Remedial Operations & Lessons-Learned for the Remediation of Contaminated Soils & Sediments

Mid-Atlantic Contaminated Sediment/Soils Symposium
Liberty House Restaurant – Jersey City, NJ
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Ric's presentation will highlight several interesting remedial projects:

- *Treatment Methods for the Remediation of Contaminated Soils at a Future London Sports Center*

- *Tampa Waters Ave - parking lot Geotube dewatering of 14,820 CY sediments*

- *Kinnickinnic (KK) River Dredging and Disposal Project - 167,000 cubic yards of PCB and PAH-contaminated sediments 2,000 linear feet of river channel*

- *Lower Fox River Operable Unit 1 - Segmented Geotube dewatering of 100,000 CY of TSCA and non-TSCA PCB sediments*
Treatment Methods for the Remediation of 1,000,000 tons of Contaminated Soils at a Future London Sports Center

"London Brownfield Redevelopment: A Case Study in the Development of Sustainable Remediation"

- The client (London Development Agency) has embarked on the regeneration of a substantial (256 Hectare) degraded area in east London ensuring that it will be revitalised resulting in positive social, economic and environmental change and the rectification of generations of environmental damage.

- The site is currently part of a major sports infrastructure development. It is this aspect which has provided the impetus for remediation works to proceed.
Treatment Methods for the Remediation of 1,000,000 tons of Contaminated Soils at a Future London Sports Center

Sustainability Metrics

• The Strategy outlined the requirements to minimize disposal to landfill and recover materials for beneficial re-use to meet the reuse and recycling target of 90% during demolition

• The developed Sustainable Development Strategy and supported by the Health, Safety and Environment Standard and Code of Construction Practice.

• Key objectives include:
  ✓ Reduce non-potable water demand by 40%
  ✓ Creation of a 45 ha eco-habitat
  ✓ maximize opportunities to design out waste
  ✓ Minimize off site disposal during demolition, with a maximum of 10% of demolition waste going to landfill
  ✓ maximize sustainable reuse of excavated materials (>85% of soil reuse)
  ✓ Identify source and use environmentally and socially responsible materials.
Vacant possession achieved for most of site in July 2007
Site Investigation – approximately 3,000 intrusions
Buildings demolished – 206 to date
97% of demolition materials have been recovered or reused (target of 90%)
Treatment Methods for the Remediation of 1,000,000 tons of Contaminated Soils at a Future London Sports Center

Remediation - Main Contaminants of concern

• Heavy Metals (e.g. Lead, Arsenic, Chromium)
• TPH Organics (e.g. Fuel Oil)
• Ammonia
• PAH Organics (e.g. Coal Tar, Bitumens)
• Chlorinated hydrocarbons (PCE, DCE, TCE and VC)
• Very low radioactive waste
• Asbestos
• Combinations of the above.
Treatment Methods for the Remediation of 1,000,000 tons of Contaminated Soils at a Future London Sports Center

• Excavation hydrocarbon Hot Spot
• Primary screening
• Treatment
Treatment Methods for the Remediation of 1,000,000 tons of Contaminated Soils at a Future London Sports Center

Soil Treatment Methods

Aerial View of 5 Soil Washing Plants Operating at the site
Treatment Methods for the Remediation of 1,000,000 tons of Contaminated Soils at a Future London Sports Center

Soil Treatment Methods

- Contaminated Soil
  - Soil washed sand
  - Soil washed gravel
- Blended Product
  - SWS+SWG+PLUG
- Filter cake waste
- Light waste
Treatment Methods for the Remediation of 1,000,000 tons of Contaminated Soils at a Future London Sports Center

Soil Treatment Methods

Stabilisation Plant

Bio-remediation Cells
Treatment Methods for the Remediation of 1,000,000 tons of Contaminated Soils at a Future London Sports Center

Sustainable Soil Reuse

- Filter Cake T&D’ed offsite to landfill - 91,000m³ at equivalent moisture
- Geotechnical unsuitable material T&D’ed offsite to landfill - 80,000m³
- **TOTAL Reused to date 1.8 Million m³**
  (89% of excavated material)
Treatment Methods for the Remediation of 1,000,000 tons of Contaminated Soils at a Future London Sports Center

Summary of Accomplishments

1. Dates of operation: First plant was mobilized to site 18th July 2007. Full production with 3 plants at the soil hospital as from February 2008. Expecting to remain on site until June 2010 at least.

2. A total of 5 soils washing plants have been provided to the site. DEC has provided 3 soil washing plants.

3. Production capacity of the 3 washing plants combined is up to 14,000 tons/week. Maximum 100t/hr per plant, average 70t/hr.

4. Operational schedule has been 12hrs/day - 6 or 7 days per week. Operations have only stopped for exceptionally cold weather.

5. Total soil washed to date is just over 1,000,000 tons

6. Cost of soil washing varies between $60-70/ton, including disposal of filter cakes (which constitutes the bulk of the cost)


8. All oversized masonry and concrete material is crushed and is usually acceptable for direct reuse on site without further treatment.

9. Enriched fines/filter cake 91,000m³ was not stabilized but simply dewatered and T&D’ed to a secured landfill.

10. Chemically stabilize 62,300t of non-washable (high fine content) soils for beneficial reuse on site.

Tampa Waters Ave. – temporary parking lot Geotube dewatering of 14,820 CY sediments

**Project Scope**

- Prepare Work Plans
- Site Mob/ Treatment Area Construction
- Clearing and Grubbing
- Debris Removal
- Dredging to Plan Grades
- Onshore Sediment Handling and Dewatering
- Water Control, Treatment and Return to Borrow Pit
- Env. Monitoring (sediment, water and air)
- Post Removal Bathymetric Surveys
- Transportation and Disposal of Sediment
- Capping
- Treatment Area Demo/ Clean-up and Demobilization
- Final Reports
Tampa Waters Ave. – temporary parking lot Geotube dewatering of 14,820 CY sediments

Dredging & Dewatering Areas
Tampa Waters Ave. – temporary parking lot Geotube dewatering of 14,820 CY sediments

8” dia. Horizontal Auger Head Dredge in Production
Tampa Waters Ave. – temporary parking lot Geotube dewatering of 14,820 CY sediments

Tampa Site Dewatering Tube Layout
Tampa Waters Ave. – temporary parking lot Geotube dewatering of 14,820 CY sediments

Geo-Tube Filling Process (Bag 1)
Tampa Waters Ave. – temporary parking lot Geotube dewatering of 14,820 CY sediments

Dewatered Sediment in Geotube
Tampa Waters Ave. – temporary parking lot Geotube dewatering of 14,820 CY sediments

Sediment Load-Out
Tampa Waters Ave. – temporary parking lot Geotube dewatering of 14,820 CY sediments

Lessons Learned

• Design methods

• Expect the unexpected!
Tampa Project Statistics

- **Amount of Sediment Removed:**
  - 14,820 CY
- **Average Percent Solids**
  - In-Situ: 9% to 28%
  - After dewatering: 55%
- **Polymer Dosage:**
  - Lab Results: 8 pounds per dry ton
  - Actual: 6.4 pounds per dry ton
- **Sediment transported for disposal:**
  - 14,600 tons vs. 26,500 from design estimate
- **Project on Schedule with no reportable injuries**
  - Project start April 25, 2007
  - Demobilization completed October 12, 2007
KK River Sediment Remediation Project

Technologies Used

Environmental Bucket & Positioning Software
Air Curtain for Turbidity Control
Dragline System w/Sauerman Bucket at CDF
Sand Broadcast Spreader
Project Overview

- Mechanical dredging using environmental bucket:
  - 167,000 cubic yards of PCB and PAH-contaminated sediments 2,000 linear feet of river channel
- Transport dredged material to Confined Disposal Facility
- Placement of sand cover to address residual contamination that cannot be dredged.
Dredged material transported by barge to cell

Dredge Project Area

Confined Disposal Facility
Kinnickinnic (KK) River Dredging and Disposal Project

Environmental Bucket & Positioning Software

[Images of environmental bucket and maps]
Air Curtain for Turbidity Control

- Installed at downstream end of project
- Operational between mid-June and end of sand placement operations
- Silt curtains were used for first 2 weeks of dredging until air curtain installation was completed, after which silt curtains were removed
Kinnickinnic (KK) River Dredging and Disposal Project

**Air Curtain for Turbidity Control**

- Installed at downstream end of project

Diagram shows:
- Air Curtain
- Induced Current
- KK River Dredge Area
- Final Grade
- Sediment
Air Curtain for Turbidity Control

• What is an air curtain?
  – Perforated pipe with custom nozzles laid across river channel (typically trenched in a few feet into the existing sediment)
  – Compressed air is continuously blown through the pipe creating a wall of bubbles that rises to the water surface
  – Wall of bubbles causes some suspended solids in the water column to fall out
Air Curtain for Turbidity Control

- Advantages of air curtains (over floating curtains)
  - Infrastructure does not move with high currents; once it is set up and operating, maintenance is minimal.
  - No disruption to boat traffic; vessels can cross curtain unimpeded.
  - Once initial monitoring establishes effectiveness of the air curtain, it is obvious when it is operational.

- Disadvantages of air curtains
  - Requires constant power source; compressor can be noisy.
  - Effectiveness limited during extremely high flow events.
Air Curtain Downstream of Dredge Area
Performance of Air Curtain

- Air curtain operated continuously throughout project & required no maintenance.
- Average drop in turbidity reading from 30 feet upstream of air curtain (KK Avenue Bridge) to 1,000 feet downstream of curtain was 25 NTUs.
- Survey indicated buildup of several feet of sediment on both sides of the air curtain (removed at end of project).
Problem: How do you move 167,000 cubic yards of material into cell w/soft bottom?
Ramsey Dragline System w/Sauereman Bucket at CDF

- Initial assumption was that offloaded material from barges would flow in CDF
- Existing material in bottom of CDF was extremely soft, too soft even for LGP equipment to distribute the off-loaded material
- Utilized logging industry technology with a dragline bucket to distribute material evenly throughout the CDF
Kinnickinnic (KK) River Dredging and Disposal Project

Dragline System w/Sauerman Bucket at CDF
Ramsey Dragline System w/Sauerman Bucket at CDF
Kinnickinnic (KK) River Dredging and Disposal Project

Sand Broadcast Spreader
KK River Sediment Remediation Project

Lessons Learned
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- Many factors in addition to contamination need to be considered
  - Access and navigation traffic
  - Background water column conditions (suspended solids)
  - Buried debris (wood, concrete, scrap, cables, etc.)
  - Currents (seasonal, tidal)
  - Dredging depth and Slope stability
  - Staging areas and disposal area
  - Transport routes for barges

- Innovative technologies developed specifically for this project kept the project on schedule and budget.
Lower Fox River Operable Unit 1
Lower Fox River Operable Unit 1

2003+ Remedial Design: Capping & Sand Cover and Hot-Spot Dredging

2004 RA Design/Build/Operate:
  • Fast-tracked permitting and construction to allow operations within 6 months of contract award
  • Full-scale testing of dredging/dewatering processes (10,000 cy) and sand cover

2005 RA Design/Build/Operate:
  • Planned capacity expansion of facilities and dredged/dewatered 90,000 cy of sediments
Lower Fox River Operable Unit 1

Lower Fox River, WI OU1 Staging Area (August 2005)
Using a Long-Reach Excavator for Debris Removal, Prior to Dredging

- Hydraulic dredging
  - One 12” cutterhead
  - 24 hours/day; 6 days/week
  - Most efficient type dredging for large projects
  - Assumed silt curtains at water intakes only
Dewatering Plan

- Geotextile tube dewatering
  - 80- and 100-foot-circumference tubes
  - Stacking up to 3 tubes high
  - 45-60 day dewatering time
  - Allows high project % up-time (high 80s to low 90s)

- Combine coarse-grained and fine-grained sediments to aid dewatering
  - One dredge in areas with coarse-grained sediment
  - One dredge in areas with fine-grained, highly organic content sediment

- Chemical Feed
  - Medium molecular weight, low cationic charge polymer
Geotube Dewatering

- Isolate >50 ppm sediment
- Feed geotubes at an average rate of 8,000 insitu CY per week
- Sediment will be stored and dewatered in geotubes on the pad
- Haul out at a rate of 1,100 tons/day
- Haul out to continue through December
LFR Geotextile Tubes on Dewatering Pad

Stacking 80-foot Circumference Tubes

Non-TSCA Sediment

TSCA Sediment
• Water Treatment
  – Heavy fraction remains in dewatering pad
  – Dissolved air flotation / filtration
  – Granular activated carbon
  – Outfall diffuser
  – Lower capital cost
  – Lower O&M cost
  – Simpler operation
Main treatment:
Air flotation and sand filtration

Polishing step:
Granular activated carbon

Process waste pumped back to geotextile tubes

Water drained from sediment dewatering pad

Clean water return to lake

2005 effluent
• TSS = ~1 mg/L
• PCBs = ND

Fox River Weepee Water Treatment Plant (Operated by CH2M HILL OMI)
Transportation and Disposal Approach Features Hauling in lined trucks

- Onyx Hickory Meadows Landfill (Chilton, WI)
- Permitted to 5 million cy
- Room for expansion
- In-State option for TSCA waste
Lower Fox River Operable Unit 1

- 2.5-yard clamshell bucket
- Haul non-TSCA material to Onyx Landfill in Chilton, WI
LFR Technical Lessons Learned

- **Geotextile tube dewatering**
  - Less combined capital/operating cost than mechanical dewatering
  - Higher offsite landfill disposal costs than mechanical dewatering (lower % solids and strength)
  - Higher dredge productivity with geotextile tubes than mechanical dewatering
  - Pre-thickening sediment slurry may be cost-effective
  - Shut down operations before winter temperatures get too cold

- **Hydraulic cutterhead dredging**
  - Acceptable operation w/o turbidity curtains
  - 4”- 6” overcut
  - Productivity for thin cuts determined by surface area coverage rate – not cubic yards per day
  - Use of concurrent multiple dredges can be cost-effective

- **Water treatment**
  - Dewatering pad significantly reduces solids prior to water treatment
  - Chemical clarification prior to sand filtration to reduce polymer/solids carryover
  - Bag filters after sand filtration did not significantly reduce solids or mercury, but significantly increased operating costs

- **Sand placement**
  - Sand can be placed over low % solids sediments w/o significant mixing
Summary & Take-aways

3 - Do's
1. Plan ahead - solicit and utilize unbiased, peer-review evaluations of the proposed project from recognize experts in the field;
2. Three most important elements of a successful project - details, Details, DETAILS;
3. Be flexible – try to expect the unexpected – *Murphy lurks everywhere*;

3 - Don'ts
1. Permitting and legal requirements – *don’t* trivialize agency submittals, review lead times and public opinion;
2. *Don’t* underestimate project contingencies (ie., bad weather, more/less material than expected, differing feed characteristics, varying contaminant concentrations, etc.);
3. *Don’t* trivialize initial feedstock preparation in bulk soil/sediment pretreatment steps such as debris separation (snag boats), coarse screening, crushing/shredding, and physical/chemical characterization of oversized material for potential non-hazardous wastes disposal alternatives;
From 1948 to 1949, a project known as MX981 took place on Muroc Field (later renamed Edwards Air Force Base) for the purpose of testing the human tolerance for g-forces during rapid deceleration. The Law's namesake was Capt. Ed Murphy, a development engineer from Wright Field Aircraft Lab. Frustration with a strap transducer which was malfunctioning due to an error in wiring the strain gage bridges caused him to remark - *"If there is any way to do it wrong, he will!"* - referring to the technician who had wired the bridges at the Lab. The PM assigned Murphy's Law to the statement and all the associated variations. – *ref. Wikipedia*

“Everything that can possibly go wrong will go wrong” - Murphy's Extended Law

If a series of events can go wrong, they will do so in the worst possible sequence.

"If there's more than one way to do a job, and one of those ways will result in disaster, then somebody will do it that way."

O'Toole's Commentary on Murphy's Law: “*Murphy was an optimist*”!

Although often equated with *Sod's law* (chiefly British),
Summary & Take-aways

MURPHY'S LAW
What can go wrong, will go wrong. Essentially, the laws of nature always work, whether we are paying attention or not.

(Equipment blows to protect fuses.)
(Interchangeable parts aren't & fail-safes don't.)

Mrs MURPHY'S COROLLARY
Murphy is too much of an optimist.