375
DMU-7D2S	5/19/2006	744	0.827	0.502	0.320	99.4%	445	171	54	612		504	108	729
DMU-11C	6/7/2006	854	0.632	0.431	0.201	100.0%	340	160	46	908		844	64	1,050
DMU-12C	6/7/2006	1,128	0.986	0.609	0.372	99.5%	530	212	52	1,225		1,104	121	1,368
DMU-13C	6/2/2006	682	0.849	0.118	0.716	98.2%	457	26	1	735		355	380	382
DMU-14C	6/7/2006	544	0.600	0.425	0.172	99.6%	323	151	94	629	*	565	64	810
Sub-area Total		**7,031**	**7.327**	**5.452**	**1.781**	**98.7%**	**3,940**	**2,401**	**2,263**	**7,233**		**6,472**	**761**	**11,136**
POG2														
DMU-1	10/5/2006	2,603	0.760	0.182	0.551	96.4%	409	60	61	2,727	*	1,727	1,000	1,848
DMU-2	10/5/2006	5,907	0.824	0.047	0.777	100.0%	443	17	7	6,372		4,582	1,790	4,606
DMU-3	10/5/2006	5,122	0.956	0.456	0.460	95.8%	514	216	188	5,294		4,269	1,025	4,673

Table 4-2
OU-1 2006 Remedial Action Dredging Summary

	Last QA Survey Date	[1, 2] DMU Volume (Cubic Yards from `06 RAWP)	[1] DMU Area (Acres)	Area Dredged At or Below Target Elevation (Acres)	Confirmed High Sub-Grade Area (Acres)	[3] Percent of DMU at or Below Target Elevation	DMU Volume of 4" Planned Overcut (Cubic Yards)	Volume of Planned Overcut Dredged (Cubic Yards)	Volume of Sediment Removed Below Planned 4" Overcut (Cubic Yards)	Volume Between 2006 Existing Conditions Survey and GMS 1 ppm Model (Cubic Yards)		Amount of Sediment Dredged to Target Elevation (Cubic Yards)	Amount of Material Remaining above Target Elevation (Cubic Yards)	[4] Total Amount of Sediment Removed (Cubic Yards)
A	B	D	E	F	G	H	I	J	K	M		N	O	P
						(F+G)/E	(((E*43560) * 0.33)/27)						(M−N)	(J+K+N)
DMU-4	9/25/2006	4,496	0.952	0.762	0.163	97.1%	512	366	309	4,834		4,604	230	5,279
DMU-5	9/25/2006	8,042	0.963	0.273	0.690	100.0%	518	129	146	8,195		6,698	1,497	6,973
DMU-6	10/18/2006	6,978	0.963	0.080	0.837	95.2%	518	36	28	7,078		5,130	1,948	5,194
DMU-7	10/18/2006	6,568	0.975	0.147	0.811	98.3%	524	70	105	6,591		4,404	2,187	4,579
DMU-8	10/18/2006	5,293	1.033	0.534	0.453	95.5%	556	217	168	5,303		4,823	480	5,208
DMU-9	10/18/2006	4,135	1.038	0.555	0.474	99.1%	558	217	156	4,103		3,792	311	4,165
DMU-10	10/18/2006	3,533	1.002	0.712	0.274	98.4%	539	296	213	3,543		3,351	192	3,860
DMU-11	10/18/2006	2,368	0.724	0.695	0.000	96.0%	389	318	277	2,450		2,443	7	3,038
DMU-12	10/30/2006	1,539	0.967	0.923	0.000	95.5%	520	399	245	1,640		1,629	11	2,273
Sub-area Total		**56,584**	**11.157**	**5.366**	**5.490**	**97.3%**	**6,000**	**2,341**	**1,903**	**58,130**		**47,452**	**10,678**	**51,696**
E1 South														
DMU-1	11/7/2006	3,066	1.158	1.038	0.075	96.1%	623	431	173	2,858		2,823	35	3,427
Sub-area Total		3,066	1.158	1.038	0.075	96.1%	623	431	173	2,858		2,823	35	3,427
Total		**122,882**	**64.396**	**21.035**	**42.449**	**98.6%**	**34,632**	**8,274**	**5,881**	**123,163**		**83,899**	**39,264**	**98,054**

[1] DMU volumes and areas exclude areas not dredged due to shoreline limitation, set back from structures, etc
[2] DMU 22 Volume derived from GMS software, all other areas calculated with CAD.
[3] Includes areas dredged to target elevation and confirmed high subgrade areas.
[4] Volume between 2006 existing conditions survey and post-dredge QA survey.
[5] Column G includes confirmed high subgrade area and areas of loose grey sand.
[6] POG3 North DMUs 30-34 were additional dredging areas completed after dredging all planned areas for the 2006 dredging season.
* DMU has undredged shoreline area due to inadequate water depth.

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To provide added assurance that the 1.0 ppm[1] PCB target elevation is attained, the dredging contractor is given an overcut allowance whereby it is not penalized for dredging below the target elevation. GW Partners selected a 4-inch overcut allowance for 2006 based on experience from the 2005 RA dredging and feedback from J.F. Brennan. The size of the equipment, the marine work environment, and operator constraints all mean that a dredge cut necessarily varies in its accuracy to an established cutline or modeled dredge target elevation.

4.1.1 Sub-area C/D2S North (area north of the gas pipeline)

The location of sub-area C/D2S is shown on Figure 4-2. Dredging within Sub-area C/D2S North was a continuation of work started during the 2005 field season. The northern part of this sub-area (area north of the gas pipeline) was not completed in 2005 due to ice forming on OU-1. Dredging began on May 1, 2006, and was completed on June 7, 2006.

- A DMU completion summary figure is presented as Figure 4-3
- An isopach map (sediment thickness contours relative to target elevation) is presented as Figure 4-4
- The thickness of sediment removed across C/D2S North is presented as Figure 4-5
- Post dredge elevations are presented as Figure 4-6
- Estimated areas of remaining soft sediment are presented as Figure 4-7
- Post-dredge sample locations are presented as Figure 4-8
- Post-dredge surface sediment PCB concentrations are presented as Figure 4-9

11,136 cy of sediment were removed from this sub-area in 2006. Table 4-2 summarizes the dredging information.

4.1.2 Sub-areas POG2 and E1 South

The location of Sub-areas POG2 and E1 South are shown on Figure 4-2. Dredging within POG2 and E-1 South began on August 25, 2006, and was completed on October 27, 2006.

- A DMU completion summary figure is presented as Figure 4-10
- An isopach map (sediment thickness contours relative to target elevation) is presented as Figure 4-11
- The thickness of sediment removed within POG2 and E-1 South is presented as Figure 4-12
- Post dredge elevations are presented as Figure 4-13
- Estimated areas of remaining soft sediment are presented as Figure 4-14
- Post-dredge sample locations are presented as Figure 4-15

[1] The LFR OU1 ROD sets forth the RAL variously as 1 ppm and 1.0 ppm. The distinction between these terms is statistically significant. GW Partners and the governments have agreed that, for the time being, GW Partners will set the target elevation based upon a 1.0 RAL, subject to P.H. Glatfelter Company's and WTMI Company's reservation of all of their rights to dispute this interpretation. Nothing in the performance of the 2006 RA or this report waives or diminishes these reservations of rights.

- Post-dredge surface sediment PCB concentrations are presented as Figure 4-16

Excluding re-dredge areas, 51,696 cy of sediment were removed from Sub-area POG2 and 3,427 cy of sediment were removed from Sub-area E-1 South. Table 4-2 summarizes the dredging information.

4.1.3 Sub-area POG3 South

The location of Sub-area POG3 South is shown on Figure 4-2. Dredging within Sub-area POG3 South began on May 1, 2006, and was completed on November 16, 2006.

- A DMU completion summary figure is presented as Figure 4-17.
- An isopach map (sediment thickness contours relative to target elevation) is presented as Figure 4-18,
- The thickness of sediment removed within POG3 South is presented as Figure 4-19,
- Post dredge elevations are presented as Figure 4-20
- Estimated areas of remaining soft sediment are presented as Figure 4-21
- Post-Dredge Sampling Plan is presented as Figure 4-22
- Post-dredge surface sediment PCB concentrations are shown as Figure 4-23.

Excluding re-dredge areas, 11,521 cy of sediment were removed from Sub-area POG3 South. Table 4-2 summarizes the dredging information.

4.1.4 Sub-area POG3 North

The location of Sub-area POG3 North is shown on Figure 4-2. Dredging within POG3 North began on June 26, 2006, and was completed on November 16, 2006.

- A DMU completion summary figure is presented as Figure 4-24
- An isopach map (sediment thickness contours relative to target elevation) is presented as Figure 4-25
- The thickness of sediment removed within POG2 is presented as Figure 4-26
- Post dredge elevations are presented as Figure 4-27
- Estimated areas of remaining soft sediment are presented as Figure 4-28
- Post-dredge sample locations are presented as Figure 4-29
- Post-dredge surface sediment PCB concentrations are shown as Figure 4-30

In addition to the two POG3 North DMUs planned for dredging during 2006 (DMUs 28 and 29) an additional 5.4 acres was dredged in POG3 North resulting in 5,303 cy of additional PCB impacted sediment removed in 2006 (DMUs 30, 31, 32, 33, and 34). Originally planned for 2007 dredging, these five DMUs were completed during 2006 because dredging proceeded ahead of schedule.

9,921 cy of sediment were removed from Sub-area POG3 North in 2006. Table 4-2 summarizes the dredging information.

4.1.5 Sub-area POG4 South

The location of Sub-area POG4 South is shown on Figure 4-2. Dredging within POG4 South began on July 24, 2006, and was completed on August 25, 2006.

- A DMU completion summary figure is presented as Figure 4-31
- An isopach map (sediment thickness contours relative to target elevation) is presented as Figure 4-32
- The thickness of sediment removed within POG2 is presented as Figure 4-33
- Post dredge elevations are presented as Figure 4-34
- Estimated areas of remaining soft sediment are presented as Figure 4-35
- Post-dredge sample locations are presented as Figure 4-36
- Post-dredge surface sediment PCB concentrations are shown as Figure 4-37

10,353 cy of sediment were removed from Sub-area POG4. Table 4-2 summarizes the dredging information.

4.1.6 No Dredge Regions

Two sets of No Dredge Regions were established for the 2006 RA work in POG3 South, and POG4 South. Locations of the No Dredge Regions are shown on Figure 4-2. The no dredge areas were established based on some or all of the following characteristics:

- Relatively thin sediment deposits (average dredge cut <6-inches)
- Higher percent solids
- Low PCB concentrations (generally less than 2.0 ppm)

The No Dredge Regions in POG3 South were established during supplemental characterization sampling (15 locations, R-1 thru R-15) and poling to better define the extent of soft sediment and to further delineate the low PCB concentrations. Results of this sampling were submitted to the Agencies and are presented in the Foth *Sub-area POG3 and POG4 Dredge Prism Refinement* memo, dated June 28, 2006. This memo is presented in Appendix B.

Table 4-3 presents the quantities and characteristics associated with the 2006 No Dredge Regions.

Table 4-3

Quantities and Characteristics Associated With 2006 No-Dredge Regions

Proposed No-Dredge Region	Area (sq. ft.)	1.0 ppm isopach volume (cy)	Maximum PCB concentration (ppm)	In situ percent solids (%)	PCB mass in 1.0 ppm isopach (kg)	Note
Sub-area C						
Northern Region						
	39,800	-	1.2	79	0.5	1
Sub-area POG3 South						
Southwest	305,729	3,282	2.1	63	3.8	
Southeast	195,340	2,998	1.7	28	1.0	2
East	31,143	319	1.9	48	0.2	
Subtotal	532,212	6,599	-		5.0	
Sub-area POG4 South						
South Region	86,740	1,805	1.6	25	0.5	2

1. Laszewski, Steve (2005), "Proposal for Sub-area A and Sub-area C/D2S Dredge Prism Refinement," Foth & Van Dyke and Associates, Inc., memorandum to Greg Hill (WDNR), Jim Hahnenberg (USEPA), and Rich Johnson (Boldt), November 1, 2005. Included in Appendix B.
2. Roznowski, D., and Eykholt, G. (2006), "Proposal for Sub-area POG3 and POG4 Dredge Prism Refinement," Foth & Van Dyke and Associates, Inc., memorandum to Bill Hartman (GW Partners), June 28, 2006. Included in Appendix B.

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Checked by: DMR

4.1.7 Other 2006 Dredge Prism Refinements

In addition to the No Dredge Regions described above, revisions were made to the POG2 dredge prism based on additional poling completed in April and July of 2006. The results of this study were submitted to the agencies and are presented in the, Foth *OU-1 Sub-Area POG2 Revisions to Dredge Prism* memo dated August 17, 2006. This memo is presented in Appendix B.

4.1.8 Vic Vac Test Areas

During the 2006 field work, a new dredge system was introduced and tested: the direct suction or Vic Vac system (patent pending). The Vic Vac system is described in detail in

Section 4.2. Two Vic Vac test areas were chosen. These areas are shown on Figure 4-38. The results of the Vic Vac testing were submitted to the Agencies and are presented in the Foth, *Vic Vac Dredge Test Area Results and Evaluation memo*, dated August 1, 2006. This memo is presented in Appendix C. The test proved favorable in areas where a thin soft sediment deposit was present above a firm substrate, and the Vic Vac Dredge was used for the remainder of the 2006 dredge season.

4.1.9 TSCA Sediment Characterization

Determination of the extent of sediments regulated under the Toxic Substances Control Act (TSCA) in 2006 OU-1 dredge areas was reviewed by the USEPA early during the 2006 dredging season and again as some unexpected high level PCB residual results became available. All dredged materials classified as TSCA regulated (≥ 50 ppm PCBs *in situ* or *ex situ* if so classified under the approved sampling protocol) were handled separately and disposed of at an out of state landfill (EQ Wayne Disposal, Belleville, Michigan) approved to receive such material. Procedures for characterizing the sediment in the 2006 dredge prism, and USEPA approval of these procedures, are included in Appendix D.

4.2 Dredge Systems

The dredge system used to remediate Sub-area C/D2S, E1, and POG's 2, 3, and 4 during the 2006 RA included the following components:

- Two 8-inch swinging ladder dredges (Dredging Supply Company), Appendix A, photographs - 1, 2, and 3.
- One 8-inch diesel engine driven booster, Appendix A - photograph 4.
- Five miles of 8-inch SDR 17 HDPE pipeline, Appendix A - photographs 5 and 6
- Various shallow draft barges and boats.

Both dredges utilized articulating ladders with different attachments to remove the contaminated sediment. A standard non-aggressive cutterhead, Appendix A – photograph 7, was used primarily in areas that contained over 12 inches of soft sediment. The other attachment used by the dredges is called the Vic Vac, Appendix A - photograph 8 which is a shrouded open suction assembly. The Vic Vac was designed by J.F. Brennan to target the removal of thin layers of soft sediment above a firm substrate without agitating the sub-bottom. This reduced both the clay plumes while dredging, and the amount of unwanted clay sent to the dewatering facilities.

Both attachments were used in all of the dredged areas this season except C/D2S. Only the cutterhead was used in C/2DS because of the area's sub-bottom characteristics.

Movement through the dredge cuts was achieved by way of a pivoting spud system at the stern of each dredge, Appendix A - photograph 2. The pivoting spud system allows the dredge to avoid downtime associated with more traditional dredge movement methods, such as anchors and cables. Each dredge used real-time kinematic (RTK) GPS in conjunction with Dredgepack, integrated with Wonderware for positioning purposes.

4.3 Dredge Elevation Results

The following sections detail the process by which documentation of sediment removal occurred in LLBdM in 2006. Processes addressed include pre- and post-dredge bathymetry, high subgrade documentation and documentation of No Dredge Regions.

4.3.1 QA Bathymetric Surveys

Post-dredge QA bathymetric surveys were conducted by J.F. Brennan with oversight provided by Foth, who was on board the survey vessel for all pre- and post-dredge QA surveys. As with the QA pre-dredge surveys, equipment calibration, survey check to benchmarks, and hydrographic surveying procedures were observed and documented by Foth for all QA post dredge surveys. At the completion of each QA survey, J.F. Brennan provided Foth with the complete unedited data files. Pre-dredge sub-area QA surveys were completed on the following dates:

- C/D2S – November, 2005
- POG2 – June, July, August, and September, 2006
- POG3 – April, June, and October, 2006
- POG4 – June and July, 2006
- E1 – September, 2006

The dates of the final QA survey for each DMU are provided in Table 4-2.

The results of the pre-dredge bathymetric survey were compared to the sub-area information contained in the March 2005 LFR OU1 BODR. The 2006 pre-dredge surveys (November 2005 for C/D2S) were used as the basis to document actual material removal in 2006.

During project operations, post-dredge QA bathymetric surveys were completed in DMUs that J.F. Brennan indicated had attained the target elevations or encountered high subgrade areas. The DMUs provided a means to divide a larger sub-area into discrete dredging units. Post-dredge QA bathymetric surveys were completed as requested by J.F. Brennan, at a minimum, at the end of every two-week period of dredging.

A real time kinematic (RTK) global positioning system (GPS) (Trimble 5700) was used by J.F. Brennan for all QA bathymetric surveys. The RTK GPS was referenced to on-shore, WDNR-established survey monuments to ensure accuracy in the collection of survey data. The coordinate system used during the survey activities was the NAVD 88 Datum (vertical) and Geodetic (WGS/NAD83) Datum (horizontal).

During the post-dredge surveys, poling was completed by Foth to verify the accuracy of the hydrographic survey procedure. The poling was completed in QA survey areas at random locations at an approximate frequency of four locations per acre with depths recorded to the nearest 0.1 feet. The pole was fitted with a standard 6inch diameter poling disc to limit sinking into soft sediments. Depth readings from poling were compared to readings being recorded by the fathometer on the hydrographic survey boat at the time of poling. The coordinates of each poling location were obtained from the HYPACK/GPS system and recorded by Foth for future use.

The calibration techniques used for the QA surveys were in accordance with the U.S. Army Corps of Engineer, Engineering and Design Hydrographic Surveying Manual No. 1110-2-1003 (January 2002).

An initial calibration check included verifying the GPS system accuracy. The GPS survey equipment used for the hydrographic survey was checked against land-based WDNR benchmarks located along OU1. The coordinates and elevations of the benchmark were checked against published values. Discrepancies outside of normal survey tolerances were addressed prior to proceeding. This check to known benchmarks occurred at the start and at the end of each QA survey day.

A latency test was also performed prior to each QA survey to align sonar depth soundings with the horizontal GPS coordinates. This calibration technique verifies that sonar depth soundings being recorded were at the same horizontal location being tracked by the GPS.

Finally, bar checks were performed daily at the start and at the end of each QA survey. A steel plate (bar) was lowered below the sonar transducer to a known depth below the water surface. The fathometer provided depth was then recorded for agreement with the bar depth. If there was a discrepancy, an adjustment was made to the HYPACK system to calibrate the fathometer reading to match the bar depth. This procedure was performed at two depths: one at the anticipated typical depth to sediment and one a few feet deeper. Foth recorded the initial bar check and adjusted readings, if necessary.

Following the field survey, Foth processed the survey data and determined whether the required dredge prism elevations had been attained by J.F. Brennan. The following processing procedures were implemented by Foth:

- For each DMU, a modeled surface was created of post-dredge elevations using the post-dredge QA survey data.
- An isopach (sediment thickness contour) drawing was developed for each DMU, comparing the post-dredge QA survey modeled surface elevations (as the upper surface) and the 1-ppm targeted surface elevations (as the lower surface).
- Using the isopach drawing, ninety-five (95) percent or more of the DMU area must be at or below the targeted 1-ppm elevation for the dredging to have achieved the design target elevations at the DMU. Confirmed high subgrade areas within a DMU were considered to have achieved the target elevation.

The survey data were also used by Foth to calculate the volume of sediment removed in a DMU and to evaluate actual dredge overcuts to planned overcuts.

4.3.2 Dredge Overcut Results

The target elevations provided to J.F. Brennan were the modeled elevation of the 1-ppm dredge cut for Sub-areas C/D2S North, POG2/E1 South, POG3 South, POG3 North, and POG4 South. An overcut allowance of 4 inches was planned for all 2006 sub-areas.

The 2006 RA contract provided a financial incentive to J.F. Brennan to minimize the overcut below the 1-ppm PCB target elevation, in order to reduce the overcut sediment volume for dewatering, transport and disposal. The actual overcut achieved during 2006 dredging was

measured by comparing the post-dredge bathymetric survey elevations to the target 1-ppm elevations.

The average overcuts achieved in the 2006 sub-areas were:

- Sub-area C/D2S North – 6.4 inches
- Sub-area POG2 – 5.9 inches
- Sub-area POG3 North – 5.7 inches
- Sub-area POG3 South –2.4 inches
- Sub-area POG4 South – 5.1 inches
- Sub-area E-1 South – 4.3 inches

On a consolidated basis, the average dredge overcut achieved for 2006 dredge areas was 5.0 inches, closely approximating the 4 inch target.

Table 4-4 summarizes the overcut achieved by sub-area and DMU. The overcut presented excludes all documented high subgrade areas. The average dredge overcut per DMU was calculated by adding the volume of overcut actually dredged below the 1-ppm PCB target elevation and dividing by the area dredged at or below target elevation. The sub-area average was calculated by summing the total overcut volumes of all DMUs in the sub-area and dividing by the summation of the area of each DMU that was at or below target elevation.

Table 4-4
Summary of 2006 Dredge Overcut

Dredge Management Unit	Average Dredge Overcut[1] (Inches)	Dredge Management Unit	Average Dredge Overcut[1] (Inches)
Sub-Area C/D2S North		**Sub-Area POG3 South (continued)**	
DMU-3D2S	6.9	DMU-12	0.7
DMU-4D2S	9.2	DMU-13	0.8
DMU-5D2S	9.7	DMU-14	2.2
DMU-6D2S	5.9	DMU-15	2.6
DMU-7D2S	3.3	DMU-16	3.1
DMU-11C	3.6	DMU-17	1.0
DMU-12C	3.2	DMU-18	3.8
DMU-13C	6.9	DMU-19	3.6
DMU-14C	4.4	DMU-20	1.6
Sub-Area Average	**6.4**	DMU-21	1.2
Sub-Area POG2		DMU-22	1.7
DMU-1	4.9	DMU-23	1.4
DMU-2	3.8	DMU-24	2.1
DMU-3	6.7	DMU-25	2.7

Dredge Management Unit	Average Dredge Overcut[1] (Inches)	Dredge Management Unit	Average Dredge Overcut[1] (Inches)
DMU-4	6.6	DMU-26	1.0
DMU-5	7.5	DMU-27	3.7
DMU-6	5.9	**Sub-Area Average**	**2.4**
DMU-7	8.8	**Sub-Area POG3 North**	
DMU-8	5.4	DMU-28	2.6
DMU-9	5.0	DMU-29	6.2
DMU-10	5.3	DMU-30	6.3
DMU-11	6.4	DMU-31	6.4
DMU-12	5.2	DMU-32	3.0
Sub-Area Average	**5.9**	DMU-33	3.1
Sub-Area POG3 South		DMU-34	6.8
DMU-1	2.0	**Sub-Area Average**	**5.7**
DMU-2	0.7	**Sub-Area POG4 South**	
DMU-3	1.9	DMU-1	4.1
DMU-4	2.7	DMU-2	2.1
DMU-5	2.4	DMU-3	2.5
DMU-6	1.4	DMU-4	4.6
DMU-7	4.8	DMU-5	6.1
DMU-8	1.9	**Sub-Area Average**	**5.1**
DMU-9	2.4	**Sub-Area E1 South**	
DMU-10	2.5	DMU-1	4.3
DMU-11	0.0	**Sub-Area Average**	**4.3**

[1] Dredge overcut excludes all confirmed high subgrade areas.

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Checked by: DMR

Figures 4-4, 4-11, 4-18, 4-25, and 4-32 illustrate the specific locations in Sub-areas C/D2S North, POG2/E1 South, POG3 South, POG3 North, and POG4 South, respectively, where overcuts occurred in OU1 in 2006.

4.3.3 High Subgrade Areas

Starting in September 2005, a high subgrade policy was implemented that allowed an area to be excluded from attaining the 1-ppm PCB target elevation if a high subgrade area had been identified and verified. The high subgrade policy established in September 2005 was implemented during the 2006 RA, as described below.

When high subgrade areas were encountered, J.F. Brennan provided GPS coordinates of potential high subgrade areas to Foth, which placed the survey data on DMU project drawings that depicted post-dredge sediment thickness using the target elevations as the

base elevation. Proposed poling and core sample collection locations were identified by Foth for high subgrade verification testing. A photograph of typical high subgrade cores is presented in Appendix A, photo number 9. A minimum of three sediment cores from each of the proposed high subgrade areas were required for verification. Additional core locations were identified if the high subgrade area was significant in size.

Foth, with assistance from J.F. Brennan, completed the probing and coring activities associated with verifying high subgrade areas. Once on location, a range pole fitted with a 1-foot long, 0.5-inch diameter threaded rod at the end, was used to probe the river bottom to estimate the soft sediment thickness. The probed depth was also taken to refusal to determine the consistency of the underlying material. Water depth was also obtained at the given location using a survey rod with a 6-inch diameter plate attached to the end.

If the soft sediment thickness was 4 inches or greater at the probing locations, a core sample was obtained using 0.75-inch diameter core tubes for visual confirmation of the probing results. Where thickness discrepancies between probing and coring results occurred, the coring result was used as the record of soft sediment thickness. If a sample could not be retained after two coring attempts, it was assumed that no soft sediment existed at that location.

Following poling and core sample collection in a DMU, the high subgrade area information was incorporated into the QA Bathymetry post-dredge isopach drawings. For designation as a high subgrade area, all core samples (or poling in the absence of core samples) needed to indicate less than 4 inches of soft sediment above an underlying hard subgrade. Areas containing 4 inches or more of soft sediment were located on project drawings and provided to J.F. Brennan to perform clean-up passes in the specified areas.

After completion of clean-up passes, post-dredge high subgrade verification procedures were again completed to determine whether areas were either dredged to target elevations or could be designated as high subgrade areas. If the first clean-up pass was not sufficient, the process was repeated until the 1-ppm target elevation was obtained or confirmed high subgrade was encountered.

As required by the 2006 RAWP, at least 95% of the area in a DMU had to be dredged to target elevation for the target elevation to have been considered met for that DMU. Therefore, in limited cases, minimal areas with 4 inches or more of soft sediment above the 1-ppm target elevation surface remained at the completion of dredging. Figures 4-7, 4-14, 4-21, 4-28, and 4-35 indicate estimated areas with 4 inches or more of soft sediment remaining above the 1-ppm target elevation in Sub-areas C/D2S North, POG2/E1 South, POG3 South, POG3 North, and POG4 South, respectively.

Appendix E contains high subgrade poling and core sample collection information for 2006. Documentation includes sample point locations, soft sediment thicknesses based on probing, and soft sediment thicknesses based on core sample measurements.

4.4 Post-Dredge Sampling Procedures

The following sections contain a description of the procedures used for the 2006 RA project regarding the collection, processing and documentation of post-dredge sediment samples. Procedures were in accordance with Appendix D and E of the 2006 RAWP.

4.4.1 Post-Dredge PCB Sampling Locations

Following a QA bathymetric survey indicating that targeted dredge elevations were achieved for a DMU, post-dredge verification sediment sampling for PCB analysis was completed in each DMU by Foth. Photographs of post-dredge sampling and post-dredge sample documentation are provided in Appendix A as photographs 10 and 11. In accordance with the 2006 RAWP, sediment sample collection was based on a 230-ft (Sub-areas C, E1, POG2, and POG3) or 345-ft (Sub-areas D2S and POG4) triangular grid unit. Primary and secondary were collected from the grid limits.

The post-dredge primary PCB sampling locations were located at a pre-design sample location nearest the center of each triangular grid unit. If a pre-design sample did not exist within a triangular grid unit, then the core sample was taken at the center of the grid unit. If the center of the grid unit fell outside of the 1-ppm dredge cut limit of the sub-area, then the primary sample location was selected randomly inside of the 1-ppm RAL limit within that grid unit.

Secondary samples typically consisted of four individual core samples, which were homogenized to form one composite sample. The number of secondary samples was proportional to the area of each grid unit. Typically grid units were split into four equal quadrants, though some grid units had less than four complete quadrants. One secondary sample was collected from each quadrant. The locations of the individual secondary samples were randomly selected within a quadrant.

Figures 4-8, 4-15, 4-22, 4-29, and 4-36 show the proposed primary and secondary post-dredge sample locations for Sub-areas C/D2S, POG2, POG3 South, POG3 North, and POG4 South, respectively. Actual sample locations are included in Table F-1 of Appendix F and shown (for primary samples) on Figures 4-9, 4-16, 4-23, 4-30, and 4-37.

4.4.2 Sediment Collection Procedures

Sediment sampling stations were located by Foth using RTK GPS capable of locating stations with an absolute and repeatable horizontal accuracy of ± 1 meter (m) and a vertical accuracy of ± 5 cm. The RTK GPS was referenced to onshore, WDNR-established survey monuments to ensure accuracy in the station location determination. The coordinate system used during the sampling activities was the NAVD 88 Datum (vertical) and Geodetic (WGS/NAD83) Datum (horizontal). A photograph of the RTK GPS setup is provided in Appendix A, as photograph 10.

Once a sampling station was located, the sampling platform (boat) was anchored or spudded in place. The coordinates of the sample location and the water surface elevation were obtained and recorded in the core collection and processing field log (field log). The actual sampling location for first attempt samples was typically within 3 feet for primary samples and 10 feet for secondary samples. Water depth was obtained using a surveyor's rod attached to a 6-inch diameter metal plate. Thickness of the soft sediment was estimated using a range pole fitted with 0.5-inch diameter threaded rod. Water depth and sediment thickness were recorded on the field log.

Hand-coring techniques were used to obtain the post-dredge core samples. The coring device consisted of a 2-foot long, 2-inch inside diameter core barrel with a T-bar (push rod).

The core barrel was pushed into the sediment until refusal with an attempt to obtain a clay plug. Once the core tube was pushed to refusal, the depth of core penetration was noted and documented on the field log.

The thickness of the sediment recovered in the core tube was measured and recorded in the field and the contents of the core tube were described and documented on the field log. Since it was not considered in the post-dredge elevation confirmation measurements, the majority of the light, low-percent solids surficial sediment layer (sometimes referred to as a fluff layer) was removed with the water on top of the sediment in the core and was not included in the total sediment thickness recorded. The core was then secured in an upright position to minimize disturbance until it was processed.

If sampling activities did not yield at least 3 inches of sediment inside the core on the first attempt, a second attempt was made to obtain a sediment core by relocating the vessel between 5 and 10 feet from the location of the first attempt. At times, the collection vessel was moved as far as 21 feet from the proposed location in an attempt to obtain a sample with the intent to keep the second sampling effort within the same triangular grid unit as the first attempt. If the second attempt failed to yield at least 3 inches of sediment, this information was recorded on the field log and no additional attempts were made to sample this location.

The PCB concentration value assigned to locations where less than 3 inches of soft sediment recovery occurred after two attempts was 0.0168 mg/kg. This value is the average PCB concentration of 12 native clay samples from different sub-areas within OU1 collected during pre-design sampling in 2003/2004. The locations of these 12 samples are shown on Figure 4-39, and the analytical results are summarized in Table 4-5.

Table 4 -5
OU1 Native Clay Sample Analytical Results

Sample ID	Average Depth (ft bgs)	PCB Value (ppm)	Percent Solids
E3-Clay1	-0.25	0.0135	75
E3-Clay2	-0.25	0.035	77
E4-Clay1	-0.25	0.032	65
E4-Clay2	-0.25	0.0135	73
E6-15	-0.16	0.0135	70
E6-16	-0.07	0.0135	77
F-Clay1	-0.25	0.0135	75
F-Clay2	-0.25	0.0135	76
POG2-22	-0.16	0.0135	71
POG4-Clay1	-0.25	0.0135	64
POG4-Clay2	-0.25	0.0135	68
POG4-Clay3	-0.25	0.0135	68
Average Values	-0.22	0.0168	72

Note: The analytical data was compiled from the March 2005 BODR.

Prepared by: TMK1
Checked by: DMR

4.4.3 Sample Processing

Sediment core samples were processed as soon as possible after the sampling event. If cores could not be processed immediately after sampling, they were kept at 4° C, or if the sample was not to be analyzed for PCBs within the holding time of 14 days the sample was frozen.

During core processing, remaining liquid above the top of sediment material was removed from the sediment core with a pipette. The sediment thickness was measured, while the sample tube was vertical, and recorded on the field log.

The sample tube was then cut in half, length-wise. The description and measurements of the entire soil/sediment core were recorded on the field log. The description of the soil/sediment units typically included the following: color; soil/sediment type (visual soil classification); moisture content; plasticity; and density. A photograph of a core being processed is presented in Appendix A, as photograph 12.

For primary sediment core samples, the top four inches were removed from the core, homogenized and placed in a sample container for delivery to the lab for PCB analysis. The minimum sample weight required was 100 grams wet. The remainder of the soft sediment within the core was divided into 4-inch intervals (minimum 3 inches) until the end of the core was reached or a 4-inch interval consisting entirely of native clay was encountered. These deeper intervals were then frozen for potential future analysis.

For secondary composite samples, the top 4 inches of each sample were removed and homogenized as described above. Typically, four secondary core samples (sometimes less, depending on the sample grid area) were needed to prepare the secondary composite sample. The secondary composite sample was prepared for laboratory analysis by taking equal amounts of each of the four homogenized secondary samples and compositing the four samples into one sample. If no sediment could be collected from a location after two attempts, no sample was collected and the location was identified as having no soft sediment; in which case, the remainder of the secondary samples were composited as described above. If all secondary samples were not yet available to generate the composite sample, each discrete secondary sample was placed into double zip lock plastic bags, labeled, and frozen until the remaining secondary samples were available. The remainder of the soft sediment within each core was divided into 4-inch intervals (minimum 3 inches) until the end of the core was reached. These deeper intervals were then frozen for potential future analysis. Sample intervals below the top 4 inch interval that consisted completely of native clay material were not analyzed.

All primary and secondary samples were kept on ice during shipment to the laboratory.

If the PCB concentration of any primary or secondary composite surficial sample exceeded 1-ppm, the directly underlying sample interval was sent in for analysis. This process occurred until the PCB concentration was less than 1-ppm or until no more sample intervals were available.

Sediments were analyzed for PCBs by Pace Analytical using the modified USEPA SW-8468082 procedure commonly referred as the “Fox River Method”, which includes an air-drying step so that samples contain between 5- and 10-percent moisture prior to extraction. The sediment samples were then extracted by USEPA SW 846 Method 3541C,

automated Soxlet (Soxtherm), followed by gas chromatography analysis using an electron capture detector (GC/ECD). The initial calibration includes an analysis of a five-point calibration curve of Aroclors 1242 and 1254, both prominent PCBs found in the Lower Fox River. A duplicate sample for every 10 primary samples and for every 10 secondary samples was also processed and delivered to Pace Analytical for PCB analysis. All post-dredge PCB results, including duplicate values, are presented in Table F-1 in Appendix F.

4.4.4 Sediment Collection Documentation

Observations and quantitative data collected during implementation of the sediment sampling procedures (e.g., DMU sampled, time sampling began and ended, sample IDs, order of sample locations completed, number of sample attempts, etc.) were recorded in the field notebook. Core collection and field log processing were completed for each core location.

4.4.5 Identification of Re-dredge Areas

As a general rule, areas with residual PCB concentrations of greater than or equal to 5 ppm were considered for re-dredging. Re-dredge areas are shown on Figure 4-40. Evaluation of potential re-dredge areas was ongoing from August until the end of the 2006 dredging operations. An evaluation of the effectiveness of re-dredging is presented in Section 4.5.2.

4.5 Post-Dredge PCB Results

Post-dredge PCB sediment results for the 2006 project are discussed and summarized in this section of the report. The PCB data are presented as sub-area surface concentrations, averaged over the 2006 dredge prism areas. Data of this type are also referred to as "Average Surface Concentrations". The Average Surface Concentrations are presented only for the 2006 dredge prisms 1-ppm PCB area of a sub-area. Sub-areas contain regions which are less than 1-ppm PCBs. Including these lower PCB concentration regions would lower the Average Surface Concentrations.

The term "Average Surface Concentration" refers to surface weighted average concentration of the top four inches of remaining sediment in a sub-area as given by the post-dredge sediment bed interpolation model. Details of estimating "Average Surface Concentration" as well as PCB mass from the sediment bed model are discussed in the following section and further in Appendix G "GMS Modeling and Average Surface Concentration Calculation Methodologies." Note that if the remaining sediment thickness was less than four inches and a post-dredge residual sample was collected and analyzed, the resultant PCB value was used in the calculation of the Average Surface Concentrations.

4.5.1 Summary of PCB Data

A total of 169 primary and 528 secondary coring locations were sampled in 2006. All post-dredge sediment PCB results are presented in Appendix F, Table F-1.

Table 4-6 presents the PCB mass and Average Surface Concentrations results for 2006 dredging by sub-area in order to evaluate the PCB removal efficiency of dredging. Also presented are the pre-dredge and 2006 post-dredge PCB concentration ranges for samples collected from the top core interval.

Table 4-6
2006 Post Dredge PCB Results Summary
(1.0 ppm Dredge Prism Only)

Sub-area [a]	Metric	Pre-Dredge	Post-Dredge	PCB Mass Removed	Percent Reduction	Pre-Dredge Surface Sample PCB Range	Post-Dredge Surface Sample PCB Range
C/D2 S North	PCB Mass (Kg)	7.8	4.2	3.6	46%	-	-
	PCB Average Surface Concentrations (ppm)	5.5	**1.2**	--	78%	0.2-17.0	<0.027-6.6
POG2	PCB Mass (Kg)	141.8	11.0	130.8	92%	-	-
	PCB Average Surface Concentrations (ppm)	4.2	**3.8**	--	10%	0.2-6.0	0.11-22
POG3 North and South	PCB Mass (Kg)	314.8	7.5	307.3	98%	-	-
	PCB Average Surface Concentrations (ppm)	21.2	**0.8**	--	96%	<0.027-360	<0.013-15
POG4 South	PCB Mass (Kg)	7.8	0.2	7.6	97%	-	-
	PCB Average Surface Concentrations (ppm)	1.0	**0.5**	--	50%	0.7-1.2	<0.027-3.7
E1 South	PCB Mass (Kg)	18.2	0.1	18.1	99%	-	-
	PCB Average Surface Concentrations (ppm)	4.9	**1.0**	--	80%	3.7[b]	0.74-2.2
Total PCB Mass Removed				**467.4 Kg**			

[a] The PCB concentrations and mass are for the area in the 2006 dredge prisms only, not for the entire sub-area.
b Only one pre-dredge sample located in E1 South.

Prepared by: SGL
Checked by: GRE

Because a substantial volume of the PCB contaminated sediment was at depth in POG2, surface concentrations in most of the POG2 dredge areas did not decrease significantly as a result of dredging.

Overall in the sub-areas targeted for dredging in 2006, the PCB mass reduction ranged from 92% to 99%, with the exception of the northern part of Sub-area C/D2S which resulted in a PCB mass reduction of 46%. The Average Surface Concentration reduction ranged from 10% in Sub-area POG2 to 96% in Sub-area POG3.

The target RAL (1-ppm) was achieved in E1 South, POG3 North and South, and POG4 South. The target RAL was nearly achieved in C/D2S North (1.2 ppm) but not in POG2 (3.8 ppm). A discussion of appropriate residuals management is presented in Section 4.5.3.

Similar to calculations given in the 2005 RA Summary Report, PCB Average Surface Concentrations were again calculated from the interpolated concentrations of the three-dimensional post-dredge sediment bed model, restricted to the top four inches of sediment. Thiessen polygon areas surrounding the post-dredge sediment bed model mesh nodes were used for surface weights.

In constructing the post-dredge sediment bed model, post-dredge data was interpolated using the same interpolation settings as those chosen for the pre-dredge (BODR) model. Secondary composite samples in the post-dredge analysis received a weighting equal to the number of samples comprising the composite (i.e., a heavier weighting than the primary samples). When re-modeling the post-dredge data, each secondary sample location was given the value of the composite result.

Unlike the 2005 post-dredge results, post-dredge data in 2006 included data with depth. Therefore, with the 2006 results, no additional assumptions were necessary for vertical PCB concentration changes.

To calculate PCB mass remaining, the post-dredge sediment bed model was used with a representative volume at each three dimensional mesh node. The mesh node volumes were derived from the Thiessen polygon area (horizontal) and multiplied by the mesh layer thickness (vertical). For each node volume, the PCB mass (kg) was found through multiplication of the representative volume, the interpolated PCB concentration, the sediment dry density and appropriate conversion factors.

The dry density used in PCB mass calculations was derived uniquely at each post-dredge interpolation model node. The post-dredge percent solids data was interpolated to the three-dimensional post-dredge sediment bed model under the BODR parameterization. At each post-dredge model node, the dry density (lbs./ft.^{3}) is given by

$$Dry\ Density = \frac{62.4}{1/G_s + 100/PS - 1}$$

where PS is the model node estimate of percent solids and G_s is the assumed specific gravity of 2.5. The PCB mass calculated at each model node is then given by the dry density multiplied by the representative cubic feet and unit-less concentration for that node. Summing over desired model nodes gives resulting PCB mass.

Undisturbed residuals were interpreted as the sediment in dredged areas with PCB concentrations greater than 1.0 ppm that are beneath the top 6 inches of sediment. The sediment in the top 6 inches of dredged areas is referred to as "disturbed residuals." An accounting of the sediment volume and PCB mass in the top 6 inches, as analyzed from the

current post-dredge model, is presented in Table 4-7 below. The accounting is based on Theissen polygon representations of the model and addresses only those regions dredged over the period from 2004 to 2006. The reported quantities are associated with the 1 ppm isopach, without any adjustment for overcut.

More than 95% of the PCB mass associated with the post-dredge residuals were in the top 6 inches of post-dredge sediment for Sub-areas A, E1, POG1, and POG4. A smaller proportion of post-dredge residual PCB mass (77 – 87%) was in the top 6 inches for Sub-areas C, D2S, and POG3. However, for POG2, most of the residual volume (72.9%) and PCB mass (69.8%) were undisturbed residuals. POG2 differed from the other sub-areas dredged to date in OU1, in that the material directly underlying the PCB impacted sediment was predominantly soft, gray, silty clay material in contrast to the hard-packed red/brown clay underlying the other sub-areas.

For all OU1 Sub-area regions dredged in 2004 – 2006, approximately 80% of the area has 6 inches or less of residual sediment (disturbed residuals only). However, undisturbed residuals account for roughly 37% of the post-dredge sediment volume and roughly 34% of the post-dredge PCB mass, primarily due to the undredged PCB impacted sediments that remain in POG2.

Table 4-7
Summary of Disturbed Residuals

OU1 Sub-area	Post-dredge Area			Post-dredge Volume			Post-dredge PCB Mass		
	Areas with PCBs > 1 ppm	Areas with 1 ppm isopach within top 6 inches		Volume of 1 ppm isopach	Volume for areas with 1 ppm isopach within top 6 inches		PCB Mass in 1 ppm isopach	PCB Mass for areas with 1 ppm isopach within top 6 inches	
	(Ac)	(Ac)	(%)	(cy)	(cy)	(%)	(kg)	(kg)	(%)
A	23.12	22.65	98.0	7,982	7,937	99.4	17.71	17.65	99.7
C	7.57	6.70	88.5	4,336	4,170	96.2	4.76	3.67	77.1
D2S	2.88	1.03	35.8	2,480	2,026	81.7	0.78	0.64	82.8
E1	0.45	0.45	100.0	203	203	100.0	0.06	0.06	100.0
POG1	3.42	3.42	100.0	714	714	100.0	1.20	1.20	100.0
POG2	6.80	1.03	15.1	18,710	5,067	27.1	24.96	7.53	30.2
POG3	9.59	7.39	77.1	5,832	5,128	87.9	7.51	6.50	86.5
POG4	0.77	0.74	96.1	407	406	99.9	0.21	0.21	100.0
Total	54.6	43.4	79.5	40,664	25,651	63.1	57.2	37.5	65.5

Prepared by: GRE
Checked by: SGL

4.5.2 Evaluation of Re-dredging

This section provides additional information on the sediment re-dredging efforts in 2006 in Sub-areas POG3 and POG2. This data was gathered in those areas in 2006 where the dredge reoccupied a location for additional dredging following the receipt of post-dredge PCB data. Re-dredging was performed under the following criteria:

1. Re-dredging was performed if the primary sample, the secondary composite sample, or both were ≥ 5.0 ppm PCBs.
2. Sample sub-triangles with no soft sediment (NSS) were excluded from re-dredging.
3. Re-dredge prisms included the entire sub-triangle extent, except as described in Criterion 5.
4. If the primary sample result was ≥ 5.0 ppm PCBs, but the composite was ≤1.0 ppm PCBs, only the area around the primary sample location was targeted for re-dredging.
5. Dredge areas already achieving the 1-ppm target elevation were re-dredged if soft sediment was present and the area was within a sub-triangle area proposed for re-dredging.

An initial dredge pass and a re-dredge clean-up pass occurred in POG2-DMU7, and up to three total dredge events (initial dredge pass and two clean-up re-dredging passes) occurred in portions of POG3 during 2006 dredging operations.

The re-dredge limits were typically bounded by the previously set post dredge verification sample triangle shapes, except under the scenario where the primary sample was greater than or equal to 5.0 ppm PCBs and the composite of the secondary samples was less than or equal to 1-ppm. In this case (see POG3 South, DMUs 19/20, triangle 53), the limits of re-dredge were established by a rectangular shape around the primary sample where the limits of the rectangle were determined by encompassing the midpoints between the primary location and each of the secondary sample locations. The re-dredge locations are shown on Figure 4-40 and the PCB results are shown on Figure 4-41.

Each re-dredge area was sampled after the initial dredge event and after each subsequent re-dredge event. A summary of the average PCB concentrations, percent solids, volume of sediment removed and estimated PCB mass removed is given for the re-dredge areas in Table 4-8. Individual sample results of PCB concentrations and percent solids collected within the re-dredge areas following dredging are given in respectively in Tables H-1 and H-2 located in Appendix H. The sample results of Tables H-1 and H-2 illustrate the data used in calculating average concentrations as given in Table 4-8. Note that composite samples receive a weighting equal to the number of samples which comprise the composite result. Also, no-recovery samples are given a value of 0.0168 ppm.

The removal estimates of PCB mass for the re-dredge areas in Table 4-8 are calculated as

$$\frac{62.4}{\left(\frac{1}{G_s}\right)+\left(\frac{100}{\%\,\text{Solids}}\right)-1} \times ft^3 \times \frac{ppm}{1{,}000{,}000} \times 0.4536\ {}^{Kg}\!/_{lbs}$$

where ft3 is the re-dredge volume, and % solids and ppm are the average % solids and PCB concentrations, respectively, given by the observed sample core results.

Table 4-8
Summary of 2006 Re-dredge Areas

DMU	Sample Triangle Numbers	PCB Average Surface Concentration[a] (ppm)	PCB Average Concentration with Depth[a] (ppm)	Average Percent Solids	Total Volume of Sediment Removed (post-dredge survey to re-dredge post dredge survey)	Volume of Sediment Removed During Re-dredging Based on Post-Dredge Surveys to 1ppm Elevation	Area of Re-dredge (sf)	PCB Mass Removed (post-dredge survey to re-dredge post dredge survey) (Kg)
POG2								
DMU-7	9 - P	73.0	37.2	38.4	93	7	3,116	1.32
	9 RD - P	2.7	2.7	47.9				
POG3 – North								
DMU-28	94 P, A	3.8	3.0	32.4	151	40	2,274	0.14
	94 RD - P, A	1.0	4.3	40.9				
POG3 - South								
DMU-2	2 - P, A	4.3	4.3	31.0	34	7	3,661	0.04
	2 RD - P	0.014	0.014	72.2				
DMU - 1 ,2 ,5	8 - P, D	4.3	2.9	53.8	72	24	5,644	0.13
	8 RD - P,D	0.015	0.015	72.2				
DMU'S – 2 ,4	10 - P	1.2	4.2	31.5	26	10	3,982	0.03
	10 RD - P	0.017	0.017					
DMU'S - 5, 6, 9	16 - P, C	6.2	4.2	53.2	82	60	3,964	0.21
	16 RD - C	7.5	7.5	74.8				
DMU'S - 5, 6, 9	16 - P, A, B, RD-C, D	7.3	4.6	64.1	68	60	22,906	0.25
	16 2nd RD - P, A, B, C	0.3	0.3	79.3				
DMU'S - 6, 8, 9	17 - P, A, B, C, D	8.3	6.7	63.9	201	135	22,906	1.06
	17 RD - P, A, B, D	1.0	1.0	72.8				
DMU'S - 7, 8	19 - P, A	8.7	8.7	55.5	34	14	11,454	0.19
	19 RD - P, A	7.3	7.3	81.6				
	19 - RD-A	14.6	14.6	81.6	58	46	5,727	1.03
	19 2nd RD - A	12.0	12.0	70.4				
DMU'S - 7, 8	21 - P, A, C, D	12.0	8.0	60.7	15	15	15,860	0.09
	21 RD - P, A, C, D	0.6	0.6	82.4				
DMU'S - 8, 11	29 - P, A, B, C, D	12.0	12.0	68.1	320	210	22,906	3.38
	29 RD - A, B	0.028	0.028	86.8				
DMU'S - 10, 13, 14	36 - P	92.0	46.1	58.0	120	70	4,820	3.76
	36 RD - P	0.014	0.014	63.9				
DMU'S - 11, 13	38 - P	5.1	5.1	64.8	32	30	2,817	0.13
	38 RD - P	0.014	0.014	75.4				
DMU'S - 17	49 - P, A, B, C	18.8	8.7	59.1	128	112	15,095	0.78
	49 RD - P, A, B, C	0.7	0.6	69.9				
DMU - 19	50 - P, A	7.0	4.7	58.8	36	6	1,570	0.12
	50 RD - P, A	0.4	0.4	54.0				
DMU'S - 19, 20	51 - P, A, B, C	4.7	33.2	64.3	437	44	16,792	11.60
	51 RD - P, A, B, C	0.17	0.17	60.6				
DMU'S - 19, 20	53 - P	11.0	11.0	74.8	19	13	4,176	0.22
	53 RD - P	0.7	0.7	73.0				
DMU-18	55 - P	57.0	19.0	68.1	62	40	2,701	1.04
	55 RD - P	0.01	0.01	72.7				
DMU-18	57 - P, A, B, C, D	11.8	6.7	67.5	463	240	21,987	2.69
	57 RD - P, A, B, C, D	0.014	0.014	65.3				
DMU'S - 21, 23	67- P	28.0	14.0	74.4	16	16	2,500	0.23
	67 RD - P	0.084	0.084	77.4				
DMU'S - 24, 25	81 - P, A, B, C, D	12.0	8.6	36.0	890	208	18,945	2.69

DMU	Sample Triangle Numbers	PCB Average Surface Concentration[a] (ppm)	PCB Average Concentration with Depth[a] (ppm)	Average Percent Solids	Total Volume of Sediment Removed (post-dredge survey to re-dredge post dredge survey)	Volume of Sediment Removed During Re-dredging Based on Post-Dredge Surveys to 1ppm Elevation	Area of Re-dredge (sf)	PCB Mass Removed (post-dredge survey to re-dredge post dredge survey) (Kg)
	81 RD - A, B, C, D	0.2	0.2	57.0				
DMU-25	85 - P, A	15.1	8.3	45.6	58	41	2,149	0.23
	85 RD - P, A	0.1	0.1	62.2				
DMU-25	87 - P, A, B	9.2	5.5	30.4	554	98	9,451	0.87
	87 RD - P, A, B	0.033	0.033	52.1				
Totals					3969	1546	227,403	32

a = Pre-dredge and post dredge PCB data, where RD indicates a re-dredge sample.

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Checked by: GRE

The PCB mass reduction in each re-dredge area is presented in Table 4-9. For each area, an estimate is made of the pre-dredge PCB mass, and the PCB mass remaining following each dredging attempt. The pre-dredge PCB mass for each area was obtained from the pre-dredge sediment bed model, and the PCB mass following the final re-dredge attempt was obtained from the post-dredge sediment bed model. (Methods of obtaining mass estimates from the sediment bed models are presented in Appendix G.) The PCB mass presented in Table 4-9 represents the mass in soft sediment vertically to native clay.

As discussed earlier, estimates of PCB mass removed during the re-dredge attempts are listed in Table 4-8. Utilizing these estimates in conjunction with those obtained from the pre-dredge and post-dredge sediment bed models gives additional estimates of remaining mass following each dredging attempt. For instance, when there was only one re-dredge attempt, the PCB mass remaining following the initial dredging is estimated by the post-dredge PCB mass plus the Table 4-8 re-dredge mass removed. When two re-dredge attempts were made, the mass remaining following the first re-dredge attempt is estimated by post-dredge PCB mass plus the mass removed during the second re-dredge attempt, and the mass remaining following the initial dredging is the post-dredge PCB mass plus the mass removed during the first and second re-dredge attempts.

As an example, the estimated PCB mass remaining following the first dredge attempt in the POG2 sample 9-P area is 1.36 Kg. This equals the post-dredge sediment bed model estimate of 0.04 Kg plus the estimated re-dredge removal volume of 1.32 Kg.

Note that in some instances the estimate of PCB mass remaining in soft sediment following the first dredge pass exceeds the pre-dredge estimate. This variation is not surprising since the re-dredge areas are regions of higher than expected post-dredge PCB concentrations and mass, as a result of either modeling uncertainty or dredging operation. In Table 4-9, the pre-dredge estimate is set to equal the larger of either the estimate of PCB residual mass remaining following the first pass of dredging, or the estimate based on the pre-dredge sediment bed model.

Table 4-9

PCB Mass Reduction for 2006 Re-dredge Areas

DMU	Sample Triangle Numbers of Calculation Areas	Area (sq. ft.)	Pre-Dredge PCB Mass Estimate[1] (Kg)	Remaining PCB Mass Estimate Following First Dredge Attempt[2] (Kg)	% Reduction From Pre-Dredge Estimate	Remaining PCB Mass Estimate Following Re-Dredge Attempt[3] (Kg)	Cumulative % Reduction
POG2							
DMU-7	9 - P	3116	1.36	1.36	0%	0.04	97%
POG3 - North							
DMU-28	94 P, A	2274	3.62	0.18	95%	0.04	99%
POG3 - South							
DMU-2	2 - P, A	3661	0.62	0.04	93%	0.00	100%
DMU - 1 ,2 ,5	8 - P, D	5644	1.25	0.13	89%	0.01	99%
DMU'S - 2 ,4	10 - P	3982	1.27	0.03	97%	0.00	100%
DMU'S - 5, 6, 9	16 - P, C	3964	1.33	1.04	22%	0.84	37%
DMU'S - 5, 6, 9	16 - P, A, B, C, D	22906	8.40	0.46	95%	0.00	98%
DMU'S - 6, 8, 9	17 - P, A, B, C, D	22906	5.21	1.13	78%	0.06	99%
DMU'S - 7, 8	19 - P, A	11454	1.54	1.54	0%	1.36	12%
DMU'S - 7, 8	19 - A	5727	NA	1.34[4]	NA	0.30[5]	80%
DMU'S - 7, 8	21 - P, A, C, D	15860	2.64	0.10	96%	0.01	100%
DMU'S - 8, 11	29 - P, A, B, C, D	22906	3.38	3.38	0%	0.00	100%
DMU'S - 10, 13, 14	36 - P	4820	3.76	3.76	0%	0.00	100%
DMU'S - 11, 13	38 - P	2817	0.58	0.13	77%	0.00	100%
DMU'S - 17	49 - P, A, B, C	15095	0.89	0.89	0%	0.11	88%
DMU - 19	50 - P, A	1570	0.31	0.12	62%	0.00	100%
DMU'S - 19, 20	51 - P, A, B, C	16792	11.60	11.60	0%	0.00	100%
DMU'S - 19, 20	53 - P	4176	0.22	0.22	0%	0.00	100%
DMU-18	55 - P	2701	1.04	1.04	0%	0.00	100%
DMU-18	57 - P, A, B, C, D	21987	2.69	2.69	0%	0.00	100%
DMU'S - 21, 23	67- P	2500	0.23	0.23	0%	0.00	100%
DMU'S - 24, 25	81 - P, A, B, C, D	18945	4.84	2.80	42%	0.11	98%
DMU-25	85 - P, A	2149	0.23	0.23	0%	0.00	100%
DMU-25	87 - P, A, B	9451	1.25	0.88	29%	0.01	99%
Totals			58.3	34.0[6]	42%	2.6[6]	96%

[1]Value given is the maximum of either the pre-dredge sediment bed model estimate for the given sample areas, or the post-dredge sediment bed model estimate plus Table 4-8 re-dredge removal estimates. Estimates are given as PCB mass in soft-sediment to the native clay surface.

[2]Calculated as the PCB mass remaining from the post-dredge sediment bed model, plus the PCB mass removed during the re-dredge attempt(s).

[3]Calculated as the PCB mass remaining from the post-dredge sediment bed model, and if applicable, the PCB mass removed during the second re-dredge attempt.

[4]Value refers to mass remaining following first re-dredge attempt.

[5]Value refers to mass remaining following second re-dredge attempt.

[6]Total does not include values from second re-dredge attempts.

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Checked by: GRE

Table 4-10

PCB Average Surface Concentration Reduction for 2006 Re-dredge Areas

DMU	Sample Triangle Numbers of Calculation Areas	Area (sq. ft.)	Pre-Dredge PCB ASC Estimate [1] (ppm)	PCB ASC Estimate Following First Dredge Attempt[2] (ppm)	Percent Reduction From Pre-Dredge Estimate	PCB ASC Estimate Following First Re-Dredge Attempt (ppm)	Cumulative Percent Reduction From Pre-Dredge Estimate
POG2							
DMU-7	9 - P	3116	6.2	73.0	0%	2.7	56%
POG3 - North							
DMU-28	94 P, A	2274	27.9	3.8	86%	1.0	96%
POG3 - South							
DMU-2	2 - P, A	3661	48.7	4.3	91%	0.0	100%
DMU - 1 ,2 ,5	8 - P, D	5644	32.1	4.3	87%	0.0	100%
DMU'S - 2 ,4	10 - P	3982	93.6	1.2	99%	0.0	100%
DMU'S - 5, 6, 9	16 - P, C	3964	26.1	6.2	76%	7.5	71%
DMU'S - 5, 6, 9	16 - P, A, B, C, D	22906	25.2	7.3	71%	0.3	99%
DMU'S - 6, 8, 9	17 - P, A, B, C, D	22906	16.5	8.3	50%	1.0	94%
DMU'S - 7, 8	19 - P, A	11454	12.9	8.7	33%	7.3	43%
DMU'S - 7, 8	19 - A	5727	NA	14.6[3]	NA	12.0	18%[3]
DMU'S - 7, 8	21 - P, A, C, D	15860	14.3	12.0	16%	0.6	96%
DMU'S - 8, 11	29 - P, A, B, C, D	22906	9.2	12.0	0%	0.0	100%
DMU'S - 10, 13, 14	36 - P	4820	9.3	92.0	0%	0.0	100%
DMU'S - 11, 13	38 - P	2817	31.3	5.1	84%	0.0	100%
DMU'S - 17	49 - P, A, B, C	15095	3.6	18.8	0%	0.7	80%
DMU - 19	50 - P, A	1570	7.8	7.0	11%	0.4	95%
DMU'S - 19, 20	51 - P, A, B, C	16792	4.7	4.7	1%	0.2	96%
DMU'S - 19, 20	53 - P	4176	3.3	11.0	0%	0.7	79%
DMU-18	55 - P	2701	1.7	57.0	0%	0.0	99%
DMU-18	57 - P, A, B, C, D	21987	4.6	11.8	0%	0.0	100%
DMU'S - 21, 23	67- P	2500	2.2	28.0	0%	0.1	96%
DMU'S - 24, 25	81 - P, A, B, C, D	18945	7.1	12.0	0%	0.2	97%
DMU-25	85 - P, A	2149	3.1	15.1	0%	0.1	98%
DMU-25	87 - P, A, B	9451	0.4	9.2	0%	0.0	93%
Averages[3]			13.6	13.2	2%	0.8	94%

[1]Calculated from pre-dredge sediment bed model for given sample areas. Estimate given is PCB average surface concentration in modeled top 4-inches of soft sediment.
[2]Calculated from post-dredge or re-dredge PCB results of top 4-inch interval for given sample areas.
[3]Value given is concentration following first re-dredge attempt, with percent reduction corresponding to reduction from first re-dredge.
[4]Averages are surface weighted by the given sample areas.
ASC = Average surface concentration

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Checked by: GRE

Mass remaining estimates in Table 4-9 are totaled for first pass dredging and first re-dredge attempt. Of these totals, the first dredging pass resulted in a 42% mass reduction corresponding to a decrease of 24 Kg. The first re-dredge attempt resulted in an additional mass reduction of 54%, corresponding to an additional decrease of 31 Kg, for a cumulative percent reduction of 96%.

Reduction of PCB average surface concentration for the re-dredge areas is summarized in Table 4-10. Similar to the pre-dredge mass estimates, pre-dredge average surface concentration estimates were obtained from the sediment bed model. (Methods of obtaining model average surface concentration estimates are presented in Appendix G.) Post-dredge surface concentrations for each region are given as the average of the top 4-inch interval concentrations measured by the sample core results within each re-dredge area. Values of 0.0168 ppm are applied for results of "no-recovery", and secondary composite results are weighted by the number of samples comprising the composite.

The overall average pre-dredge average surface concentration values and average surface concentration values following each dredge pass are given for the re-dredge regions. These averages are surface weighted by the given re-dredge area sizes. Note that only a small reduction (2%) occurred in surface concentration following the first dredge pass, corresponding to a decrease from 13.6 ppm to 13.2 ppm. Following the first re-dredge attempt, the average surface concentration for these regions fell 94%, from 13.6 ppm to 0.8 ppm.

4.5.3 Residuals Management

As discussed in Section 4.5.1, the post-dredge average surface concentration for each sub-area dredged in 2006 was as follows:

- C/D2S North 1.2 ppm
- POG2 3.8 ppm
- POG3 North 0.8 ppm
- POG4 South 0.5 ppm
- E1 South 1.0 ppm

In 2006, dredging in Sub-areas C/D2S North and POG2 did not result in a residual average surface concentration PCB concentration at or below 1-ppm. These sub-areas, along with portions of other sub-areas dredged in 2005 and 2006 are being evaluated for appropriate residuals management.

In general, re-dredging will be completed in specific areas previously dredged with a post-dredge result ≥ 5 ppm PCB and a residual sand cover will be placed over all areas previously dredged with a post dredge result ≥ 1.4 ppm but < 5 ppm.

SECTION 5

Dewatering

5.1 Description & Process Flow

Geotextile tubes continued to be used for sediment dewatering in 2006. However, the 2006 RA sediment dewatering process was modified with the addition of two sediment screening and thickening units prior to the geotextile tubes, Appendix A - photograph 14. The addition of screening and thickening provided the following benefits:

- Screening of debris larger than 1/8 inch resulted in improved sediment dewatering and decreased the potential for geotextile tube tears.
- Thickening of the sediment slurry prior to introducing into the geotextile tubes reduced the hydraulic loading on the geotextile tubes, reducing the number of tubes online, and providing a uniform slurry for dewatering.
- Decreased the dredge pump discharge pressure as a result of pumping material directly to the screens, rather than pumping directly into the geotextile tube header system. This resulted in the overall effect of improving dredge efficiency while minimizing the amount of carriage water that is delivered to the dewatering pad with the dredge slurry.
- Reducing the dewatering time and allowed stacking of the geotextile tubes sooner.

The dewatering system is made up of a manifold system, thickener system, geotextile tubes, dewatering pad, and carriage water sump. Photographs of the geotextile tubes are presented in Appendix A – photographs 15, 16, and 17, and a photograph of the dewatering pad as photograph 18. The process flow diagram for the sediment dewatering system is shown on Figure 5-1. A conditioning chemical (polymer) was added to the sediment slurry prior to discharge into the trammel screens. The dosing rate was based on the dredge slurry flow rate, the slurry solids content, and resulting visual floc characteristics. The material was then screened and allowed to settle before being pumped to the geotextile tubes. Carriage water from the geotextile tubes wept through the geotextile fabric, percolated through the dewatering pad gravel, and flowed to the carriage water sump before being pumped to the water treatment system. With the use of the thickeners in 2006, the tubes were only filled two or three times and allowed to decant between fillings versus up to eight times in 2005. This allowed the stacking of the tubes to occur in a much more rapid fashion than in 2005.

5.2 Chemical Addition

During the 2006 Remedial Action, a cationic polymer was fed to the dredge slurry to flocculate the sediment particles, thus aiding the geotextile tube dewatering process. The dewatering system was designed to deliver both a cationic polymer, Appendix A – photograph 19, and ferric sulfate, Appendix A – photograph 20, to the slurry. There were three injection points, which were used for polymer addition at different times, during the

dredge season. The first injection was approximately 200 feet before the thickeners and was an injection ring in the pipeline, Appendix A – photograph 21. The second point was after the trammel screens but before the thickener tank, but the second point was seldom used. The third was at the discharge of the thickeners to the geotextile tubes. It consisted of an injection ring in the pipeline and a static mixer immediately following it.

Samples were taken at various locations periodically throughout the day to monitor particle charge of the water. The samples were taken from the geotextile weep, thickener effluent, dewatering pad sump, and a background from the lake. These were used to monitor the dosage of polymer used. Visual observations also were used to adjust the polymer dosage.

Target dosages were tracked as the amount of polymer per unit weight of dry sediment solids. The polymer was fed with adjustable rate progressive cavity pumps. Flow rate and density of the slurry paced the chemical feed rate. A flow meter and online density meter, Appendix A – photograph 22, fed signals to a programmable logic controller, which in turn adjusted the feed rates. A total of approximately 120,600 pounds of polymer were used for the geotextile tube dewatering system.

5.3 Sediment Screening and Thickening

From the dredge pipeline the dredge slurry was discharged into the rotating trammel screens from the inclined end of the screens. The screens removed any material from the slurry 1/8 inch and larger. These screenings were then discharged onto a conveyor belt that piled the material for load out. The remaining slurry entered the thickeners where the flocked sediment was allowed to settle to the bottom. The supernatant overflowed the weirs from the thickeners and flowed through a filter fabric lined area (commonly referred to as the "hot tub") before percolating through the dewatering pad gravel, Appendix A, photograph 23.

The thickened sediment was pumped periodically to the geotextile tubes. The frequency of this pumping was dependent of the level of material in the thickeners. As described below, a contingency bag was located on an area opposite of where the thickened sediment was being sent to the tubes. The filling of the contingency bag was accomplished through the use of a bypass valve located immediately upstream of the discharge into the screens. Flexible piping, similar to that used for the thickened sediment tubes, connected this valve to the contingency tube, which was used in the rare event of a mechanical malfunction of the thickeners.

The maximum design capacity of each of the two thickeners is 2,400 gpm, which is sufficient to handle flow from two dredges. The normal operating design capacity for each of the two thickeners is between 1,100 and 1,900 gpm. During normal operating conditions in 2006, both thickeners units were employed, treating an average actual influent flow total of approximately 1,800 gpm. The units were designed so that in the event of mechanical problems with one of the units, the remaining unit could treat the material from both dredges for a period of up to 8 hours without negatively impacting operations. It was anticipated that two thickeners would only be absolutely required when dredging in Sub-area POG2, due to the poor-settling nature of the POG2 sediment. This was confirmed during the 2006 operation, when one unit was overloaded for a period of approximately 2 hours because both dredges were in POG2. During this period, the influent was sent

directly to a geotextile tube. The operational procedures were subsequently modified to place only one dredge in POG2 at a time.

5.4 Dewatering Pad Management

The dewatering pad area is approximately 510 feet by 410 feet surrounded by containment berms. The pad and berms are lined with a composite barrier layer consisting of compacted clay subgrade, a geosynthetic clay liner, 30-mil PVC geomembrane, and 20-ounce per square yard non-woven geotextile. A minimum 2-foot thickness of 2.5-inch crushed limestone drainage layer covers the liner to protect it from vehicle traffic and provides storage volume for flow equalization into the water treatment plant, stormwater retention, and spill containment. A 6-inch-thick layer of 0.75-inch gravel overlays the stone drainage layer -- providing a base suitable for supporting the geotextile tubes and acting as a filter for sediment solids. As designed, sediment solids associated with geotextile tube filtrate, spills, and load-out operations accumulate in the surface of the dewatering pad gravel and stone layers. An excessive accumulation of solids in the gravel and stone can inhibit the free passage of water through either or both layers.

Prior to the start of the 2006 dredge season, STS conducted an investigation to visually observe and assess the pad and pipe. The objective of the investigation was to assess whether clogging/blinding of the gravel pore space and drain pipe had occurred due to dewatered river sediments and/or biological growth. Blinding of the surface gravel was first observed in the dewatering pad at locations that received the majority of the geotextile tube filtrate. Subsequent failures of five geotextile tubes released additional sediment onto the dewatering pad, which increased the magnitude and lateral extent of the pad blinding and potentially the depth of blinding.

The investigation consisted of excavating test pits into the stone drainage layer at various locations across the pad, jet cleaning the 18-inch drain pipe, and video inspecting the drain pipe. A total of 16 test pits were excavated by JF Brennan Company, Inc. on March 16, 2006.

Based on field observations on March 16, 2006, STS concluded that the 0.75-inch gravel layer was functioning, as designed, as a gravel filter, preventing sediments from migrating into and clogging the stone drainage layer. STS recommended a targeted removal of the 0.75-inch gravel layer. The gravel layer contained a significant fraction of sediment and therefore did not allow the free flow of water. The 0.75-inch gravel layer was removed, washed, and replaced.

The gravel washing operation began on April 3, 2006, and was completed on April 7, 2006. As the gravel layer was removed and washed from a particular location, a visual assessment of the underlying stone was made to determine if it was substantially free of sediment or fines, and if needed, additional gravel or stone was excavated. In the proposed discharge location from the thickeners, additional drainage stone below the gravel layer was excavated, washed, and replaced. The sediment removed from the stone was placed into one of two geotextile tubes for dewatering and subsequently disposed of at the Veolia Environmental Services Hickory Meadows Landfill. Following the gravel washing operation, approximately 15 additional loads of clean 0.75-inch gravel was brought to the site and spread in locations where additional stone was required.

The March 22, 2006, correspondence addressing the results of the dewatering pad blinding investigation is included in Appendix I

The April 21, 2006, correspondence addressing the dewatering pad blinding investigation and rehabilitation is included in Appendix I

5.5 Geotextile Tube Operations

Geotextile tubes were constructed of Geolon GT500, or an equivalent material, and were manufactured by Miratech. All the tubes were 60 feet in circumference and ranged in length between 203 to 158 feet, with the exception of one 112 foot long tube that was filled at the end of the season.

Figure 5-2 shows the final geotextile tube layout. Geotextile tube operation began on May 1, 2006, in conjunction with hydraulic dredging of sediment in Sub-area C/2DS and continued until November 16, 2006. The first geotextile tube filled was on the northeast side of the dewatering pad. The geotextile tubes were stacked on the northeast side until this area was almost filled. The operations then moved to the northwest side of the pad. When this side was approximately half complete tubes on the southwest side of the pad began being filled in conjunction with the tubes on the northwest. This was continued until the bags on the entire western half of the pad had been filled. Of note, on the evening of October 4th, 2006, there was a failure of the first tube situated on the fourth row in the northwest corner. The cause of this failure has not been determined. However, because of the time of occurrence and the location of the failed tube it did not interfere with the pad management for the remainder of 2006.

Aggressive stacking plan was used to accommodate the anticipated volume to be dredged in 2006. Geotextile tubes were placed up to four-high in a pyramid fashion lying side by side. Geotextile tubes were stacked as soon as safety would allow. Level "A" was considered the first layer and consisted of tubes 203 feet in length. The second layer was level "B", with tubes 15 feet shorter in length. This pattern continued to level "D" or the fourth layer. The goal of the aggressive stacking was to minimize the time between the "A" level and the "D" level geotextile tubes on the pad. This was critical so that the load out of the dewatered material could proceed as planned.

The labeling of the tubes was modified from 2005 in an effort to create less confusion and, on the east side of the pad, initially consisted of a number preceded by two letters. For example, the first tube (1) located on the first, or bottom, layer (A) on the eastern (E) half of the pad was labeled E-A-1. The second tube on the first layer, on the eastern side of the pad, was labeled E-A-2, with the first tube on the second layer labeled E-B-1. This labeling scheme was followed until the entire eastern half of the pad was filled. However, because the pad management in 2006 dictated the need to place tubes on the east side of the dewatering pad a second time, after all material from the tubes initially filled had dewatered and been removed, these bags were labeled with an N preceding the original label during the second filling. Thus the first tube situated on the first layer on the east side the second time was labeled as NE-A-1, the next tube NE-A-2, and so forth. In addition, because there were distinct divisions on the western side of the pad, due to the presence of the thickeners and the filter fabric lined area, hot tub, the western half of the dewatering pad was divided into two distinct sections, the northwest section (NW) and the southwest (SW)

section. The same labeling scheme described above was used in the northwest and southwest quadrants of the pad.

TSCA material was dredged from POG3 starting July 18, 2006, and was completed on July 22, 2006. The TSCA sediments were dewatered in a separate geotextile tube located in the southwest corner of the pad, physically separated from the tubes containing non-TSCA sediments. The material from this tube was removed from the pad in mid-September, prior to the placement of any other tubes in the southwest corner.

Each of the geotextile tubes was initially filled to a height of 6 feet. When the geotextile tube reached 6 feet, the flow of dredge slurry to the tube was stopped to allow the water in the tube time to decant. After this, the tube was filled again, but never to a height greater than 6 feet. As the geotextile tubes gradually accumulated more solids, they filled to 6 feet more quickly and dewatered more slowly. While geotextile tubes were being filled, they were carefully observed for signs of rips, separations, or places where the geotextile fabric had been weakened.

With the addition of the thickeners there was no need to "work" the tubes as was the standard procedure in 2005. In 2006, the percent solids of the sediment slurry entering the tubes ranged from 15% - 35%, versus 2% - 3% in 2005. This allowed for a reduction in manpower required for the dewatering pad operations and for stacking on top of tubes within a day or two after they were taken off line.

Screenings were loaded out periodically during the project as needed and began in June. July 11, 2006, was the first day of load out of material from the geotextile tubes, with material from the contingency bag. Full scale load-out began on August 14, 2006. See Section 6.3 for a detailed description of the loading sequence.

5.6 Geotextile Tube Dewatering Results

Dewatered sediment was sampled from the geotextile tubes to determine free liquids (paint filter), percent solids (moisture content), and the required geotechnical data for disposal purposes. This section summarizes the geotextile tube sampling procedures and dewatering results.

5.6.1 Dewatered Sediment Sampling Overview

Two to three grab samples were obtained from each tube depending on its location in the stacking pyramid. All A, B, and C level tubes, excluding perimeter tubes, were sampled by completing one hand auger core on each exposed end. A photograph of dewatered sediment sample retrieval is provided in Appendix A, as photograph 13. A third sample was not collected from most of the level A, B, and C geotextile tubes, as the majority of these tubes were not completely exposed. Geotextile tubes on the perimeter and upper levels of the stacking pyramid were sampled at three locations as the entire tube surface was exposed. Vane shear measurements were completed at each sampling location prior to collecting the sediment sample. Vane shear measurements were completed to help in the determination of geotechnical strength characteristics. The thickness of each geotextile tube was poled or measured and then recorded upon completion of the grab sample. A hollow stem hand auger was used to obtain dewatered sediment samples. The auger consisted of a 3-inch-inside-diameter, cylinder type hand auger that removes one foot of sediment sample

each time it is advanced in the sample hole. All of the sample borings were advanced the entire thickness of the geotextile tube. Refusal was not encountered.

Sediment samples were extracted directly from the hand auger and transferred to a plastic-bag lined 5 gallon bucket. The hand auger was field cleaned between sample holes, however, it was not decontaminated as no PCB sampling was completed by this method. Each grab sample from the geotextile tubes that had two grab samples collected, were placed into separate durable plastic bags, homogenized within the bag, then analyzed for QC percent solids and free liquids. For geotextile tubes that had three grab samples collected, equal volumes of sample from each of the three sample locations were placed into a stainless steel bowl for homogenization to produce a single representative sample. This composite sample was then placed in a jar, cooled to 4 degrees Celsius, and sent to the laboratory for QA percent solids analyses. Results of the percent solids and free liquids tests are presented in Table 5-1.

5.6.2 Analytical Protocol

Dewatered sediment was sampled from each geotextile tube in order to obtain specific information required prior to landfill disposal and to evaluate the performance of the geotextile tubes. These parameters include: percent solids (moisture content) (ASTM D2216), free liquids content (Paint Filter Test in accordance with EPA Method 9095B Revision 2), and geotechnical strength characteristics (field vane shear ASTM D 2573-01). Additional geotechnical testing was completed on a deposit basis at a rate of one sample per 30,000 cy's of in-place sediment per deposit for the following parameters: consolidated-undrained triaxial compressive strength (ASTM D4767); consolidated-drained direct shear strength (ASTM D3080); Atterberg limits (ASTM D4318); and grain size distribution (ASTM D422).

5.6.3 Sampling Procedure

5.6.3.1 Geotextile Tube Sampling Procedure

Dewatered sediment was sampled in accordance with Appendix E of the 2006 RAWP. For the geotextile tubes on the lower levels of the stacking pyramid only two sample augers were advanced, one on each exposed end. Perimeter and upper level geotextile tubes required three hand auger advancements. These upper, exposed geotextile tubes were measured for total length. Sample locations were randomly placed over the width of each geotextile tube and equally spaced over the length. The sample locations were marked on the top of each geotextile tube to be sampled, and the locations were recorded on a field form. A small hole was cut in the top of the geotextile tube at each sample location. First, an in-situ vane shear test was performed in the sample hole, typically at the approximate midpoint of the geotextile tube thickness. The *in-situ* vane shear result and depth was recorded on the field form. In the small hole, a stainless steel hand auger was used to obtain a sample for the entire dewatered sediment thickness in the geotextile tube at each location. At no time was auger refusal observed. Finally, once the sample hole was completed the sediment probing rod was inserted to determine the total thickness of dewatered sediment in the geotextile tube.

Grab samples from each borehole were placed into a separate durable plastic bag and homogenized within the bag. During sample processing activities, each homogenized grab

sample was tested for free liquids using the Paint Filter test, and the results were recorded on the field form. A visual description of each grab sample was also documented on the field form. A QC percent solids analysis was completed for each sediment sample. Earth Tech and Foth personnel completed these tests on site. For final percent solids analysis, a portion of each of the homogenized grab samples was placed into individual 4-oz clear glass jars. An equal volume of sediment from each homogenized sample bag was placed into a stainless steel bowl for homogenization to produce one composite sample for percent solids analyses (placed in an 8-oz amber glass jar). A composite sample for geotechnical strength analyses was completed once for approximately every 30,000 cy dredged. The composite sample was placed in a durable plastic bag within a 5-gallon bucket for delivery to the geotechnical lab. A composite sample was also tested for free liquids in the field.

Undrained shear strength testing was originally required by the Veolia Environmental Services Hickory Meadows Landfill Plan of Operation Modification and the WDNR; however, since the dredged sediment was predominantly non-cohesive, consolidated-drained direct shear strength and consolidated-undrained triaxial compressive strength were tested alternatively.

5.6.3.2 Slurry Sampling

During the 2006 season composite samples of thickener slurry were collected prior to discharging to the geotextile tubes and analyzed for PCBs. A composite sample of the thickener slurry was collected over the course of one week during the 2006 RA activities. This was completed by thickener operators, every two hours during thickener operation, collecting an approximate 200 ml sample. Thickener operators recorded time of sample removal, geotextile tubes being filled at the time of the sample, and initials. Each two hour sample, over the course of an operational week, was placed in a covered, plastic bag lined, 5-gallon pail and stored in a cooler containing ice. At the end of each week, Foth removed the plastic bag from the pail and homogenized the week's samples. Upon completing homogenization, three equal aliquots of slurry were removed from the bag and placed in 4 ounce glass jars supplied by the laboratory. The samples were delivered to Pace Analytical for PCB analysis (Fox River Method) within the maximum 14-day holding time for PCBs. The PCB result for each week was recorded as the arithmetic average of the three aliquots.

Over the course of the 2006 RA activities a total of 72 aliquots of thickener slurry were sampled and analyzed for PCBs. The weekly average PCB values were all below 50 ppm for 2006. The weekly average PCB values ranged from a low of 0.80 to a high of 28 ppm, with the average for the entire season being 5.62 ppm.

5.6.3.3 Stockpile Sampling

In 2006, two new trammel screen units were installed to screen the sediment slurry prior to entering the thickener units, removing materials 1/8 inch or larger. The screened materials generally included gravel, larger wood chunks/chips, and foreign debris (golf balls, shotgun shells, fishing lures, etc.). Materials caught in the trammel screen were directed towards a conveyor belt which placed the materials in a stockpile on the dewatering pad. Periodically, as the pile grew in size, Foth sampled the pile for PCBs as required by the landfill for disposal purposes.

Foth followed Standard Practice for Sampling Aggregates (ASTM D75-87) to collect a representative sample for PCB analysis. The sampling procedure included using a 3" diameter hand auger to retrieve discrete samples from beneath the surface of the pile. Following ASTM D 75-87, a field technician used a hand auger in three locations from the lower, middle, and upper 1/3 of the stockpile. A spade shovel was pushed vertically into the pile just above the sampling point to help prevent further sample segregation. Each of the nine samples were placed into a plastic bag-lined 5-gallon bucket and homogenized into one composite sample. One aliquot was removed from the composite sample and placed into a 4 ounce glass jar for laboratory analysis.

Eleven stockpile composite samples were collected over the course of the 2006 sampling season. PCB analytical results ranged from 0.35 – 25.0 ppm with an average of 6.67 ppm.

5.6.4 TSCA Sediments

Geotextile tubes containing TSCA sediments were sampled using the same procedures as non-TSCA sediments for percent solids and free liquids testing. All TSCA sediments were transported to and disposed at EQ Wayne Disposal in Belleville, Michigan. In 2006, no PCB or TCLP sampling was completed on the dewatered TSCA material. Since the TSCA sediments for 2006 were within close proximity of the 2005 sediments, EQ Wayne Disposal elected to use analytical data from 2005 along with 2006 dredge prism characterization data for landfill permitting.

5.6.5 Sampling Frequency

Analyses for percent solids and free liquids content were completed for each geotextile tube. Vane shear testing was also performed for each geotextile tube. Geotechnical strength analyses were completed at a frequency of once for every 30,000 cubic yards of dredged sediment.

Geotextile tubes were sampled at a minimum, 30 days after the last discharge to the tube.

5.6.6 Percent Solids Results

A summary of the geotextile tube sampling results for Sub-areas POG2, POG3, POG4, C, D2S, and E1 for percent solids and free liquids is provided below in Table 5-1. Table 5-2 summarizes the data by sub-area. It should be noted that Table 5-1 shows that many of the geotextile tubes contained sediments from multiple sub-areas. The following method was used to obtain overall percent solid values for the individual sub-areas.

For average percent solids per sub-area, it was assumed that the result from the composite sample (shown in Table 5-1) represented, equally, all sub-areas contained within that geotextile tube. For example, the composite sample result for geotextile tube EA-1 is 54.7%. This result represents the percent solids from a composite of sediments from sub-areas C/D2S and POG3. In calculating the average it was assumed that C/D2S and POG3 both had a percent solid result of 54.7%. This method was carried through all geotextile tubes providing an average percent solid result by sub-area (Table 5-2). Average values, per sub-area, were calculated in the same manner for the geotechnical data with the results presented on Tables 5-3, 5-4, and 5-5.

Table 5-1

Dewatered Sediment Free Liquids and Percent Solids Results

Geotextile Tube Number	Circumference (ft) x Length (ft)	Contained Sub-Areas (s)	Date Taken Out of Service	Percent Solids Sample Date	Paint Filter Test Free Liquids	Percent Solids QA	Percent Solids QC Average
EA1	60 X 205	CD2S/POG3	5/8/06	6/8/06	Pass	54.7	53.3
EA2	60 X 205	CD2S/POG3	5/11/06	6/13/06	Pass	-	39.2
EA3	60 X 205	CD2S/POG3	5/13/06	6/13/06	Pass	-	46.8
EA4	60 X 205	CD2S/POG3	5/16/06	6/20/06	Pass	-	50.0
EA5	60 X 205	CD2S/POG3	5/23/06	6/27/06	Pass	-	41.5
EA6	60 X 205	CD2S/POG3	5/26/06	6/27/06	Pass	-	51.5
EA7	60 X 205	CD2S/POG3	6/20/06	7/25/06	Pass	-	58.0
EA8	60 X 205	POG3	7/1/06	8/8/06	Pass	-	48.0
EA9	60 X 205	POG3	7/11/06	8/14/06	Pass	-	34.6
EA10	60 X 205	POG3	7/18/06	8/28/06	Pass	-	52.2
EA11	60 X 205	POG3/POG4	8/2/06	9/7/06	Pass	-	43.5
EA12	60 X 205	POG3/POG4	8/4/06	9/14/06	Pass	-	44.1
EA13	60 X 205	POG3/POG4	8/8/06	9/14/06	Pass	-	41.9
EA14	60 X 205	POG3/POG4	8/16/06	9/20/06	Pass	-	46.3
EA15	60 X 205	POG2/POG3/POG4	8/25/06	9/26/06	Pass	-	43.3
EA16	60 X 205	POG2/POG3	8/31/06	10/3/06	Pass	-	37.2
EA17	60 X 205	POG2/POG3/ POG4	8/31/06	10/3/06	Pass	-	34.8
EA18	60 X 205	POG2/POG3	9/6/06	10/10/06	Pass	33.6	33.5
EB1	60 X 190	CD2S/POG3	5/18/06	6/20/06	Pass	50.4	48.0
EB2	60 X 190	CD2S/POG3	5/19/06	6/20/06	Pass	-	40.0
EB3	60 X 190	CD2S/POG3	5/23/06	6/27/06	Pass	-	41.5
EB4	60 X 190	CD2S/POG3	6/14/06	7/18/06	Pass	-	53.5
EB5	60 X 190	CD2S/POG3	6/15/06	7/18/06	Pass	-	53.0
EB6	60 X 190	POG3	6/26/06	8/3/06	Pass	-	56.5

Geotextile Tube Number	Circumference (ft) x Length (ft)	Contained Sub-Areas (s)	Date Taken Out of Service	Percent Solids Sample Date	Paint Filter Test Free Liquids	Percent Solids QA	Percent Solids QC Average
EB7	60 X 190	POG3/POG4	7/25/06	8/28/06	Pass	-	39.0
EB8	60 X 190	POG3/POG4	7/25/06	8/28/06	Pass	-	54.6
EB9	60 X 190	POG3/POG4	7/28/06	8/28/06	Pass	-	43.6
EB10	60 X 190	POG3/POG4	8/8/06	9/14/06	Pass	-	41.8
EB11	60 X 190	POG3/POG4	8/11/06	9/14/06	Pass	-	38.4
EB12	60 X 190	POG3/POG4	8/14/06	9/20/06	Pass	-	42.2
EB13	60 X 190	POG3/POG4	8/24/06	9/26/06	Pass	-	51.3
EB14	60 X 190	POG2/POG3	8/29/06	10/3/06	Pass	-	32.6
EB15	60 X 190	POG2/POG3	9/6/06	10/10/06	Pass	-	34.4
EB16	60 X 190	POG2/POG3	9/13/06	10/18/06	Pass	-	32.4
EB17	60 X 190	POG2/POG3	9/13/06	10/18/06	Pass	36.0	35.0
EC1	60 X 175	CD2S/POG3	6/5/06	7/13/06	Pass	61.6	60.3
EC2	60 X 175	CD2S/POG3	6/5/06	7/13/06	Pass	-	46.0
EC3	60 X 175	POG3	6/16/06	7/18/06	Pass	-	61.5
EC4	60 X 175	POG3	6/22/06	7/25/06	Pass	-	57.0
EC5	60 X 175	POG3	6/30/06	8/8/06	Pass	-	44.9
EC6	60 X 175	POG3/POG4	7/27/06	8/24/06	Pass	-	48.5
EC7	60 X 175	POG3/POG4	8/1/06	9/7/06	Pass	-	44.9
EC8	60 X 175	POG3/POG4	8/1/06	9/7/06	Pass	-	45.3
EC9	60 X 175	POG3/POG4	8/9/06	9/14/06	Pass	-	43.3
EC10	60 X 175	POG3/POG4	8/16/06	9/20/06	Pass	-	42.7
EC11	60 X 175	POG3/POG4	8/17/06	9/20/06	Pass	-	44.6
EC12	60 X 175	POG3/POG4	9/1/06	10/3/06	Pass	-	34.9
EC13	60 X 175	POG2/POG3	9/6/06	10/10/06	Pass	-	35.5
EC14	60 X 175	POG2/POG3	9/12/06	10/18/06	Pass	-	38.3
EC15	60 X 175	POG2	9/18/06	10/24/06	Pass	-	32.6

Geotextile Tube Number	Circumference (ft) x Length (ft)	Contained Sub-Areas (s)	Date Taken Out of Service	Percent Solids Sample Date	Paint Filter Test Free Liquids	Percent Solids QA	Percent Solids QC Average
EC16	60 X 175	POG2	9/19/06	10/24/06	Pass	28.0	27.9
ED1	60 X 160	CD2S/POG3	6/12/06	7/13/06	Pass	62.3	59.0
ED2	60 X 160	POG3	6/21/06	7/25/06	Pass	70.0	71.7
ED3	60 X 160	POG3	6/30/06	8/3/06	Pass	58.7	58.7
ED4	60 X 160	POG3	7/11/06	8/14/06	Pass	32.7	32.2
ED5	60 X 160	POG3/POG4	8/1/06	8/24/06	Pass	48.3	48.0
ED6	60 X 160	POG3/POG4	8/4/06	8/6/06	Pass	41.1	41.2
ED7	60 X 160	POG3/POG4	8/4/06	8/7/06	Pass	43.4	42.6
ED8	60 X 160	POG3/POG4	8/15/06	9/14/06	Pass	47.9	45.2
ED9	60 X 160	POG3/POG4	8/21/06	9/26/06	Pass	49.0	47.9
ED10	60 X 160	POG3/POG4	8/28/06	9/26/06	Pass	39.9	41.7
ED11	60 X 160	POG2/POG3	9/5/06	10/10/06	Pass	36.7	36.8
ED12	60 X 160	POG2/POG3	9/11/06	10/18/06	Pass	36.9	36.5
ED13	60 X 160	POG2/POG3	9/18/06	10/30/06	Pass	25.5	25.8
ED14	60 X 160	POG2	9/19/06	10/30/06	Pass	27.7	27.0
ED15	60 X 160	POG2	9/21/06	10/30/06	Pass	25.4	25.0
NWA1	60 X 205	POG2	9/18/06	10/24/06	Pass	31.4	31.7
NWA2	60 X 205	POG2/POG3	9/14/06	10/18/06	Pass	-	33.9
NWA3	60 X 205	POG2,3,4/CD2S	9/7/06	10/10/06	Pass	-	30.5
NWA4	60 X 205	POG2/POG3	9/12/06	10/18/06	Pass	-	34.3
NWA5	60 X 205	POG2/POG3	9/19/06	10/24/06	Pass	-	34.1
NWA6	60 X 205	POG2	9/20/06	10/24/06	Pass	31.7	30.8
NWB1	60 X 190	POG2/POG3	9/26/06	10/30/06	Pass	34.0	34.4
NWB2	60 X 190	POG2	9/20/06	10/24/06	Pass	-	29.2
NWB3	60 X 190	POG2	9/20/06	10/24/06	Pass	-	31.5
NWB4	60 X 190	POG2/POG3	9/26/06	10/30/06	Pass	-	34.7

Geotextile Tube Number	Circumference (ft) x Length (ft)	Contained Sub-Areas (s)	Date Taken Out of Service	Percent Solids Sample Date	Paint Filter Test Free Liquids	Percent Solids QA	Percent Solids QC Average
NWB5	60 X 190	POG2/POG3	10/11/06	11/13/06	Pass	31.6	32.1
NWC1	60 X 175	POG2/POG3	10/2/06	11/8/06	Pass	30.0	28.5
NWC2	60 X 175	POG2/POG3	9/26/06	10/30/06	Pass	-	37.1
NWC3	60 X 175	POG2/POG3	10/6/06	11/13/06	Pass	32.5	31.5
NWC4	60 X 175	POG2/POG3	11/7/06	12/11/06	Pass	35.2	32.8
NWD1	60 X 160	POG2/POG3	10/4/06	11/14/06	Pass	29.1	28.8
NWD2	60 X 160	POG2/POG3	10/11/06	11/14/06	Pass	30.5	29.6
SWA0	60 X 205	Water Treatment	11/16/06	1/8/07	Pass	33.1	-
SWA1	60 X 205	POG2/POG3	10/19/06	12/1/06	Pass	38.7	40.5
SWA2	60 X 205	POG2/POG3	10/5/06	11/13/06	Pass	-	32.7
SWA3	60 X 205	POG2/POG3	10/5/06	11/13/06	Pass	-	32.4
SWA4	60 X 205	POG2/POG3	10/5/06	11/13/06	Pass	-	33.3
SWA5	60 X 205	POG2/POG3	10/11/06	11/13/06	Pass	-	31.8
SWA6	60 X 205	POG2/POG3	10/11/06	11/13/06	Pass	32.2	31.4
SWB1	60 X 190	POG2/POG3	10/27/06	11/8/06	Pass	27.0	25.6
SWB2	60 X 190	POG2/POG3	10/24/06	12/1/06	Pass	-	36.0
SWB3	60 X 190	POG2/POG3	10/17/06	12/1/06	Pass	-	31.9
SWB4	60 X 190	POG2/POG3	10/18/06	12/1/06	Pass	-	32.4
SWB5	60 X 190	POG2/POG3	10/31/06	12/1/06	Pass	36.8	37.6
SWC1	60 X 175	POG2/POG3/ E1S	11/9/06	12/11/06	Pass	29.2	28.9
SWC2	60 X 175	POG2/POG3	11/9/06	12/11/06	Pass	28.6	27.0
SWC3	60 X 175	POG2/POG3	11/9/06	12/11/06	Pass	27.8	27.9
NEA1	60 X 205	POG2/POG3	9/26/06	10/30/06	Pass	39.9	39.1
NEA2	60 X 205	POG2/POG3	9/26/06	10/30/06	Pass	-	33.6
NEA3	60 X 205	POG2/POG3	9/26/06	10/30/06	Pass	-	40.3
NEA4	60 X 205	POG2/POG3	9/27/06	10/30/06	Pass	-	35.7

Geotextile Tube Number	Circumference (ft) x Length (ft)	Contained Sub-Areas (s)	Date Taken Out of Service	Percent Solids Sample Date	Paint Filter Test Free Liquids	Percent Solids QA	Percent Solids QC Average
NEA5	60 X 205	POG2/POG3	10/6/06	11/13/06	Pass	-	31.6
NEA6	60 X 205	POG2/POG3	10/10/06	11/13/06	Pass	-	31.5
NEA7	60 X 205	POG2/POG3	10/19/06	12/1/06	Pass	-	36.6
NEA8	60 X 205	POG2/POG3	10/24/06	12/1/06	Pass	-	34.0
NEA9	60 X 205	POG2/POG3	10/24/06	12/1/06	Pass	39.2	36.7
NEA10	60 X 205	POG2/POG3	11/9/06	12/13/06	Pass	32.7	31.9
NEA11	60 X 205	POG2/POG3	11/15/06	12/20/06	Pass	30.6	30.6
NEA12	60 X 205	POG2/POG3	11/15/06	12/20/06	Pass	34.1	33.6
NEA13	60 X 205	POG2/POG3	11/15/06	12/20/06	Pass	31.5	32.6
NEA14	60 X 205	POG2/POG3	11/16/06	12/20/06	Pass	29.7	29.9
NEB1	60 X 190	POG2/POG3	10/6/06	11/8/06	Pass	29.0	27.9
NEB2	60 X 190	POG2/POG3	10/6/06	11/13/06	Pass	-	32.7
NEB3	60 X 190	POG2/POG3	10/6/06	11/13/06	Pass	-	31.2
NEB4	60 X 190	POG2/POG3	10/13/06	11/13/06	Pass	-	31.6
NEB5	60 X 190	POG2/POG3	10/17/06	12/1/06	Pass	38.3	37.1
NEB6	60 X 190	POG2/POG3	11/9/06	12/20/06	Pass	28.2	27.8
NEB7	60 X 190	POG2/POG3	11/9/06	12/20/06	Pass	30.8	30.1
NEB8	60 X 190	POG2/POG3	11/9/06	12/20/06	Pass	30.5	30.6
NEC1	60 X 175	POG2/POG3	11/9/06	12/13/06	Pass	35.6	32.9
NEC2	60 X 175	POG2/POG3	11/9/06	12/13/06	Pass	32.2	33.0
NEC3	60 X 175	POG2/POG3	11/9/06	12/13/06	Pass	30.2	34.7
NEC4	60 X 175	POG2/POG3	11/9/06	12/13/06	Pass	32.4	31.4
T1	60 X 160	POG3 TSCA	7/22/06	8/18/06	Pass	-	69.8

Prepared By: TAG

Checked By: NED

Table 5-2

Dewatered Sediment Free Liquids Percent Solids Data Summary

Sub Area	Paint Filter Test (Free Liquids)	Percent Solids Average (QA)	Percent Solids Range (QA)	Percent Solids Average (QC)	Percent Solids Range (QC)
C/D2S	Pass	57.3	50.4 – 62.3	48.3	30.5 – 60.3
POG2	Pass	31.2	25.4 – 39.9	32.6	25.0 – 40.5
POG3	Pass	37.4	25.5 – 70.0	39.5	25.6 – 71.7
POG4	Pass	44.9	39.9 – 49.0	43.2	30.5 – 54.6
E1	Pass	29.2	29.2	28.9	28.9

Prepared By: TAG

Checked By: NED

5.6.7 Dewatered Sediment Geotechnical Characteristics

In accordance with WDNR *Conditional Plan of Operations Approval Modification – Special Waste Acceptance Plan for Dredged Material Disposal at the Veolia Environmental Services Hickory Meadows Landfill,* dated September 29, 2005, dewatered sediment from OU-1 was tested for: 1) percent solids / moisture content (ASTM D2216 or 2974); and 2) Unconfined Compressive Strength (UCS) (cohesive soils only) (ASTMD2166 or pocket penetrometer) or Undrained Shear Strength (ASTM D2573 or D4648). In addition, Appendix J of the 2006 Remedial Action Work Plan "*2006 RA Loading, Transportation, and Disposal Plan*", required dewatered sediment to be tested for Grain Size Distribution (ASTM D422); Triaxial Shear (ASTM D2573 or D4648); Consolidation (ASTM D2435); Hydraulic Conductivity (ASTM 5084), and Atterberg Limits (ASTM 4318). Composite samples analyzed for these parameters were collected at an approximate frequency of one per 30,000 cy.

Gradation analysis was performed for dewatered sediments from sub-areas C/D2S, POG2, POG3, POG4, and E1. Referring to Table 5-3 below, the sediment in sub-areas POG2, and POG4 can be characterized as fine grained (i.e. P200 > 50%). Sub-areas C/D2S, POG3, and E1, are characterized as coarse grained (ie P200 < 50%). The absence of gravel sized sediment is likely due to the result of the 1/8-inch trammel screen removing the gravel and probably some coarse sand from the dredge slurry before it was consolidated in the thickeners and pumped to the geotextile tubes.

Table 5-3
Dewatered Sediment Gradation

Sub-area	Clay (%) D422	Silt (%) D422	Sand (%) D6913	Gravel (%) D6913
C/D2S	**3.9**	**29.1**	**67.0**	**0.0**
POG2	**16.1/19.5**	**37.1/39.5**	**46.8/41.0**	**0.0/0.0**
POG3	**2.7/8.6**	**23.3/41.6**	**74.0/49.8**	**0.0/0.0**
POG4	**5.1**	**45.8**	**49.1**	**0.0**
E1	**9.9**	**35.0**	**55.1**	**0.0**

Note: Refer to Appendix J for a complete listing of gradation test results.

Prepared by: TAG
Checked by: NED

Testing for Atterberg limits was also performed on dewatered sediment samples to determine plasticity. With the exception of one of the samples from POG3 (determined granular, non-plastic) the sediments are classified as either fat clay (CH), organic silt (OH), or elastic silt (MH). Atterberg limits values of the sediments within each sub-area are summarized in Table 5-4.

Table 5-4
Dewatered Sediment Atterberg Limits

	Liquid Limit (LL) D4318	Plastic Limit (PL) D4318	Plasticity Index (PI) D4318	USCS Classification
Sub-area C/D2S	59.0	38.0	21.0	MH/OH
Sub-area POG2	204.0	68.0	136.0	CH
Sub-area POG2	160.0	73.0	87.0	CH
Sub-area POG3	NL	NP	0.0	-
Sub-area POG3	131.0	86.0	45.0	MH/OH
Sub-area POG4	88.0	35.0	53.0	CH
Sub-area E1	204.0	101.0	103.0	MH

Refer to Appendix J for a complete listing of Atterberg Limits test results.

Prepared by: TAG
Checked by: NED

Following a period of dewatering within a geotextile tube, sediment was sampled from predetermined locations within each geotextile tube and field tested for strength using in-situ field vane shear ASTM 2573. Sample location, and frequency within each geotextile tube was based upon geotextile tube size and associated sediment volume (refer to Section 5.6.5 Dewatered Sediment Sampling). The test was conducted using a calibrated GEONOR H-60 Field Vane device. Average results of the Field Vane Shear test are provided in Table 5-5.

Unconfined Compressive Strength (UCS) testing (ASTM D2166) was required to further characterize the dewatered sediment. To perform this test, a sample to be tested is molded

into a cylindrical shape with height equal to twice the cylinder's diameter. Dewatered sediment collected for UCS testing ranged from 26.7 percent to 57.2 percent solids. Laboratory test results for UCS ranged from less than 0.20 tsf, to sediment not capable of retaining its shape under its own weight. UCS can also be estimated by doubling the result of the field vane shear (tsf). These results ranged from 0.6 (tsf) to 0.0 (tsf). The Veolia Environmental Services Hickory Meadows Landfill, LLC (Veolia Environmental Services) is permitted to accept normal and low strength dewatered sediment for disposal. Normal strength dewatered sediment should be 50% solids or greater, with a UCS > 0.4 tsf, and have an undrained shear strength > 400 psf. Low strength dewatered sediment should be 20-50% solids, with a UCS > 0.1 tsf. In addition, because of the uncertainty regarding the physical properties of the dewatered river sediment from the Lower Fox River, Veolia Environmental Services, and GW Partners agreed to a workability standard that requires the sediment to have the ability to support its own weight, support the weight of material placed over it, be capable of holding a 3H:1V slope under dynamic conditions, and be capable of being worked and managed by the landfill's low ground pressure bulldozer to be considered workable.

While there were samples tested that achieved the required percent solids and met the estimated UCS for normal strength testing, none of the sediment passed the "Baseline Workability/Strength Requirements" of being capable of being worked and managed by the disposal site's low ground pressure bulldozer. As a result, almost all of the dewatered river sediment was required to be handled and disposed of as low strength material.

Table 5-5
Dewatered Sediment Field Vane Shear Tests

Sub-area	Vane Shear ASTM D2573 (tsf) MIN/MAX/AVE	Estimated UCS ASTM D2166 (tsf) MIN/MAX/AVE
CD2S	0.2/0.5/0.3	0.4/1.0/0.6
POG2	0.0/0.3/0.1	0.0/0.6/0.2
POG3	0.1/0.5/0.2	0.2/1.0/0.4
POG4	0.1/0.3/0.2	0.2/0.6/0.4
E1	0.1/0.1/0.1	0.2/0.2/0.2

Note: Refer to Appendix J for a complete listing of Field Vane Shear test results.
Vane Shear * 2 = UCS

Prepared by: TAG
Checked by: JOS1

5.6.8. Amendment Evaluation

During the 2006 activities an evaluation was made to determine the feasibility and cost effectiveness of adding a wood by-product to the sediment in an attempt to make the sediment "workable" at the landfill. The material chosen was a waste product from a nearby sawmill, and consisted of a sawdust type material. This was selected due to its low cost and relative abundance. Approximately 100 cubic yards of the sawdust material was used in the trials. The sawdust was mixed with the dewatered sediment from the tubes using the excavator/clamshell. Once the material was mixed with the sediment it was loaded onto trucks for disposal at Hickory Meadows. Upon arriving at the landfill the

amended sediment from several trucks was dumped unto the ground where a low pressure dozer was used to move the material, in the typical manner that the sediment is handled.

These trials indicated that the strength of the sediment was improved by amending it with sawdust. However, after adding varying amounts of the sawdust material to the sediment, up to 4:1 sawdust to sediment (on a volume basis), it was determined the material, while marginally improving the strength of the sediment, was not a cost effective solution and the sawdust admixture approach was abandoned.

5.6.9 Piezometer Monitoring Results

As part of the 2006 Remedial Action Work Plan, GW Partners committed to the WDNR to evaluate the geotextile tube dewatering rate. To achieve this objective, STS instrumented several geotextile tubes with vibrating wire piezometers to measure and record pore pressures.

A total of six geotextile tubes were instrumented using the piezometers. The piezometers were left in place as long as possible to obtain the maximum number of readings from each installation. The piezometers recorded hourly temperature and pressure readings from each geotextile tube.

The maximum piezometer readings observed in the field were less than 5 kilopascals, more than an order of magnitude less than expected. Additionally, the piezometer readings showed a corresponding increase in pore pressure due to filling the geotextile tubes above the instrumented tube; however, the recorded increase in pore pressures were not consistent, in that the increases were relatively small.

To date, the length of time each geotextile tube is allowed to dewater on the dewatering pad is a function of the space requirements needed to maintain dredging rather than achieving optimum dewatering. STS instrumented several geotextile tubes to monitor pore pressure dissipation to develop a graph of pore pressure dissipation versus time in an attempt to optimize dewatering. In general, the results were as expected, a temporary increase in pore pressure can be correlated to the filling of geotextile tubes above the instrumented tube and pore pressure readings decreasing over time as the geotextile tubes dewatered. However, the magnitude of the pore pressures observed in the geotextile tubes was more than an order of magnitude lower than expected, making it difficult to distinguish changes in pore pressure due to loading or changes in pore pressure due to barometric pressure.

Based on the field observations and the pore pressure data collected from the geotextile tubes, it is STS' opinion that dewatering continues over time, but only to the extent that sediment can gravity drain through the geotextile tube. The observed pore pressures of geotextile tubes in the first, second, third, or top layer were all in the same range, typically 2-3 kilopascals. As such, using pore pressure data to optimize geotextile tube dewatering is not practical using the instruments employed with the study.

Please refer to Appendix K for the January 26, 2007, dewatering rate study.

SECTION 6

Dewatered Sediment Load-out, Transportation, and Disposal

6.1 Dewatered Sediment Load-out, Transportation, and Disposal

The load-out, transportation, and disposal (LTD) of the dewatered sediment removed during the 2006 dredging season began on August 14, 2006. As in 2005, the load-out, which involved the removal of both TSCA and non-TSCA sediments, was contracted to J.F. Brennan Company (Brennan) of La Crosse, Wisconsin. Transportation of dewatered non-TSCA sediment was contracted with Frederickson Trucking of Kaukauna, Wisconsin. Non-TSCA sediment was disposed of at Veolia Environmental Services Hickory Meadows Landfill in the Town of Chilton, Wisconsin. The transportation and disposal of TSCA sediment is planned for completion in early March 2007 as contracted with EQ Wayne Disposal of Belleville, Michigan.

During 2006, Brennan had three pieces of equipment onsite for the load-out activities. These included: one 950 Case excavator outfitted with a clamshell. This was the main piece of equipment used for load-out. The clamshell bucket had a capacity of approximately 2.5 cubic yards and had proven capable of removing the sediment from the geotextile tubes, and loading the material into dump trucks, in an effective and efficient manner. Brennan also had onsite one 360 Hyundai excavator with a standard bucket. This piece of equipment was used as a backup, should mechanical issues develop with the Case excavator. The third piece of equipment that was used is a 950 Caterpillar loader. The loader was used primarily to maintain the haul road located within the dewatering pad.

In 2006, the sediment handling process was similar to 2005 with the exception of the addition of two thickeners, each outfitted with a trammel screen. With the implementation of the use of the thickeners stacking of the tubes occurred much more rapidly after the retirement of a tube, than in 2005. Because of this, material from several bags was removed at the same time during the loading process (refer to Figure 5-2). Typically, there was material from tubes on four different layers being loaded simultaneously.

The screens were added to remove material greater than 1/8 inch in diameter from the dredge slurry prior to its introduction to the thickeners. This material, commonly referred to as “screenings” was allowed to accumulate in a pile located adjacent to the screens. A photograph of these screenings is provided in Appendix A, photograph 23-A. The first LTD activities of 2006 occurred on June 6, 2006, approximately a month after the initiation of dredging activities. At this same time retired media from the Krofta, which had been placed on the pad a few days earlier when it had been removed from the unit, was loaded, transported and disposed at Hickory Meadows.

The LTD activities associated with the dewatered sediments in the tubes initially began on July 11, 2006, with the removal of material from the first contingency tube, which was located in the northwest quadrant of the pad. Full scale LTD operations began on August 14, 2006 with the load-out of material from geotextile tubes situated in the northeast corner of the dewatering pad. The initial LTD on the east began with material from tubes E-A-1, E-A-2, E-B-1, E-B-2, E-C-1, and E-D-1. Once this material had been removed, the excavator proceeded to the south in an orderly fashion, continuing to remove the material from approximately six tubes at one time, until all of the material in bags located on the eastern side of the pad had been removed. This was completed on November 29, 2006. The LTD activities followed the filling sequence of the tubes, as detailed in Section 5, so as to allow maximum drying time of the sediment.

LTD activities in the northwest section of the pad began on November 29, 2006, with material from tubes NW-A-1, NW-A-2, NW-B-1, NW-B-2, NW-C-1, NW-C-2, and NW-D-1. The LTD of all material in the northwest section of the pad was completed on December 21, 2006. There were no LTD activities from December 22, 2006 until January 2, 2007 due to the holiday season. LTD activities associated with the material from tubes in the southwest section of the pad began on December 21, 2006, and were completed on January 22, 2007. The removal of the bags placed during the second rotation on the east side of the pad began on January 23, 2006, and is planned for completion in early March 2007.

6.1.1 Sampling Plan

The original load-out plan determined that the material on the east side of the dewatering pad would be removed from the pad first. This was due to the fact that the geotextile tubes on the east side of the pad had been offline longer because they had been filled first. This additional time that the material sat in the geotextile tubes was assumed to have aided de-watering. However, the geotextile tubes on the east side of the dewatering pad had been stacked four high, and in previous year's stacking posed problems for sampling the sediment in the tubes, specifically the tubes on the bottom row. After discussing the proposed layout of the geotextile tubes for 2006 with the Foth sampling team, the load-out and sampling plan was confirmed.

The 2006 sampling plan was based on dewatered sediment testing requirements for the Veolia Environmental Services Hickory Meadows Landfill, as specified by the September 29, 2005 "Conditional Plan of Operation Approval Modification – Special Waste Acceptance Plan for Dredged Material Disposal," (Permit). Sampling of the material in the geotextile tubes consisted of one sample for approximately every 3,000 cubic yards of sediment. This sample was analyzed for percent solids/moisture content and vane shear/undrained shear strength. In addition, one sample for approximately every 30,000 cubic yards of material was collected and analyzed for grain size distribution, triaxial shear, consolidation, hydraulic conductivity, and Atterberg limits. The dredge slurry being sent to the thickeners was sampled every two hours during operations and these samples were combined to form one composite sample per week, which was analyzed for PCB concentration. Finally, the material that had been removed during the screening process was sampled approximately once per month and analyzed for PCB concentration, prior to its transport to the landfill.

A detailed description of the sampling procedures can be found in Section 5.6 and in Appendix L, which contains the "Geotube Sediment Sampling Plan 2006" and a memo regarding "Dewatered Sediment PCB Sampling Plan".

6.1.2 Loading and Transport of Non-TSCA Sediment

As in previous years, GW Partners contracted with Frederickson Trucking of Kaukauna, Wisconsin, to perform the non-TSCA transportation phase of the 2006 RA activities. Trucks that were used for the transportation activities had been previously outfitted with permanent liners. In addition, tarps were employed to cover the sediment during transport, and tailgates with rubber seals and turnbuckles were used to ensure that there was no leakage of material during the transportation of the material to the landfill. There were also several occasions when disposable plastic liners were used because temperature conditions were such that they caused the sediment to stick to the sides of the trucks.

The LTD activities associated with the sediment contained in the geotextile tubes began daily between 6:00 and 6:30 a.m. and continued until approximately 3:00 p.m. at the staging area. The hours of operation at the landfill were 6:30 a.m. to 4:00 p.m. The schedule relating to LTD was re-evaluated on a weekly basis to ensure that all of the sediment was removed from the de-watering pad in time to allow preparations of the pad for the 2007 RA work. Once load-out was in full-scale operation, a target of 4,000 tons removed from the pad on a weekly basis was selected. This value, along with target and the starting date of August 14, 2006 start date for the removal of sediment from the pad, was were chosen because of the need to remove the material from the east side of the pad so that this area could be filled a second time.

At the staging area, trucks entered through the south entrance and proceeded along the marine access road and turned north towards the dewatering pad and then east where they proceeded along the berm until they again turned north and entered the pad along the haul road in the center of the dewatering pad. The trucks then continued on to the area where they were loaded. A photograph of loading operation is provided in Appendix A, photograph 23-B. This year the temporary mats, which had been used in the past, were not required. After the trucks were loaded they proceeded forward and exited the pad to the west along the north berm. Prior to leaving the site, the trucks were cleaned in the decontamination area.

A decontamination building was erected in December 2005, over the decontamination pad located on the northwest side of the site. The decontamination staff sprayed the trucks as they entered the decontamination building to remove any sediment placed on the trucks by the loading process. Once the trucks were sprayed clean, they entered the decontamination building, where scaffolding had been positioned on each side of the building. This allowed de-contamination personnel to clean the top rails of the truck before a tarp was positioned over the sediment in the box of the truck. Once the tarp was fastened into place, the decontamination process was complete and the trucks proceeded to the landfill. A photograph of the decontamination process is provided in Appendix A, photograph 23-C.

Disposal of the OU1 non-TSCA sediment was contracted to Veolia Environmental Services Hickory Meadows Landfill in the Town of Chilton, Wisconsin. Upon arrival at the landfill, trucks were weighed. They then proceeded into the landfill. During 2006, unworkable

materials were disposed of in specified monofills. In 2005 two monofills were constructed and in 2006, a third monofill was constructed and began receiving sediment.

Monofill 1 was determined to be full as of December 12, 2005. In 2006, the filling of Monofill 2 was completed. Monofill 2 had a certified capacity of 73,110 cubic yards and was deemed full on November 7, 2006, after receiving a total of 105,288 tons of unworkable sediment. On November 8, 2006, the first sediment was placed into Monofill 3, which has a capacity of more than 100,000 cubic yards. GW Partners has reserved 80,000 cubic yards of this space for sediment from the OU1 project. At the completion of LTD activities associated with the 2006 remedial work 52,696 tons of unworkable sediments had been placed in Monofill 3.

All workable material was disposed in specific areas on the landfill's working face and co-mingled with municipal waste as directed by Veolia Environmental Services personnel. During 2006, the majority of the sediment was deemed unworkable at the landfill and, therefore, placed into the monofills. A total of 100,412 tons of non-TSCA material was disposed at Hickory Meadows landfill. This material was made up of 95,679 tons of unworkable sediment, 409 tons of workable sediment, 3,289 tons of screening (all workable), 201 tons of water treatment plant media (all workable) and 834 tons of gravel from the de-watering pad work in March, 2006 (all workable).

After disposing of the materials, the trucks proceeded to the landfill decontamination area. The trucks were again sprayed to remove any sediment that may have been placed on the truck or tires during the disposal process. After decontamination, the trucks would leave the landfill and return to the OU1 facility. The trucks would typically make five turns on a daily basis.

6.1.3 Loading and Transport of TSCA Sediment

GW Partners contracted with The disposal of TSCA sediments has been contracted to EQ Wayne Disposal of Belleville, Michigan, for the disposal of OU1 TSCA sediments.. TSCA sediments were removed from one location of OU1 in 2006, the southern portion of Sub-area POG3. LTD activities for the TSCA material began in 2006 and proceeded until all of the TSCA material had been removed from the pad. Onsite loading hours for the TSCA material varied daily due to the LTD activities associated with the non-TSCA sediment. In 2005 concerns with free water on top of the sediment when the trucks arrived at the disposal facility required that amendment material and drying agents be added before the trucks containing the TSCA sediment left the pad. This issue did not occur in 2006. Up to ten trucks were employed to transport the material to the EQ Wayne Disposal site in Belleville, Michigan. The total amount of TSCA material disposed in 2006 was 626.18 tons.

6.1.4 LTD Schedule

As mentioned above, the LTD activities began on August 14, 2006. Initially the goal was to remove enough sediment to have the dewatering pad cleared of all sediment by the end of March so that one month could be reserved to prepare the pad for 2007 operations. However, a decision was made to begin the 2007 in-water remedial activities on April 1, 2007, which meant that the pad had to be empty by the end of February. This was accomplished, as the last sediment was removed from the pad on March 20, 2007.

SECTION 7

Water Treatment Plant

7.1 Process Description

Water from the dewatering pad carriage water sump was pumped to the water treatment plant (WTP), which, at the beginning of the 2006 remedial action activities, consisted of:

- A chemical conditioning system
- A Krofta Sandfloat SAF-BP unit (combined dissolved air flotation [DAF] clarifier and sand media bed filter), Appendix A – photographs 24 and 25
- GAC vessels, Appendix A – photograph 26
- A sludge tank
- A non-potable water tank

During the 2006 operations five bag filter units were added to the process at the Agencies' direction. These bag filters are shown in Appendix A, photographs 27, 28, and 29. This addition is detailed below. In addition, injection points for the introduction of chlorine were installed at several locations in the treatment plant. Finally, a city water line was run to the WTP to aid in the treatment process. The process flow diagram for the current WTP configuration is shown on Figure 7-1.

During the 2006 remedial activities, the WTP was operated by Earth Tech personnel, a subcontractor to Brennan. At the beginning of operations Earth Tech personnel were asked to identify any concerns that needed to be addressed in the WTP to improve operations. On June 5, 2006, Earth Tech issued a memo expressing potential problems, which was subsequently followed by an additional memo issued June 13, 2006. These memos are included in Appendix M. The concerns that were identified were discussed with the project team and addressed in conjunction with the installation of the bag filters and as the operations proceeded throughout the summer. A summary of some of the more significant water treatment plant issues that were identified and addressed are as follows:

- Effluent Meter: the effluent meter was inaccurate when the effluent valve is 100% open. To address, a trap in the effluent line was incorporated, along with an air release valve.
- Influent Piping: The inlet meter to the Krofta had an accuracy problem caused by air buildup. To address, an air valve was installed.
- ADT System: The ADT System was supplied water from the same header as the Krofta filter water pumps. The smaller ADT pump competed with the larger filter water pumps for available water. At the lower flow rates the ADT system had some limited success. At higher flow rates, hydraulic and design issues did not permit the

ADT system to operate as designed. To address this problem, the pump was relocated.

- Chemical Feed: The need to introduce sodium hypochlorite to four locations within the water treatment process was identified. To address, chemical feed points were added.

The plant influent was pumped from the dewatering pad into the Sandfloat unit by Godwin pumps, Appendix A – photograph 30, where suspended solids were removed with dissolved air flotation and sand filtration. Effluent from the Sandfloat was pumped directly through the GAC vessels for final treatment before discharge into the river. A portion of the effluent from the GAC vessels was stored in the non-potable water tank for plant use for dry polymer makeup water, and backwash cycles.

Sludge from the DAF portion of the Sandfloat was sent to the sludge tank before being pumped back into the geotextile tubes. GAC backwash water was discharged directly to the geotextile tube dewatering pad.

Through the majority of the 2006 RA, the WTP was operated on a 24 hour/day, 5 day a week (24/5) schedule.

The WTP was designed to remove suspended solids and dissolved organics such as PCBs. Table 7-1 shows the average TSS concentrations throughout the 2006 RA at various locations in the treatment system based on QC sampling performed by Brennan.

Table 7-1
Water Treatment System
Average Total Suspended Solids

Krofta Influent Composite (mg/L)	Krofta Effluent Composite (mg/L)	WTP Effluent Composite (mg/L)
9.64	4.55	3.04

mg/L = milligrams per liter

7.2 Sandfloat Upgrades and Operation

During the majority of the 2006 RA, two 8-inch hydraulic dredges operated on a 24/hour day, 5 day per week (24/5) schedule. As a result, the Sandfloat needed to operate continuously (as per its design). Prior to the start of 2006 operations a sample of the media was collected and sent Krofta for analysis. A copy of this report is attached in Appendix N.

When 2006 operations began it was immediately evident that the design flow of 4,000 gpm was not achievable. As such, after an examination of the condition of the media and discussions with Krofta personnel, the Sandfloat media was replaced during the weekend of May 19-21 and the underdrain system was cleaned. In addition, several other upgrades to the Sandfloat unit were performed, as identified by Earth Tech. These included; the relocation of the ADT pump, installation of additional chemical feedlines, installation of

additional sample taps, modifying the speed of the backwash valve, unplugging the drain lines and installing a flush line, and installing a cross-connect, with flush lines, between the backwash sludge pumps.

As in the previous years, the Sandfloat experienced solids loading during the 2006 RA activities, which resulted in gradually decreasing performance. As part of the on-going improvement in WTP operations, a modified backwash was implemented that improved cleaning of the media. In addition, a different chemical boil-out, using sodium hydroxide, was identified and implemented on a regular basis. A report detailing the first boil-out is attached in Appendix N. The first boil-out with the sodium hydroxide returned the unit to optimum performance. However, as the operations progressed more frequent boil-outs were required and the results of the latter treatments did not show the improved flow.

Near the completion of the 2006 remedial operations it became apparent that with each successive chemical boil-out the performance of the Krofta did not recover as well as it had following the previous one that had been implemented. This required that there would need to be an investigation into the performance of the unit after the 2006 project work had been completed. It is currently planned that the media will be replaced in March 2007.

Following the completion of the 2006 project work, in March 2007, an investigation was conducted and it was determined that the backwashing of the unit, which followed the chemical treatments, did not remove the accumulated fines. It then was discovered that the cause of this situation was that the gravity line, which allows the overflow of the waste material to the sump, had become plugged. Arrangements were made to remove the material from this line and the performance of the unit returned to normal. In addition, the backwash flow from the GAC and Krofta now go to a separate area on the de-watering pad, which is lined with filter fabric. This enhances the removal of the fines from the system during the treatment process. Finally, during the 2007 operations the chemical treatment of the media will occur during weekend, non-production periods, to minimize or eliminate the potential to negatively impact dredging.

7.3 Granular Activated Carbon Operation

The WTP GAC units have a design capacity of 3,000 gpm. The anticipated flow to the WTP during 2006 was approximately 2,400 gpm, which was based on the operation of two 8-inch hydraulic dredges.

The GAC units operated from the beginning of startup with minimum pressure loss through the units. However, as 2006 operations progressed, high pressure loss in several vessels occurred on a more frequent basis. Although vigorous backwashing was performed on these vessels, the high pressure loss occurred on a more frequent basis which resulted in the vessels being backwashed daily. In conjunction with the operations during this timeframe discussions took place with U. S. Filter to search for a way to improve operations. However, it became necessary to replace the fouled media on several of the units with new media. This occurred during the production shutdown that coincided with the July 4th holiday. Samples of the removed carbon media were collected and analyzed in a certified off-site laboratory and in a Glatfelter laboratory. Analyses concluded that the carbon media had fouled with polymer and clay, with some biological growth present.

Following the change out of the media discussions continued with U.S. Filter and a chemical boil-out, similar to that being employed with the Krofta, was implemented using sodium hydroxide. This initially improved operations but during the course of the 2006 project the flow capable of being sent through the units continued to decrease. During the dredging off-season it was decided to remove the GAC media from one the units to see if the cause of the decreasing flow was attributable to the plugging of the Septas, or the under-drain system of the units. On January 23, 2007 the media in GAC vessel #3 was physically removed using a vacuum truck equipped with a hydrocyclone. After the media was pulled from the unit and passed through the hydrocyclone it was placed into several lined metal tanks. The media appeared to be free flowing and without residual contaminants. At this same time, the inside of the GAC vessel was visually inspected to determine if the Septa were plugged. Upon viewing the inside of the vessel it was evident that there was no media plugging the Septa's. During the inspection valves were opened to allow water to flow into the vessel through the Septa to determine if the Septa were operating as required. The visual inspection indicated that the units were in proper working order. After the inspections were complete the media was placed back into the unit, at which time a backwashing of the unit was conducted. This backwash was followed by a chemical boil-out. Once the boil-out was completed the unit was placed into service and was able to process up to 1,100 gpm for a 24-hour period. Prior to the inspection the unit was only capable of processing a flow of less than 300 gpm.

While it was unclear whether the Septa had blinded over during 2006 operations, it is clear that the removal of the media had a significantly positive impact on the capacity of this unit, as flows through the unit increased nearly 4-fold. As a result of the successful treatment of the media from this unit, the media from the remaining 5 units was removed and treated in a similar manner in early March 2007. Following the removal of the media from each unit, it was inspected and then placed back into the unit. At this time, the unit was backwashed and then placed into operation to determine if it could treat design flows. Upon verifying that all units could now perform as designed, they were filled with water containing a slight residual chlorine concentration.

7.4 Bag Filter Operation

7.4.1 Introduction

During 2005 and 2006, the OU1 water WTP typically did not meet the Agencies' performance expectation for mercury discharge of 0.2 to 0.5 ng/L (parts per trillion). As a result, the Agencies directed GW Partners to install bag filters to attempt to remove trace amounts of mercury from the water released during on-site sediment dewatering operations. The intended purpose of the bag filters was to remove fine particulate matter from this water, and in so doing also reduce mercury concentrations prior to discharge of the treated water to Little Lake Butte des Morts. During June 2006, GW Partners installed a bank of 30 bag filters at the OU1 water treatment plant. GW Partners collected operational and analytical data during the operation of these filters from June 21, 2006 through August 9, 2006. As described in more detail below, the testing revealed that the bag filters were not effective in removing total mercury from the effluent. The results of the bag filter study were submitted to the Agencies and are presented in the August 24, 2006, Foth

memorandum, *OU1 Evaluation of Bag Filter Performance*. This memorandum is provided in Appendix O.

The Agencies authorized GW Partners to discontinue using the bag filters by memorandum dated September 27, 2006, provided in Appendix O.

7.4.2 Operational Description and Test Data

The installed bag filter system consists of 5 filter units and each unit contains 6 individual bag filter housings for a total of 30 bag filters. The filters were installed downstream of the Krofta system and prior to the GAC system. The following filter bag types were installed and tested:

- PONG1, 1 micron polypropylene nominal (35 micron removal at 98% efficiency)
- PENG5, 5 micron polyester felt nominal (50 micron removal at 98 % efficiency)

Testing was run intermittently from June 21 to July 28, 2006. During testing, samples were taken at the following points:

- Krofta influent (influent to water treatment plant)
- Pre-bag filters (effluent from the Krofta unit)
- Post-bag filters (pre-GAC)
- Final Effluent (post-GAC)

These samples were analyzed for TSS and total mercury. The resulting data are summarized in Table 7-2.

Table 7-2
1- and 5-Micron Standard Bag Filter Removal Efficiencies

Bag Type	Date	Pre-Bag Filters (BI)		Post-Bag Filters (BE)		Percent Removal	
		Hg (ng/L)	TSS (mg/L)	Hg (ng/L)	TSS (mg/L)	% Hg Removed	% TSS Removed
1 Micron	6/30/2006	3.22	5.00	2.75	4.00	14.6	20.0
1 Micron	7/12/2006	1.02	1.90	1.08	1.30	-5.9	31.6
1-Micron	7/13/2006	1.20	2.00	1.33	1.80	-10.8	10.0
1-Micron	7/14/2006	1.44	2.00	1.53	1.50	-6.3	25.0
1-Micron	**Average**	**1.72**	**2.73**	**1.67**	**2.15**	**-2.1**	**21.6**
5-Micron	7/12/2006	1.69	1.90	1.76	1.40	-4.1	26.3
5-Micron	7/13/2006	1.65	1.80	1.25	1.60	24.2	11.1
5-Micron	7/14/2006	1.77	2.00	1.58	1.40	10.7	30.0
5-Micron	7/20/2006	2.53	6.60	1.84	2.00	27.3	69.7
5-Micron	**Average**	**1.91**	**3.08**	**1.61**	**1.60**	**14.5**	**34.3**

The testing showed that the filter cloth quickly became plugged with fine particles that passed through the Krofta unit, causing a pressure drop across the system and requiring frequent change-out of the filter bags. The system ran for an estimated average of 4 hours (range: 1 to 8 hours) until the pressure drop across the filters required change-out of the

bags. The service time required to change out all 30 bags was approximately 35 minutes, which was difficult for 1 WTP operator to perform. Based on a 4 hour filter run time, the daily (24 hour/day) operation cost for the filter bags was estimated at $626/day for the PENG5 bags and $734/day for the PONG1 bags. (This cost does not include labor and is based on a PENG5 bag cost of $3.48 each and a PONG1 bag cost of $4.08 each.)

Because of the low percentage of mercury removal achieved during the initial testing, (average negative 2.1% (effectively 0%) and 14.5% for the 1 and 5 micron bags, respectively) additional testing was completed using specialty type filter bags. These specialty filter bags have higher filtering capabilities, as shown by the removal efficiency particle size specifications below. The following filter bag types were installed and tested:

- PENG1, 1 micron polyester felt nominal (25 microns at 98% removal efficiency)
- POMF2, 2 micron polypropylene microfiber (10 microns at 98% removal efficiency)
- BOS10, 10 micron polypropylene microfiber (10 microns at 98% efficiency)
- BOS3, 3 micron poly microfiber with cartridge insert (3 microns at 98% efficiency)
- BOSG5, 5 micron graded density poly microfiber (5 microns at 98% efficiency)

The effectiveness of these filter bags was tested using a single bag filter unit with a bypass around the filter unit (slip stream). A flow meter was used to split the flow through the single unit (approximately 70 gpm flow rate) and the pressure drop across the filter was monitored. Each filter was installed and tested both before and after the GAC filters. The analytical results for TSS and mercury for these filter bags are summarized in Table 7-3.

Table 7-3
Specialty Bag Filter Removal Efficiencies

Bag Type	Bag Location	Date	Pre-Bag Filters (BI)		Post-Bag Filters (BE)		Percent Removal	
			Hg (ng/L)	TSS (mg/L)	Hg (ng/L)	TSS (mg/L)	% Hg Removed	% TSS Removed
PENG1	Pre-GAC	8/1/2006	3.22	3.30	2.80	3.50	13.0	-6.06
PENG1	Post-GAC	8/4/2006	1.03	1.60	1.06	1.80	-2.91	-12.5
PENG1	Pre-GAC	8/4/2006	2.95	3.20	2.73	2.50	7.46	21.9
POMF2	Pre-GAC	8/1/2006	3.25	3.20	2.33	2.40	28.3	25.0
POMF2	Post-GAC	8/4/2006	0.89	1.27	0.85	1.60	4.49	-26.0
BOS10	Pre-GAC	8/1/2006	3.24	3.25	2.41	1.70	25.5	47.7
BOS10	Post-GAC	8/4/2006	0.84	1.00	1.01	1.10	-20.0	-10.0
BOS3	Pre-GAC	8/1/2006	3.24	3.25	2.40	1.00	25.8	69.2
BOS3	Post-GAC	8/4/2006	0.89	1.27	0.77	0.90	13.6	29.1
BOS3	Pre-GAC	8/9/2006	7.83	3.50	5.29	1.70	32.4	51.4
BOS3	Post-GAC	8/9/2006	4.00	2.20	2.78	1.00	30.5	54.6
BOSG5	Pre-GAC	8/1/2006	3.24	3.25	2.46	1.30	24.0	60.0
BOSG5	Post-GAC	8/4/2006	0.81	1.20	0.95	1.00	-17.9	16.7
BOSG5	Pre-GAC	8/9/2006	8.54	3.80	6.91	2.20	19.1	42.1
BOSG5	Post-GAC	8/9/2006	4.22	2.70	3.58	1.80	15.2	33.3

The TSS removal across the filters ranged from 0% to 69% and the mercury removal across the filters ranged from 0% to 32%. (Negative removal percentages were interpreted as 0%.) The filter run times in the pre-GAC location were monitored once and are as follows:

- PENG1 – 34 minutes
- POMF2 – 27 minutes
- BOS10 – 25 minutes
- BOS3 – 13 minutes
- BOSG5 – 34 minutes

The focus of this slip stream analysis was to determine if the specialty bags could reduce mercury levels to the Agencies' performance expectations. As the data shows, this was not achieved.

7.4.3 Analysis of Bag Filter Effectiveness

In summary, the nominal 1- and 5-micron bag filters removed, respectively, 21.6% and 34.3% of the TSS, but only 0% and 14.5% of the total mercury. The nominal 1- and 5-micron pre-GAC bag filter system run time until filter bag change out is estimated at an average of 4 hours with a range of 1 to 8 hours. The specialty filter bags removed between 0% and 32% of the total mercury, but had run times of 34 minutes or less.

By contrast, the existing dewatering process and water treatment train already removes approximately 97% of the background mercury. For example, the 2005 treatment process removed about 0.094 pounds of mercury and returned about .003 pounds of mercury to the river at an average concentration more than an order of magnitude below background. The addition of bag filters in 2006 did not reduce mercury concentrations to levels appreciably lower than the existing treatment train had achieved in 2005, without bag filters.

The daily cost for the filter bags is estimated is estimated at $626/day for the nominal 5 micron bags and $734/day for the nominal 1 micron bags. These costs do not include labor. Costs for the specialty bags are much higher.

7.4.4. Discontinuance of Bag Filters

The results of the bag filter testing show that mercury in the effluent cannot be reduced to the Agencies' performance expectation of 0.2 to 0.5 ng/l using bag filter technology. On August 24, 2006, GW Partners submitted a memorandum to the Agencies detailing the bag filter testing and results and requesting that bag filters no longer be required as part of the treatment train. On September 27, 2006, the Agencies responded by letter agreeing that the bag filters were not effective in further reducing mercury concentrations in the effluent, and authorizing GW Partners to discontinue using the bag filters unless and until conditions change. The September 27, 2006, correspondence from the Agencies is included in Appendix O.

7.5 Accumulation of Solids on the De-watering Pad

An investigation in March 2006, following the 2005 RA activities, indicated that, even though there was some build up of solids on the gravel of the de-watering pad, it didn't appear that this would lead to any treatment issues in the future operation of the WTP. However, as the RA operations in 2006 progressed it was noted that the amount of solids loading to the WTP was increasing. While there was only one tube failure, where a

significant amount of solids was released to the de-watering pad in 2006, it was felt that the smaller/finer solids, which pass through the tubes during the de-watering process, in addition to the solids from the bag failures in 2005 were beginning to accumulate in the gravel and pass through to the WTP.

In an effort to remove the accumulated solids from the pad, during the last week of March 2007, the water from the de-watering pad was treated with polymer and/or ferric sulfate or aluminum chlorohydrate, and passed through the thickening process, allowing the solids to settle out. The effluent from the thickeners was returned to the "hot tub" and treated again, while the solids that settled to the bottom of the thickeners were sent to a geotextile tube. This operation continued for approximately three days, at which time it was determined that the amount of solids being removed was negligible. Please note that the effluent from the "hot tub" did not enter the WTP, but was, instead, pumped back to the de-watering pad to begin this treatment process again. This was done to eliminate any potential contamination to the media of the Krofta and GAC units prior to the start up of the 2007 remedial work.

7.6 Chemical Addition

During the 2006 RA activities in late October, as in 2005, a white foam accumulated on the water surface of the Sandfloat. Investigation of the foam in 2005 by technical representatives of the polymer supplier, concluded that the foam was due to the presence of biological material (bio-film) in the system. In 2006 samples of the foam were also collected. These samples were taken to the Neenah – Menasha Municipal plant for analysis by their micro-biologist and she confirmed the presence of a significant amount of microbes. Chlorine dosing to control bacterial growth in the WTP system, as mentioned above, was performed utilizing sodium hypochlorite. A field colorimeter test kit was used to monitor residual chlorine in the system. Sodium bisulfite was staged on-site in the event that overdosing of chlorine occurred. It is anticipated that additional chlorine dosing, possibly in the de-watering pad "hot tub" effluent may be required to improve the operations.

7.7 Performance

The WTP was designed to remove suspended solids and dissolved organics such as PCBs. WDNR's performance expectations of the plant are listed in Table 7-4. For the majority of the 2006 operations all WDNR performance expectations were met, except mercury. However, towards the end of the dredge season, there were periods were the TSS and BOD5 exceed the daily limit values. As in previous years, there were no detectable concentrations of PCBs in the effluent discharged in 2006. Water treatment effluent quality is discussed in Section 10.2.

Table 7-4
Water Treatment Plant Effluent Expectations

Parameter	WDNR Performance Expectation
TSS (mg/L)	5 (monthly average) 10 (daily peak)
BOD (mg/L)	10
PCB (µg/L)	<0.1-0.5
Flow (mgd)	1.2-1.7
Ammonia (mg/L)	67
Mercury (ng/L)	<0.2-0.5

SECTION 8

Productivity

8.1 Percent Uptime

Percent uptime is a key measure of productivity for the project as a whole and for its individual operations -- dredging, dewatering, and water treatment. Percent uptime is the percentage of time operating compared to the time available for operations (not including scheduled off days such as holidays and most weekends). Table 8-1 (Refer to the "Tables" tab following the text of this report.) uses information from the daily reports to calculate percent uptime for the project and the individual operations. The load-out, transport, and disposal (LTD) operations did not impact the other operations and were not included in the percent uptime evaluation.

The total project percent uptime (equal to the dredge efficiency) was 84%. The 84% uptime calculation includes the 235 hours of delay for the dewatering and water treatment plant operations. If adjusted to remove the effect of the dewatering and water treatment operations, the total project percent uptime (also dredge percent uptime) would have been 87%. The dredging operations achieved their percent uptime without the need for a standby dredge and with both of the dredges pumping through a booster pump for a majority of the project.

8.2 Sediment Removal Efficiency

The 2006-dredging season for Little Lake Butte des Morts began on May 1, 2006, and concluded on November 16, 2006. During this time J.F. Brennan Co. compiled 6,136 gross operational hours (GOH) on the project. Of those gross operational hours, 5,129 hours were net operational dredging hours (NOH) for both of the 8 inch hydraulic articulating ladder dredges: the Fox River and the Grand Calumet. This yielded an 84% overall efficiency rate. The remaining 16% was spent on a variety of delays that were encountered throughout the dredging process.

Operational reporting was separated into five production categories for activity codes as listed in daily production reports. These activity codes are as follows: Standard Configuration First Pass (Cutter head), Standard Configuration Second Pass (Cutter head), Vic Vac, Second Pass Vic Vac, and Day Rate. Second pass was reported as anytime a dredge covered an area more than once. These efficiency rates were evaluated on the individual dredges and combined. Table 8-2 shows the operational hours of the individual dredges and combined per dredging activity.

Table 8-2
Operational Hours/Production Categories

Standard Configuration First Pass			
	Fox River	**Grand Calumet**	**Both**
GOH	1,592	1,264	2,856
NOH	1,217	1,100	2,317
Efficiency	76%	87%	81%
SF	947,590	781,711	1,729,301

Standard Configuration Second Pass			
	Fox River	**Grand Calumet**	**Both**
GOH	50	457	507
NOH	38	407	445
Efficiency	76%	89%	88%
SF	33,450	423,157	456,607

Vic Vac First Pass			
	Fox River	**Grand Calumet**	**Both**
GOH	818	946	1,764
NOH	687	794	1,482
Efficiency	84%	84%	84%
SF	556,496	633,984	1,190,480

Second Pass Vic Vac			
	Fox River	**Grand Calumet**	**Both**
GOH	272	340	612
NOH	245	285	529
Efficiency	90%	84%	87%
SF	226,942	307,888	534,030

Day Rate Re-dredging			
	Fox River	**Grand Calumet**	**Both**
GOH	395	0	395
NOH	356	0	356
Efficiency	90%	0%	90%
SF	232,995	0	232,995

The production of dredges was also separated by the areas they worked in. Table 8-3 shows the operational hours of the individual dredges and combined per dredge sub-area.

Table 8-3
Operational Hours/Sub-areas

C/D2S			
	Fox River	**Grand Calumet**	**Both**
GOH	0	567	567
NOH	0	475	475
Efficiency	0%	84%	84%

POG3 S			
	Fox River	**Grand Calumet**	**Both**
GOH	2,021	881	2,902
NOH	1,604	728	2,332
Efficiency	79%	83%	80%

POG4			
	Fox River	**Grand Calumet**	**Both**
GOH	321	316	637
NOH	242	265	506
Efficiency	75%	84%	79%

POG2			
	Fox River	**Grand Calumet**	**Both**
GOH	446	1,242	1,688
NOH	397	1,119	1,515
Efficiency	89%	90%	90%

POG3N			
	Fox River	**Grand Calumet**	**Both**
GOH	340	0	340
NOH	302	0	302
Efficiency	89%	0%	89%

The dredges delays were divided in 19 delay categories for evaluation. As each delay occurred, the dredge operator logged its time. Table 8-4 shows the total time per delay for each dredge and both of them combined.

Table 8-4
Dredge Delay Summary

Time Consumption/Delay (hours)		Fox River	Grand Calumet	Both
OPERATIONAL	Obstructions	1.5	1.0	2.5
(Sediment)	Clean Pipeline	23.8	54.0	77.8
	Clean Cutter head	7.5	7.3	14.8
	Clean Main Pump	2.0	30.3	32.3
	Change Cutter head	35.8	9.0	44.8
(Execution)	Move Dredge	78.8	71.8	150.5
	Move and Repair Pipeline	13.8	18.5	32.3
	Pipeline Anchors	4.3	1.5	5.8
	Wait on Tug	0.0	0.2	0.3
(Mechanical)	Sensors, Dredge Pack, GPS	16.0	24.0	40.0
	Engine Room & Spuds	57.3	71.5	128.8
	Startup - Shutdown	49.3	44.8	94.0
	Dredge Pumps	0.5	0.0	0.5
	Booster	19.0	20.5	39.5
PROJECT	Water treatment plant	117.8	17.5	135.3
	Clarifier	59.8	40.3	100.0
	Geo Tube	0.0	0.3	0.3
OUTSIDE	Water Quality & Weather	1.0	0.0	1.0
	Misc	95.8	10.5	106.3
	TOTAL DELAYS (hours)	584	423	1,007
	NET OPERATIONAL (hours)	2543	2586	5,129
	GROSS SERVICE (hours)	3128	3,009	6,136
	EFFICIENCY	81%	86%	84%

8.3 Sediment Load-Out Rates

Sediment LTD activities were originally scheduled to begin on July 10, 2006, but the start of the 2006 LTD was delayed due to the under run of cubic yards and to allow the geotubes to dewater the maximum amount of time. Load out of the non TSCA material began on August 14, 2006, in the northeast side of the pad. LTD activities continued through early March 2007. The amounts of sediment loaded on a daily basis averaged over 900 tons per day. This rate continued through the end of 2006 and into 2007.

Table 8-5 shows the 2006 RA daily and monthly load-out rates.

Table 8-5
Load-Out Rates for Sediments Remediated in 2006

	Maximum Daily Tonnage	Average Daily Tonnage	Total Tons Removed
August 2006	1,041	861	13,780
September 2006	1,134	997	10,968
October 2006	1,241	929	17,650
November 2006	1,148	943	13,196
December 2006	1,143	971	11,658
January 2007	1,108	993	16,888
February 2007	990	943	6,599
March 2007	1,134	936	8,427
Total	--	--	99,166

SECTION 9

POG1 Phase II Work

Deposit POG1-B is located on the shore of Little Lake Butte des Morts, directly east of Deposit POG1-A. Deposit POG1-B consists of a relatively thin surface layer of wood chips, which is contaminated with low concentrations of polychlorinated biphenyls (PCBs), less than 50 milligrams per kilogram (mg/kg). Deposit POG1-A was dredged in the autumn of 2005, leaving an abrupt bank of approximately 2 to 4 feet on the west side of Deposit POG1-B. From this bank, Deposit POG1-B (an upland area) extends at a nearly level grade to the levee of the Menasha Lock and Channel.

To remediate Deposit POG1-B, a two phase approach was developed. Phase I was intended to secure the deposit in the winter of 2006, before potential high water flooded the area during spring thaw. Phase I also included securing the slope of the adjacent Menasha Channel and Lock by installing riprap and removing trees. This work was completed in January 2006. Phase 2 of the remedial activities was outlined in a July 27, 2006 Work Plan and included grading the bank riprap and recycled construction road gravel to form a gradual slope into the lake. The Work Plan included filling the levee slope with clean imported soil fill and topsoil to a 3 to 4:1grade. The newly formed shore slope and the relatively flat area between the levee and the shore would be covered with clean imported fill and topsoil. Following soil placement, the site was to be seeded with native grasses and forbs and planted with shrubs. A line of trees was also proposed along the pedestrian path at the top of the levee.

Phase 2 remedial activities were completed in September through early November 2006. The construction summary report for Phase 2 is included in Appendix P. The document describes the work activities and construction materials used to complete Phase 2. Monthly updates will be provided to document site conditions until the vegetation is established and the site is stable.

SECTION 10

Environmental Monitoring

10.1 Surface Water Quality

10.1.1 Turbidity

During dredging operations, surface water turbidity, reported as nephelometric turbidity units (NTUs), was continuously measured in the river at three locations, one upstream and two downstream of in-river RA activities. The upstream monitoring location was between 100 and 500 feet from the RA activities. The goal for the downstream locations was within 500 feet or less of RA activities; however, if the dredge pipelines or other obstacles prevented this, the locations were kept as close to the dredges as conditions allowed. The monitoring locations were adjusted as needed to reflect the changing locations of the RA activities. Foth representatives verified the monitoring locations.

Turbidity was measured using in-stream, real-time turbidity meters (YSI Model 600), which took 30 successive readings per hour. Average turbidity data were collected in the base station every 15 minutes. The data was digitally recorded and stored with time and date for downloading via radio modem to an onsite PC located in the Foth OU1 office.

The limit for dredging-induced increases in surface water total suspended solids (TSS) was 80 ppm increase above background. Surface water turbidity was used as a surrogate for TSS based on a correlation developed from the 2004 RA. The Foth Environmental Data Packet sent to the Agencies on December 14, 2004, presented a TSS/turbidity correlation, whereby, TSS = 2.108 + 0.995*(Turbidity) with (Correlation) r = 0.88. This correlation was based on surface water data from OU1 collected between October 30, 2004, and December 1, 2004. Using this correlation, an action level was set at 38 NTU (comparable to 40 TSS) difference between upstream and downstream conditions.

The three real-time, in-river turbidity meter rafts were used to detect exceedances of the trigger level of a difference of greater than 38 NTU and exceedances of the shut-down level of a difference of greater than 78 NTU between upstream (background) and downstream turbidity. A photograph of turbidity raft 902 is presented in Appendix A, as photograph 31. Foth monitored the readings collected by the real-time turbidity meters and confirmed the real-time monitoring results 2-3 times weekly by collecting hand-held field turbidity measurements at each turbidity meter location. Also, visual observations of turbidity, dredging near intakes, or other circumstances required the collection of additional hand-held turbidity readings by Foth. When on-site at the time of high turbidity events, Foth used the hand-held turbidity meter to further delineate any visible turbidity downstream of the dredge. All hand-held readings were documented in a field book. Turbidity meters were calibrated according to manufacturer specifications.

If turbidity readings significantly higher than background were continually noted from the real-time turbidity data, hand-held turbidity data, or by visual inspections, the J.F. Brennan Site Manager was notified. Follow-up notifications were issued weekly to the J.F. Brennan

Project Manager, GW Partners' representative Project Coordinator, and a representative from the Agencies/Oversight team. Once J.F. Brennan's Site Manager was notified, he contacted the leverman on the dredge. The leverman then implemented procedures to minimize the turbidity. All steps taken by the leverman to control the turbidity were recorded and summarized in the daily production report. The same procedure was used if high turbidity was detected by other members of the project team. Any observations or turbidity readings collected by Foth during turbidity events were also documented and summarized in the daily production reports.

10.1.2 Total Suspended Solids (TSS)

Surface water grab samples were obtained 2-3 times weekly at the same location and time as the turbidity field measurements to validate turbidity results. The grab samples were collected from a boat utilizing a discrete grab sampler (Kemmerer Water Sampler) and analyzed for TSS. During each sampling event, one water sample was collected at the approximate mid-point of the total water depth at each sampling location. Relevant information collected during sampling was documented in the field notebook and on field forms including weather conditions, raft ID, and location, water depth, sample time, turbidity reading, and water temperature. Field duplicates and rinsate blanks were collected for every 10 water samples collected.

The trigger level was defined as the difference between upstream (background) turbidity and downstream turbidity of greater than 38 NTU. Exceedances of the trigger level usually occurred during dredging in high subgrade areas where clay was being disturbed. The shut-down level was defined as the difference between upstream (background) turbidity and downstream turbidity of greater than 78 NTU. As previously described, steps were taken to monitor and minimize high turbidity. Table 10-1 summarizes the turbidity and TSS data obtained at the turbidity raft locations.

Table 10-1
Summary of Turbidity Readings and TSS Results Obtained at Raft Locations

	Minimum	Maximum	Average	Standard Deviation
Hand-Held Turbidity (NTU)	0.5	91.8	16.9	13.1
Telemetric Turbidity[1] (NTU)	0	989.5	16.2	20.5
TSS (mg/L)	5.6	110	20.6	13.0

1 –Negative data points and erratic data points >1000 NTUs can be attributed to other non-turbidity events (i.e. weather conditions or equipment malfunction) and were not used to prepare this table.

Prepared by: SVF
Checked by: TAG

Table Q-1 in Appendix Q contains laboratory TSS results with corresponding hand-held and telemetric turbidity readings. Monitoring of visible turbidity plumes was completed 8 times during 2006. Table Q-2 in Appendix Q contains readings collected during the delineation of high turbidity events.

10.2 Water Treatment Plant Effluent Quality

Treated effluent water was sampled prior to discharge to the Lower Fox River using a 24-hour, flow-proportional, composite sampler. A photograph of the composite sampler is presented in Appendix A, as photograph 32. The composite samples were collected daily during operation of the water treatment plant (WTP) and analyzed for PCBs, ammonia, TSS, and BOD. Field duplicates were collected for every 10 samples collected by replicating the sample collection from the composite sampler.

During WTP operation, effluent water was also collected for low-level mercury analysis once per week from a spigot in the discharge pipe just outside of the WTP. A photograph of the spigot is presented in Appendix A, as photograph 33. The WTP ceased to operate continuously on November 16, 2006, and the sampling plan was revised so that low-level mercury sampling was only required on days when the plant ran (maximum once per week).

Low-level mercury sampling procedures were utilized during sampling events. A field blank was collected with each low-level mercury sample. In addition, field duplicates were collected for every 10 low-level mercury samples collected. Beginning on May 25, 2006, at each sample collection point for low-level mercury, water was also collected for QC TSS analysis. In 2005 an evaluation of TSS compared to low-level mercury results was performed. The analysis looked for a correlation of mercury to TSS within river water, effluent, tube weep, and carriage water. One correlation was found – within river water only, as TSS increased low-level mercury also increased. This same correlation was observed in the 2006 data.

Water samples were sent to Pace Analytical for PCB, ammonia, TSS, BOD, and low-level mercury analyses. Tables Q-3 and Q-4 in Appendix Q contain a complete data set for these parameters.

PCB and ammonia effluent concentrations consistently met the WDNR's performance expectations of less than 0.1-0.5 ug/L and 67 mg/L, respectively. The WDNR's daily TSS expectation (less than 10 mg/L) was exceeded 15 out of 151 operation days and the monthly TSS expectation (less than 5 mg/L) was exceeded 4 times during the 9 months of WTP operation. The WDNR's BOD expectation (less than 10 mg/L) was exceeded 8 out of 151 operation days.

Table 10-2 summarizes the QA analytical results by day for WTP effluent. Table 10-3 summarizes the monthly averages of laboratory analytical results for water treatment plant effluent.

Table 10-2
Summary of Laboratory Analytical Results for Water Treatment Plant Effluent

	Minimum	Maximum	Average	Standard Deviation
TSS (mg/L)	0.40	22	3.0	3.3
BOD (mg/L)	1.0	22	3.1	3.7
Ammonia Nitrogen (mg/L)	0.10	23	4.3	5.1
Total PCBs (ug/L)	0.12	0.17	0.12	0.01

Note: For values less than the detection limit, half the detection limit value was used for minimum, maximum, average and standard deviation calculations.

Prepared by: SVF
Checked by: TAG

Table 10-3
Monthly Averages of Laboratory Analytical Results for Water Treatment Plant Effluent

Month	TSS (mg/L)	BOD (mg/L) [1, 3]	Ammonia Nitrogen (mg/L)	Total PCBs (ug/L) [1,3]
May	1.7	1.3	0.93	0.13
June	1.4	1.2	0.49	0.12
July	1.6	1.4	1.4	0.12
August	2.5	2.2	4.4	0.12
September	2.4	8.8	13	0.12
October	5.5	3.5	6.1	0.13
November	7.2	4.3	3.4	0.12
December[2]	--	--	--	--
January	15	7.6	3.1	0.12
February[2]	--	--	--	--
March	22	4.9	2.4	0.12

Prepared by: SVF
Checked by: DMR

Notes:
1 – Limits of detection (LOD) vary for BOD and total PCBs. The highest LOD reported in Table Q-3 for each was as follows:
BOD – 2 mg/l
total PCBs – 0.34 ug/l.
2 – The WTP did not run in December or February, and therefore no effluent samples were taken.
3 – Half of the LOD was used to calculate the average when the compound was not detected above the LOD.

As in 2005, the low-level mercury concentrations in the effluent generally exceeded the WDNR's performance expectation of <0.2 -0.5 ng/L. Table 10-4 summarizes the low-level mercury results.

Table 10-4
Summary of WTP Final Effluent Low-Level Mercury and QC TSS Results

	Minimum		Maximum		Average		Standard Deviation	
	LL Hg (ng/L)	QC TSS (mg/L)	LL Hg (ng/L)	QC TSS (mg/L)	LL Hg (ng/L)	QC TSS (mg/L)	LL Hg (ng/L)	QC TSS (mg/L)
Effluent	0.42	0.50	15.2	14	2.0	2.0	2.5	2.5

Note: For values less than the detection limit, half the detection limit value was used for calculations.

Prepared by: SVF
Checked by: TAG

While this remediation project's primary function was the removal of significant PCB contaminated sediment, a secondary benefit was the removal of mercury suspended within the water column near sediment removal areas. Laboratory analysis shows that the average ambient mercury concentration found within LFR OU1's near surface water is 42.69 ng/L, while the average mercury levels in the treated effluent water was 2.0 ng/L. Effluent water returned to the Fox River was twenty-one times cleaner than near ambient surface water, when comparing low-level mercury averages.

During the 2006 Lower Fox River OU1 remediation project, from May 5, 2006, through November 28, 2006, there were 44 field blanks decanted while sampling treated effluent. Low-level mercury laboratory analysis of the field blanks revealed that only 13 of the 44 field blanks had non-detectable levels of mercury.

Low-level mercury contamination of field blanks may have come from many sources, most of which are likely to be airborne. Airborne mercury may have come from factories – both near and far, metallic objects near the sampling location, dust, upwind smokers or even the breath of the sampling crew (mercury/amalgam fillings in teeth).

Field sampling and field blank decanting procedures were established and approved prior to beginning 2006 sampling and did not change during the project. Clean and dirty areas were established prior to sampling as well as clean-hand/dirty hand assignments for the sampling team.

10.3 Air Quality

Air samples were collected and analyzed for PCBs to assess possible airborne concentrations of PCBs before removal of dewatered sediment began to establish a baseline for 2006 and again when TSCA-level dewatered sediment was being removed from the geotextile tubes during loading for off-site disposal. Air sampling was limited to baseline data collection and periods of TSCA-level excavation and load-out since PCBs were not detected at any of the four air samplers during the 2006 remedial activities.

Four high-volume samplers were used to measure possible PCB emissions leaving the site. A photograph of one of the air sample locations is presented in Appendix A, as photograph 34. Locations were selected and placed on and adjacent to the site, based on residential receptors, site topography, site operations, and prevailing wind directions. Three of the high-volume samplers were located in close proximity to the dewatering pad: on the north berm of the pad, east of the pad between the pad and the river, and west of the pad between the pad and the house on-site (O'Keefe House). The fourth high-volume sampler was located between the dewatering pad and the house adjacent to the former Huber property on North Lake Street (Mills House). Figure 10-1 shows the locations of the air monitors.

Baseline monitoring commenced on April 27, 2006, and was completed on May 6, 2006. PCB ambient air was continuously sampled during baseline sampling and four rounds of air monitoring were completed when TSCA-level dewatered sediment was being removed from the site between August 14, 2006, and September 20, 2006.

All PCB samples were collected using a high-volume sampler (Tisch Environmental TE-PUF) loaded with a combination quartz filter and Polyurethane Foam (PUF) cartridge, following EPA TO-4A protocols. Air was drawn through the sampler at about 8 cubic feet (226 L) per minute. Sampling periods were 72 hours in length to allow for sufficient sample and volume to permit detection of PCBs at low concentrations.

During each sampling event, the starting and ending magnehelic readings, elapsed time indicator readings, and real times for each monitor were documented on field forms. A single-point operational flow rate calibration check was performed prior to the start of each sampling period and after its completion. The post-sampling calibration check served as the pre-test calibration check for the next sample. The calibration results were also documented on the field forms.

During each 72-hour sample interval, operational status was observed and magnehelic gauge readings, elapsed time indicator readings, and real times were documented daily on the field forms.

Following collection of each sample, the filter and PUF cartridge was packed in hexane-rinsed aluminum foil and shipped to Pace Analytical for analysis. In the laboratory, PUF cartridges and filters were extracted with 5 percent ethyl ether/hexane and brought to a final volume of 10 mL. The extracts were then analyzed by gas chromatography with an electron capture detector to determine the presence of PCB compounds. At least one filter/PUF cartridge per 20 samples was shipped to the field and returned to the laboratory unused to serve as a field/handling blank.

Sample results from the laboratory, field data with respect to flow and sample collection times, and meteorological conditions during sample collection were used to calculate PCB concentrations. The calculation equations outlined in USEPA Method TO-4A were used to determine the concentrations.

Meteorological data was obtained from the National Oceanic Atmospheric Administration (NOAA) weather station at the Appleton, Wisconsin airport. It was assumed that data from this location was representative of the meteorological conditions encountered at the OU1 site. The following average meteorological data was obtained: barometric pressure, temperature, and wind speed.

Eight rounds of air sampling were completed and consisted of 32 samples plus a field blank. The laboratory reported that all samples for this period were below the limit of detection for PCBs, which is 0.5 micrograms per sample cartridge. For purposes of developing airborne concentration values, it was assumed that all concentrations were at the limit of detection. Although air volumes vary slightly from sample to sample, this cartridge concentration translates into a calculated PCB concentration that is approximately $< 0.0005\ \mu g/m^3$ at each sampler for each sampling event. Refer to Table 10-5 for a summary of the air monitoring results.

Due to the design of the OU-1 air samplers, field duplicates can not be collected as specified in Table E-4 of the RAWP. In place of field duplicates, field blanks are collected in accordance with USEPA Compendium Method TO04A. This deviation from the 2006 RAWP will be made permanent and will be reflected in the 2007 RAWP.

Table 10-5
Air Monitoring Results Summary

	Minimum	Maximum	Average	Standard Deviation
Total Air Volume Sampled (Total m^3)	991.9	1142.5	1082.6	35.9
Calculated PCB Conc'n ($\mu g/m^3$)	≤ 0.00044	≤ 0.00050	≤ 0.00046	≤ 1.59×10^{-5}

Prepared by: SVF
Checked by: PRB

Table Q-5 in Appendix Q contains the laboratory PCB air sampling results, the total air volumes sampled, and calculated PCB concentrations for each air sample (calculated at the limit of detection).

10.4 Data QA/QC

10.4.1 Data Reduction, Validation and Reporting

Foth performed QA activities to ensure that the collected data were scientifically defensible, of known quality, properly documented, and met the project objectives. Once a final data package containing laboratory results was received by Foth, the package was logged into a data tracking table. The final analytical data package was then sent to MAKuehl Co. for third party validation and verification.

A minimum of ten percent of the analytical data was verified and validated by MAKuehl Co. to ensure that the laboratory performed sound QC practices and to assess the possible effects of each deviation from the QAPP on the usability of associated data, the contribution to the quality of reduced and analyzed data. The following steps were used:

- The completeness, correctness, and contractual compliance of the data were evaluated against the USEPA or other reference method, or laboratory- or field-specific SOP.
- The qualification of data was extended beyond method and procedural compliance (i.e., data verification) to determine the data's analytical quality.
- Individual data sets were evaluated to identify the measurement permanence/ usability issues or problems affecting the ultimate achievement of project data quality objectives (DQOs).
- An overall evaluation of all project data was performed.
- Project-specific measurement performance criteria and data validation criteria were evaluated to determine if they appropriately met project DQOs.
- Additionally, Foth performed a forms review on one hundred percent of the analytical data.

10.4.2 Reconciliation with Data Quality Objectives

Data quality objectives (DQOs) are qualitative and quantitative statements that clearly define the objectives of the project, define the most appropriate type of data, determine the appropriate procedures for data collection, and specify acceptable decision error limits that establish the quantity and quality of data needed for decision making. The technical planning team developed project-specific DQOs in accordance with USEPA's Guidance for Data Quality Objectives Process (EPA QA/G-4).

The final data validation activity consisted of assessing whether the data met the planned DQOs for the unit-specific project. The final results, as adjusted for the findings of any data validation/data evaluation, were checked against the DQOs. The data acquired during the environmental monitoring fulfilled the project objectives to support remedial activities in the Lower Fox River OU1.

Data validation technical memoranda received to date from MAKuehl are contained in Appendix R.

SECTION 11

Summary

11.1 Project Performance Versus Objectives

The following narrative summarizes the project performance versus the 2006 objectives.

Objective No. 1: Install screening and thickener unit operations to increase the percent solids in the sediment slurry fed to the geotextile tubes.

- The 2006 RA sediment dewatering process was modified with the addition of a sediment screening and thickening unit prior to the geotextile tubes.
- The average percent solids of the inflow into the thickeners was 4% (similar to the percent solids to the geotextile tubes in 2005) and the average percent solids of the discharge from the thickeners into the geotextile tubes was 17%.
- The WTP became operational prior to beginning dredge operations on May 1, 2006.

Objective No. 2: Dredge Sub-areas C/D2S North (remaining portion of Sub-areas C and D2S – meaning the portion north of the gas pipeline), POG2, POG3 South, a portion of POG3 North (adjacent to POG2), POG4 South, and E1 South (which is essentially a northern extension of POG2) and dewater thickened sediment slurry in geotextile tubes**..**

- All of the sub-areas targeted for dredging were completed.
- 94% of the total PCB mass was removed from the sub-areas dredged in 2006.
- Surface water turbidity downstream of the dredges rarely exceeded the 38 NTU above background turbidity project limits.
- Dredging of Sub-area C/2DS North was completed on June 7, 2006.
- Dredging of Sub-area POG4 South was completed on August 25, 2006.
- Dredging of sub-area POG3 South was completed on November 16, 2006.
- Dredging of Sub-area POG3 North was completed on November 16, 2006.
- Dredging of Sub-area POG2 and E1 South was completed on October 27, 2006.
- Dewatering operations occurred as planned and were enhanced via the addition of a sediment thickening and screening unit prior to the geotextile tubes.

Objective No. 3: Remove debris (with silt curtains installed) from the areas to be dredged.

- No debris removal was necessary during the 2006 RA.

Objective No. 4: **Optimize dredging operations to minimize turbidity, over dredging, and residual PCB concentrations.**

- Surface water turbidity downstream of the dredges rarely exceeded the 38 NTU project limits above background turbidity.
- An overcut allowance of 4 inches was planned for all 2006 sub-areas. On a consolidated basis, the average dredge overcut for 2006 dredge areas was 5.0 inches, closely approximating the 4 inch target. A detailed evaluation of overcut results is presented in Section 4.3.2.
- Average post-dredge PCB surface concentrations for the 2006 dredge areas were:
  - 1.2 ppm in Sub-area C/D2S North
  - 3.8 ppm in Sub-area POG2
  - 0.8 ppm in Sub-area POG3 North and South
  - 0.5 ppm in Sub-area POG4 South
  - 1-ppm in Sub-area E1 South
- PCB mass percent reduction for the 2006 dredge areas were:
  - 46% in Sub-area C/D2S North
  - 92% in Sub-area POG2
  - 98% in Sub-area POG3 North and South
  - 97% Sub-area POG4 South
  - 99% ppm in Sub-area E1 South
- Sub-areas C/D2S North and POG2 along with portions of other sub-areas dredged in 2005 and 2006 are being evaluated for appropriate residuals management. A complete residual management plan will be presented in the 2007 RAWP.

Objective No. 5: Install bag filters downstream of the Krofta sand float and upstream of the granular activated carbon units.

- GW Partners installed bag filters at the WTP in 2006. After rigorous testing and evaluation, GW Partners concluded that the Agencies' mercury performance expectation could not be met using bag filters. The Agencies approved discontinuance of the bag filters by memo dated September 27, 2006. A more detailed discussion of the bag filters appears in Section 7.4.

Objective No. 6: Optimizing dewatering and water treatment operations to maximize dewatered percent solids while minimizing operating costs and meeting environmental standards.

- GW Partners monitored overall chemical usage in 2006, providing for better sediment slurry conditioning and lower residual polymer in the water treatment influent.

- The reduction of water pumped through the geotextile tubes was calculated using the average inflow to the thickeners of 1,800 gpm, or 2.6 mgd. The average flow pumped to the geotextile tubes was 853 gpm, but this only occurred for approximately 25 minutes out of every hour, for a daily total of 511,800 gallons.
- GW Partners added a rotating Trammel screen at the influent end of each of the thickeners to remove materials greater than 1/8" in size. The material that was removed by these screens, prior to the introduction of the sediment to the geotextile tubes, was all workable material at the landfill.
- Effluent from the thickeners was passed through filter fabric prior to the de-watering pad to aid in reducing the solids loading to the WTP.
- Stacked geotextile tubes enhanced dewatering as a result of compression of lower tubes and lengthening dewatering period.

Objective No. 7: Load, transport, and dispose of the dewatered sediment.

- Full-scale loading, transport, and disposal operations began on August 14, 2006, and are expected to be concluded on March 20, 2007, in order to clear the dewatering pad for the 2007 RA.
- 100,412 tons of non-TSCA sediment was disposed at the Veolia Environmental Services Hickory Meadows Landfill in the Town of Chilton, Wisconsin
- 626.18 tons of TSCA sediment was disposed at the EQ Wayne Disposal Landfill in Belleville, Michigan

Objective No. 8: Monitor RA activities and their impacts (sediment removal verification, water treatment, and air/water quality).

- Dewatered sediment paint filter and percent solids tests were performed on materials from each geotextile tube.
- Additional analysis of dewatered sediment for PCB concentration and strength parameters was completed to meet specific landfill requirements.
- Air quality was sampled and analyzed for PCBs, with no PCB's detected.
- WTP effluent was sampled and analyzed for PCBs, TSS, BOD, ammonia, and mercury.
- Surface water quality real-time turbidity testing was performed upstream and downstream of dredges.
- PCB and ammonia effluent concentrations consistently met the WDNR's performance expectations.
- Daily TSS expectation was exceeded 15 out of 151 operation days.
- Monthly TSS expectation was exceeded 4 times during the 9 months of WTP operation.
- Monthly BOD expectation was exceeded 8 out of 151 operation days.

- Effluent water quality for mercury did not meet WDNR performance expectations; however, 2006 RA effluent low-level mercury concentrations were on average an order of magnitude less than background river water concentrations.
- Sediment removal verification.
    - Bathymetric surveys were performed and confirmed that the 1-ppm PCB target dredge elevation (or documented high subgrade areas) had been attained in over 95% of each dredge management unit.
- Dredged areas were sampled and analyzed for residual PCB concentrations.
- A secure website was utilized to communicate environmental and production data requested by Agencies/Oversight Team and GW Partners.