Boskalis
Environmental

11 YEARS BENEFICIAL REUSE OF SAND LOWER FOX RIVER REMEDIATION PROJECT

Terri Blackmar, P.E.; Ron Dielhof; Richard Feeney, P.E.; Neil Geevers

Green Bay, Wisconsin

MARCH 23, 2022

Boskalis
Environmental

Project Overview

- **Combination Remedy:** designed to reduce risk to human health & environment caused by presence of PCBs in the river sediments
- **Scope:** fast track Design-Build-Operate of dredging, desanding & dewatering, water treatment, capping/covering, transportation & disposal
- **Size:** remains one of the largest sediment remediation projects in the world; Lower Fox River Operable Units 2-5 ➔ 13.3 mile stretch of the river

Boskalis Environmental

Project Team

- **Client:** Lower Fox River Remediation LLC

- **Regulatory agencies:**
  - United States Environmental Protection Agency (USEPA)
  - Wisconsin Department of Natural Resources (WDNR)
  - The Agencies/Oversight Team (A/OT) – Regulatory staff and consultants for USEPA & WDNR

- **General Contractor:** Tetra Tech EC, Inc. (design, construction, and operation of the water treatment plant)
  - **Subcontractors:**
    - J.F. Brennan Company, Inc. (dredging, capping and sand covering)
    - Stuyvesant Projects Realization Inc. with engineering & equipment from Dutch sister company, Boskalis Environmental B.V. (sediment desanding and dewatering)

➔ **Integrated Approach =** seamless integration of all aspects of the work by all parties

➔ **Memorandum of Understanding =** defines scope/"ownership" and methods for collaboration and conflict prevention/resolution among Tetra Tech, Brennan and Stuyvesant

Boskalis
Environmental

Why Separate Sand?

1) Avoid unnecessary transportation & disposal (T&D) cost;
2) Produce material that can possibly be beneficially reused, thereby conserving valuable landfill space; and,
3) Prevent additional wear and tear on downstream processing equipment.

Boskalis Environmental

Project Approach

Benefits of Early Contractor Involvement

1. Identify data gaps & how best to fill them to enhance design
2. Apply proven field experience & lessons learned
3. Ensure the constructability of remedial alternatives

Sediment Testing Program

1. Review available sampling info
2. Sampling plan (*note debris & oily waste)
3. Chemical analysis
4. Geotechnical testing
   - particle size distribution (method that accounts for presence of organics such as Protocol BS 1377 "Methods of test for soil for civil engineering purposes“; 1990; British Standard Institute)
5. Desanding & dewaterability testing (*simulate “real world” conditions)

Boskalis
Environmental

Results of Testing

Data from sediment testing program enabled:

- Analysis of various sediment types
- Development of mass balance ➔ estimate the total amount and rate of sand and fines to be produced during full-scale remediation
- Selection & sizing of appropriate sediment processing equipment (*along with estimated dredge production rate ➔ to avoid operational constraints)
- Evaluation of reuse and disposal options & costs

Boskalis
Environmental

Design of Plant

The design of the Sediment Desanding and Dewatering Plant (SDDP) for the Lower Fox River sediment remediation project included four major unit operations:

1. Feed system
2. Sand separation
3. Chemical addition
4. Mechanical dewatering

Boskalis
Environmental

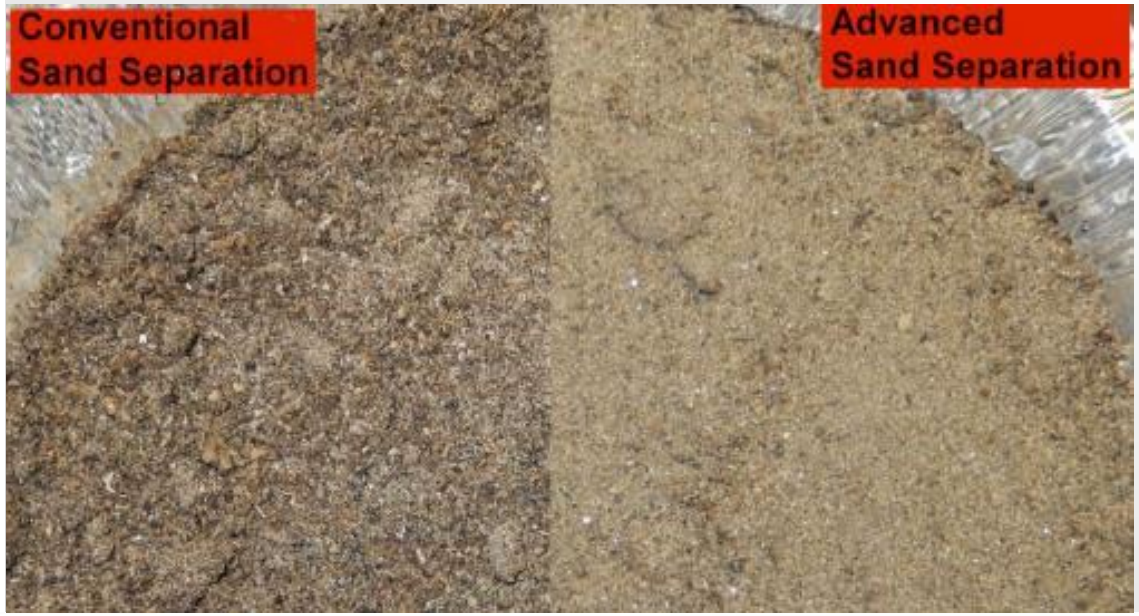
Design of Separation

Advanced sand separation

Scalping screen > 6 mm
Sand separation @ 2 cut points; 150µm and 63µm

Our conservative design basis assumed up to 40% sand content in the feed.

Approach based on extensive experience, aim for beneficial reuse, and the fact that PCBs typically adhere to organic particles present in the sediments (ranging12-20% by weight) rather than to sand.



Boskalis Environmental

Regulatory Approval

USEPA's 2007 Record of Decision (ROD) Amendment for the Lower Fox River and Green Bay Site contemplated the beneficial reuse of sand processed at the Site as follows:

"Sediment de-sanding. In general, PCBs tend to adhere to smaller sediment particles (such as silt or some clays) rather than to larger-sized sediment particles (such as sand and gravel). For that reason, the sand fraction of sediment that is removed from the River may be recovered, washed or otherwise treated, and beneficially reused. Thus, under the Amended Remedy, relatively uncontaminated sand and/or gravel may be recovered from dredged sediments, if USEPA and WDNR have approved specific beneficial uses of such sand and/or gravel. The PCB concentration of the recovered sand would generally need to be less than 0.25 ppm before it could be beneficially reused, although USEPA and WDNR may approve an alternate concentration threshold for particular uses. Some examples of potential beneficial uses would be use as partial fill for staging areas, road fill, or daily cover for a landfill. It is estimated that approximately 172,025 cubic meters (225,000 cubic yards) of segregated sand and/or gravel material may be available for potential beneficial reuse under the Amended Remedy."

Boskalis Environmental

Regulatory Approval

Timeline:

July 2, 2010 – Tetra Tech submitted project's 1st Low Hazard Exemption Request to WDNR.

➔ Overall procedure for obtaining WDNR approval requires:

- Each request must be for a specific offsite project(s)
- Proposed location, use, tons shipped, schedule, analytical & geotechnical data
- Licensed in-state landfills are automatically approved to use sand as BRM for construction purposes.

Tetra Tech addressed WDNR's comments

October 18, 2010 - WDNR issued Tetra Tech a "Conditional Grant of Low Hazard Exemption for the Beneficial Reuse of Separated Sand" from dredging non-TSCA sediment.

2011 - Our team began shipping sand from the project as beneficial reuse material (BRM).

Boskalis Environmental

Regulatory Approval

Timeline (continued):

2012 - WDNR modified original exemption to *extend the expiration date, expand the uses of the material, and relax notification requirements*.

2013 - USEPA confirmed that based on input from their Region 5 TSCA program, they had no objection to the proposed beneficial reuses provided that the PCB concentration of the sand is less than 1 mg/kg, however WDNR amended the PCB limit to match that for sand separated from dredging non-TSCA sediment, a maximum 0.49 mg/kg PCB concentration.

USEPA further clarified that their 2013 approval includes all sand material generated by our project regardless of *in situ* TSCA or non-TSCA sediment designation.

Boskalis Environmental

Regulatory Approval

Process:

WDNR approval required a test frequency for the separated sand to be beneficially reused:

- ✓ One sample per 765 cubic meters (1,000 cubic yards [cy]) for the first 7,650 cubic meters (10,000 cy), beginning each dredge season
- ✓ Then one sample per 7,650 cubic meters (10,000 cy) thereafter.

WDNR provided the **Maximum Allowable Contaminant Concentrations** as part of their conditional approval ➔ Table 1(next slide).

*Note: Concentrations shown pertain to sand that is not capped in place and are therefore conservative if applied to sand that will be capped.

Target limit of 0.49 mg/kg established by WDNR as an alternate concentration threshold based on the particular use.

Therefore, separated sand from all sediment is eligible as BRM provided it meets the WDNR requirements specified in Table 1.

Boskalis Environmental

Regulatory Approval

Table 1. Chemical and Geotechnical Characterization Criteria for Separated Sand Beneficial Reuse Projects

Chemical Parameters	Maximum Allowable Contaminant Concentrations (mg/kg, unless otherwise noted[1])
PCB, Total	0.49
Total 2,3,7,8 TCDD	0.19 (ug/kg)
Total 2,3,7,8 TCDF	0.19 (ug/kg)
DDT (and its metabolites DDD & DDE)	1.0
Arsenic	8.0
Barium	500
Cadmium	7.8
Chromium	14.5
Copper	150
Cyanide	100
Iron	20,000
Lead	50
Manganese	1,100
Mercury	4.7
Nickel	250
Selenium	63
Zinc	1,500
Geotechnical Properties	
Total Organic Carbon	Max. 5% by weight
Grain Size analysis, percent moisture/solids content, permeability	Information purposes only

Boskalis Environmental

Performance 2009 – 2019

Average PCB Concentration (mg/kg) vs. target of 0.49 mg/kg	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018 *	2019 *
Fine sand (63 µm to 150 µm)	**0.266**	**0.184**	**0.137**	**0.101**	**0.088**	**0.085**	**0.198**	**0.159**	**0.112**	-	-
Coarse sand (150 µm to 6 mm)	**0.353**	**0.113**	**0.075**	**0.079**	**0.053**	**0.063**	**0.191**	**0.126**	**0.094**	-	-
Running average (combined fractions)	**0.280**	**0.148**	**0.100**	**0.091**	**0.075**	**0.075**	**0.196**	**0.145**	**0.106**	**0.120**	**0.094**

* No separate testing was performed, only for the combined stockpiles

Note: these numbers represent test results from all produced sand during each specific operational season, dredged from both TSCA and non-TSCA designated areas. The running average is not the result over the entire 11 years

Note that approximately 90% of all sand separated from dredged sediment during the 11 years of operations was beneficially reused.

Boskalis Environmental

Logistics

- Public works (e.g., infrastructure projects such as for the Wisconsin Department of Transportation (WisDOT)) are preferred for such beneficial reuse opportunities.
- Sand from our project was shipped to various reuse locations - construction sites managed by WisDOT.
- Commercial arrangements were made between our client, the local trucking company and the receiving party.
- Tetra Tech tracked & reported on sand shipments from the processing site to the approved reuse sites and provided annual reports to WDNR on amounts shipped & test results.
- Onsite stockpiles were initially covered with liner ➔ later replaced by sprayed-on polymer emulsion bonding agent.

Boskalis
Environmental

WisDOT construction using project sand

Approved sand from Lower Fox River project was used in road base construction

Shawano-US 41 intersection (facing northeast)

Boskalis Environmental

Production & Lessons Learned

Wide variety in sediment composition:

- Sand content 10% - 80%; average 30%
- Fines content 35% - 95%; average 68%
- Remaining 2% represents the fraction > 6 mm (ranging 0% - 15%)

Sand totals through 2019:

~842,200 tons separated
~766,500 tons hauled offsite for reuse in local construction projects
Therefore, 91% reused, remainder disposed

Successfully separated sand meeting regulatory criteria for reuse in local infrastructure projects.
➔ 1st implementation on full-scale contaminated sediment remediation project in the US.

Win-Win for 2 major projects:

❖ Client saved substantial cost by not having to transport the sand for landfill disposal as waste
❖ WisDOT benefitted from local sand at no cost (instead of purchasing from commercial sources)

Boskalis Environmental

Conclusions

Project success on beneficial reuse due to:

- ✓ Client's willingness to share cost savings (Value Engineering)
- ✓ Experienced project team using the integrated approach
- ✓ Early contractor involvement, including pre-proposal (2007) sediment testing program
- ✓ Collaboration with regulatory agencies (2007 ROD Amendment) and other stakeholders
- ✓ Support of the local community
- ✓ Operation of advanced sand separation unit
- ✓ Identification of suitable local reuse sites

Boskalis Environmental

Questions?