Northwest Oil Drain (NWOD) Sediment Removal Project

IV International Seminar On Remediation and Redevelopment of Contaminated Sites

Sao Paulo, Brazil
November 2006
Presentation Outline

1. Introduction
2. Scope of Work
3. Construction Activities
   - Sediment Removal
   - Quality Assurance
   - Water Quality Protection
   - Sediment Management
   - Regulatory Agency Relations
4. Lessons Learned
5. Conclusion
1. Introduction

Salt Lake City, Utah

Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
1. Introduction

Project Background

• NWOD received historical petroleum discharges since 1920s
• SL County wanted to dredge in 1990s for flood control
• Required coordination with EPA, Utah DEQ, US Fish & Wildlife and other stakeholders
• Working Group organized to characterize canal and developed remediation plan
• AOC signed with EPA for remedy implementation
• ERM hired as Project Manager in August 2003
• Compass Environmental hired as Design/Build Contractor in April 2004
• Sediment removal and management August 2004 to present.
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
2. Scope of Work

ERM Management Scope

1. Prepare design/build bid package
2. Coordinate bid process & contractor selection
3. Prepare Project Work Plan for EPA approval
4. Provide project management & technical Oversight
5. Serve as regulatory liaison
6. Prepare Project Completion Report to EPA
2. Scope of Work

Compass Construction Scope

1. Contractor Work Plan
2. Health & Safety Plan
3. Quality Control
4. Mobilization/Demobilization
5. Common Fill for Non-Flowing Segment
6. Excavation and Dredging
7. Canal Water Diversion and Water Quality Protection
8. Sediment Handling & Dewatering
9. Sediment Transportation & Disposal

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Specification Reference Number/Classification of Unit Price Work</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>01.381 - Contractor Work Plan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>01.200 - Health and Safety Plan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>14.30 - Quality Control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>01.705 - Mobilization/Demobilization</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>02.055 - Common Fill (General Fill) for Non-Flowing Segment</td>
<td>7,000 cu yd.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>02.315 - Excavation and Dredging (Segment 1)</td>
<td>11,570 cu yd.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Segment 2)</td>
<td>24,910 cu yd.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Segment 3)</td>
<td>4,690 cu yd.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>02.316 - Canal Water Diversion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>02.317 - Sediment Handling and Dewatering (Segment 1)</td>
<td>11,570 cu yd.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Segment 2)</td>
<td>24,910 cu yd.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Segment 3)</td>
<td>4,690 cu yd.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>02.318 - Sediment Transportation and Disposal (Segment 1)</td>
<td>10,175 ton1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Segment 2)</td>
<td>20,833 tons</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Segment 3)</td>
<td>3,987 tons</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Base Bid Total</strong></td>
<td></td>
<td></td>
<td><strong>$</strong></td>
</tr>
</tbody>
</table>
3. Construction Activities

3.1 – Sediment Removal

• Remove all hydrocarbon affected sediment from canal
• Minimize over-excavation into native canal bottom soil
• Method design by Contractor
• Estimated volume was 41,170 cu. yd.
• Payment on unit price basis per removed cu. yd.
• Volume determined by cross section surveys pre- and post-removal
• Protect Utilities
• Ensure embankment stability
3.1 Sediment Removal

Long-Stick Excavator

- Upstream section
- Scrape canal slopes
- Around utilities
- Debris removal
3.1 Sediment Removal

Hydraulic Dredge Equipment

- 1st Cutter-Head Dredge
- 2nd Small Auger Dredge
- 3rd Large Auger Dredge

Auger Dredge proved most effective for NWOD objectives
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Sediment Quantity Removed

Station Location vs Actual and Estimated Accumulated Sediment Removed from the NWOD

26.5% sediment increase above expected volume
Sediment Quantity Removed

Station Location vs Accumulated Sediment to be Removed in the Northwest Oil Drain Canal

Volume removed increased from about 42,000 to 56,000 Cubic Yards

Delivering sustainable solutions in a more competitive world
3. Construction Activities

3.2 - Quality Assurance

- Quality Assurance Project Plan (QAPP) prepared to complement project specifications
- Canal soil liner sampling (qualitative/quantitative)
- Canal water quality inspection and monitoring
- Geotechnical testing – moisture content
- Surveying for volume
- QC documentation and reporting (daily reports)
3.2 Quality Assurance

Visual Samples – Every 100 feet to inspect for visible evidence of hydrocarbons

Example Passed (48+32)  Example Failed (46+92)
### 3.2 Quality Assurance

**Canal Bottom Confirmation Samples**

Every 2,000 feet for laboratory analyses

<table>
<thead>
<tr>
<th>Station</th>
<th>TPH-DRO Results (mg/kg)</th>
<th>Oil and Grease Results (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2+05</td>
<td>82.00</td>
<td>310.00*</td>
</tr>
<tr>
<td>21+36</td>
<td>150.00*</td>
<td>&lt; 150.00</td>
</tr>
<tr>
<td>21+36 (Sample Replicate)</td>
<td>150.00*</td>
<td>&lt; 150.00</td>
</tr>
<tr>
<td>21+36 (Equipment Blank)</td>
<td>&lt; 0.50</td>
<td>38.00</td>
</tr>
<tr>
<td>40+67</td>
<td>&lt; 20.00</td>
<td>&lt; 210.00</td>
</tr>
<tr>
<td>61+23</td>
<td>&lt; 20.00</td>
<td>&lt; 150.00</td>
</tr>
<tr>
<td>81+39</td>
<td>200.00</td>
<td>340.00*</td>
</tr>
<tr>
<td>101+23</td>
<td>&lt; 20.00</td>
<td>&lt; 150.00</td>
</tr>
<tr>
<td>121+80</td>
<td>&lt; 20.00</td>
<td>&lt; 150.00</td>
</tr>
<tr>
<td>141+56</td>
<td>&lt; 20.00</td>
<td>&lt; 150.00</td>
</tr>
</tbody>
</table>

* Samples did not meet the TPH-DRO or Oil and Grease Limits; TPH-DRO 100 mg/kg, Oil and Grease 300 mg/kg
3. Construction Activities

3.3 – Water Quality Protection

Contractor to preclude upstream flooding

<table>
<thead>
<tr>
<th>Segment</th>
<th>Beginning Station</th>
<th>Ending Station</th>
<th>Length (Feet/Miles)</th>
<th>Flow (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3+00 (Boy Scout Drive)</td>
<td>39+00 (Pump Station)</td>
<td>350/0.66</td>
<td>210</td>
</tr>
<tr>
<td>2</td>
<td>39+00 (Pump Station)</td>
<td>115+00 (Chevron Bridge)</td>
<td>7,600/1.44</td>
<td>325</td>
</tr>
<tr>
<td>3</td>
<td>115+00 (Chevron Bridge)</td>
<td>125+00 (Confluence with City Drain)</td>
<td>4,000/0.76</td>
<td>375</td>
</tr>
<tr>
<td>4</td>
<td>125+00 (Confluence with City Drain)</td>
<td>335+00 (Elbow turn in canal direction)</td>
<td>20,000/3.79</td>
<td>525</td>
</tr>
<tr>
<td>5</td>
<td>335+00 (Elbow turn in canal direction)</td>
<td>435+00 (End of Study Limits)</td>
<td>10,300/1.96</td>
<td>525</td>
</tr>
</tbody>
</table>
3. Construction Activities

3.3 Water Quality Protection

Contractor Required to Protect Canal Water Quality (see QAPP)

- Silt fence used to prevent erosion and sedimentation along work area
- Dredge method(s) minimized water quality impact
- Silt curtains and sorbent booms used to remove sediment and hydrocarbon sheens
- Daily turbidity measurement and sheen inspection performed & recorded
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
3. Construction Activities

3.4 – Sediment Management

• Contractor used drying beds and Geotubes for wet sediment

• Geotubes placed in four Sediment Processing Areas (SPAs)

• Water returned to NWOD upon achieving water quality goals

• Transport & disposal on unit price basis (weight tickets)

• Sediment blended to make asphalt road sub-base material
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
Delivering sustainable solutions in a more competitive world
3. Construction Activities

3.5 Regulator Agency Relations

• Lead agency expectations – Open dialogue
• Negotiate key issues at beginning – Work Plan
• Comply with AOC requirements
• Monthly Progress Reports and periodic meetings & inspections
• Kick-off Meeting with agency to begin sediment removal - August 2004
• Work together on challenges – sheen releases
• Work to be complete – December 2006
• Project Completion Report to EPA within 60 days
4. Lessons Learned

4.1 – Assure Knowledge of Sediment Properties and Use of Vendor Tools

- Dispute resolution relating to in-place sediment condition and dredge production rate ($1.6-2.5 million issue)
- Understand full sediment profile properties (density, water content and % solids)
- Know capabilities of dredge equipment (wet sediment pump rate)
- Understand working constraints (efficiency)
- Be careful using vendor cost estimating tools
- Assure Contractor & Engineer are clear on proposal assumptions and basis – explain details of method
### Geotube Volume Spreadsheet

#### Known Volume

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project:</strong> NWOD</td>
<td><strong>Production Rates:</strong></td>
</tr>
<tr>
<td><strong>Date:</strong> 7-Feb-05</td>
<td>Total Gallons Pumped</td>
</tr>
<tr>
<td><strong>Materials Information:</strong></td>
<td></td>
</tr>
<tr>
<td>Type of Material to be Dewatered</td>
<td></td>
</tr>
<tr>
<td>Sludge</td>
<td>Total Production Wet Volume (cy)</td>
</tr>
<tr>
<td>Volume of Sludge to be Dewatered (cy)</td>
<td>Production Wet Volume Per Day (cy/day)</td>
</tr>
<tr>
<td>Specific Gravity of Solids Within Sludge</td>
<td></td>
</tr>
<tr>
<td>2.54</td>
<td>Total Bona Dry Tons</td>
</tr>
<tr>
<td>Percent Solids of the In situ Sludge</td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>Total Required Dredging Days</td>
</tr>
<tr>
<td>Percent Solids During Dredging Operation</td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Percent of Course Grain Solids in The In situ Sludge</td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Production Rates:</td>
<td></td>
</tr>
<tr>
<td>Dredge / Pumping Operation Rate (GPM)</td>
<td>Production Due to Dewatering:</td>
</tr>
<tr>
<td>1,000</td>
<td>Infiltrage Factor</td>
</tr>
<tr>
<td>Dredge Operating Time Per Day (hrs/day)</td>
<td></td>
</tr>
<tr>
<td>6.09</td>
<td>Total Dewatered Volume (cy)</td>
</tr>
<tr>
<td>Dredge Operating Efficiency</td>
<td></td>
</tr>
<tr>
<td>65%</td>
<td>41,170</td>
</tr>
<tr>
<td>Geotube Costs ($/lin. ft.):</td>
<td>Total Dewatered Volume (tons)</td>
</tr>
<tr>
<td>30 Ft. Circumference</td>
<td>58,650</td>
</tr>
<tr>
<td>45 Ft. Circumference</td>
<td></td>
</tr>
<tr>
<td>60 Ft. Circumference</td>
<td></td>
</tr>
<tr>
<td>90 Ft. Circumference</td>
<td></td>
</tr>
<tr>
<td>$14.58</td>
<td></td>
</tr>
<tr>
<td>$21.50</td>
<td></td>
</tr>
<tr>
<td>$29.00</td>
<td></td>
</tr>
<tr>
<td>$44.63</td>
<td></td>
</tr>
</tbody>
</table>

#### Geotube Cost:

<table>
<thead>
<tr>
<th>Length (ft)</th>
<th>Total $</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 Ft. Circumference</td>
<td>20,585 $300,129.39</td>
</tr>
<tr>
<td>45 Ft. Circumference</td>
<td>11,763 $252,901.43</td>
</tr>
<tr>
<td>60 Ft. Circumference</td>
<td>7,624 $221,098.16</td>
</tr>
<tr>
<td>90 Ft. Circumference</td>
<td>4,574 $204,157.40</td>
</tr>
</tbody>
</table>
4.1 Assure Knowledge of Sediment Properties & Use of Vendor Tools
4.1 Assure Knowledge of Sediment Properties and Use of Vendor Tools

Summary of Geotube & Production Estimates based on Sediment Properties

<table>
<thead>
<tr>
<th>% Solids (Ws/Wt)</th>
<th>No. Geotubes</th>
<th>Dredge Pumping Rate Resulting in No. Days for Dredge Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2000 gpm</td>
</tr>
<tr>
<td>25</td>
<td>17</td>
<td>26</td>
</tr>
<tr>
<td>42</td>
<td>29</td>
<td>50</td>
</tr>
<tr>
<td>52</td>
<td>38</td>
<td>67</td>
</tr>
<tr>
<td>Actual Requirement</td>
<td>56</td>
<td></td>
</tr>
</tbody>
</table>
4. Lessons Learned

4.2 – Select Appropriate (Dredge) Equipment

Cutter-Head Dredge

Auger Dredge
4. Lessons Learned

4.3 – Warning: Project Incidents

• Safety – Long-stick excavator hit High Voltage Line

• Geotube rupture released hydrocarbons and sediment onto adjacent property and back into canal – requiring further cleanup

• Excessive hydrocarbon sheen required formal EPA reporting, work stoppage, increase in controls, and downstream sampling

• Heavy loads damaged earth roadways
4.3 Warnings: Project Incidents

Geotube Rupture and Clean Up
4.3 Warnings: Project Incidents

Geotube Rupture and Clean Up
4.3 Warnings: Project Incidents

Hydrocarbon Sheen Release & Reporting
4.3 Warnings: Project Incidents

Heavy Equipment Damaged Earth Roads
5.0 Conclusion

Project Chronology – 2 Years Construction

• Work Plan Approved – July 2004
• Compass Mobilization - August 2004
• Compass Dredging 12+50 to 36+24
• Winter Shutdown - December 2004
• Sediment Hauling - January 2005
• Compass Remobilization - May 2005
• Compass Completes Segment 1 - August 2005
• Winter Shutdown – December 2005
• Compass Remobilization – May 2006
• Compass Completes Segment 2 – August 2006
• Compass Completes Segment 3 – October 2006
• Sediment Hauling – August 2006 to Present
5.0 Conclusion

Project Costs

• ERM – Engineering/Management Services: $600,000
• Compass – Construction: $5.6 million

• Original Bid (unit price based): $2.8 million; next lowest bid was $4.6 million
• 25% volume and 20% weight increases would have led to price of $4.1 million using original unit prices
• Dispute resolution lead to increase in select unit prices and final construction cost above
• Based on actual volumes/weights, the next lowest bid would have been $6.1 million
5.0 Conclusion

Closing Statements

• Hydraulic dredge and Geotube method proved to be good solution for NWOD
• Auger-type dredge worked best to achieve clean canal bottom
• Improved understanding of sediment and dredge production rate would have altered schedule and cost projection
• Compass price may have exceeded other bids, and resulted in selection of other contractor
• Engineer must understand and assure contractors assumptions to protect client from dispute claims
5. Conclusion

Applications in Brazil

Delivering sustainable solutions in a more competitive world