ST. LOUIS RIVER/INTERLAKE/DULUTH TAR SITE REMEDIATION SEDIMENT OPERABLE UNIT – 2006 SAND CAP/ SURCHARGE PROJECT DULUTH, MINNESOTA

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ABSTRACT

The work was performed within Stryker Bay, in the St. Louis River estuary, approximately 6.4 kilometers (4 miles) up river from Lake Superior in Duluth, Minnesota, at the St. Louis River/Interlake/Duluth Tar Site (SLRIDT) site. The scope of work for this phase of the project required the installation of a 616 meter (2,020 LF) sheet-pile containment wall around an 4.45 hectares (11-acre) area in the Bay, with subsequent placement of a sub-aqueous sand cap/surcharge of approximately 68,814 cubic meters (~90,000 cubic yards), followed by conventional/civil sand cap/surcharge placement effort of approximately 68,814 cubic meters (~90,000 cubic yards). The scope of work also included site preparation; spill boom and silt curtain installation and maintenance; installation of deep and shallow sediment monitoring instrumentation; performing a sub-aqueous capping demonstration lift; and sub-aqueous installation of approximately 44,313 square meters (53,000 square yards) of a Reactive Carbon Mat (RCM) geo-textile material between the first 15.2 centimeters (6 inch) lift of sand and the remaining material placed.

The project approach developed focused on the goal of providing the safest, most cost-effective, efficient, and best quality service possible to meet the stakeholder's objectives. This was accomplished by coordinating the work effectively with the stakeholders, regulatory agencies, and the public to meet the required schedule completion date.

INTRODUCTION

A structured schedule was developed that facilitated the completion of numerous work activities simultaneously; thereby consolidating the overall project completion in an attempt to ensure milestone completion dates were met. This schedule was formulated in an attempt to reduce the overall on-site time required for fieldwork activities.

Prior to mobilization, specialty marine equipment was fabricated to allow the sub-aqueous sand cap to be spread evenly and uniformly in a manner that allowed the rate of placement to be tracked and confirmed. The introduction of slurry into the water was at reduced velocities, via a state-of-the-art spreader box. Turbulence and sediment disruption was minimized, thereby providing greater safety protection factors for water and air resources as well as the public and surrounding residents.

This specialized marine equipment operated in very shallow water depths (draft). This allowed the sub-aqueous sand cap materials to be placed according to the specifications, in specified lifts, to approximately the water surface elevation using the specialty fabricated marine equipment. The control of location and rate of placement of sub-aqueous sand material using this equipment allowed precise monitoring and recording of the depth and location of materials.

An integral component of the sub-aqueous placement activity included a computerized QA/QC system for monitoring and optimizing the cover placement. The system continuously monitored the cover feed versus the movement of the cover placement equipment. This data stream allowed the QA/QC system to continuously monitor cover thickness as the cover was placed. Based on the QA/QC system feedback, the operator adjusted the feed rate and/or placement equipment movement to produce cover lift thickness as required. A calibrated load cell on the conveyor belt continuously monitored the weight of cover material as it was fed into the cover placement equipment. A GPS unit on the placement equipment provided the equipment's location. A computer was used to gather the input data, calculate the cover thickness, and store the raw data and calculation results in a database.

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The RCM geo-textiles were assembled in rolls 12.2 to 22.9 meter (40 to 75 feet) wide and up to 122 meter (400 feet long. The rolls were installed on reels fastened to the deck of a barge and unreeled over the advancing side of the barge using an idler roller. The starting end of the geo-textile was anchored at the shore and/or the sheet-pile wall. A guide float system and conduit/pin guides (installed in the sediment) were used to keep the geo-textile placement in the intended location. Settlement monitoring plates were installed immediately behind the RCM geo-textile installation task.

The sand was spread and placed using a special arrangement to insure that the spreading box traversed the cap area on a linear line. The barge and spreader box were connected by a floating pipeline to the dredge pump at the south end of the cap area, near sand surge piles. This dredge pump was connected to a modified hopper pipe intake to accept sand feed from a portable belt conveyor with a variable-rate feed hopper. The belt conveyor had a weight-belt-scale. The weight belt scale was converted using a weight-to-volume relationship for the sand fed into the pump during the day's spreading activity. The feed was at a rate of approximately 153 cubic meters per hour (200 cubic yards per hour). The sand pump delivered the sand slurry to the spreader barge at approximately 18,925 liters per minute (5,000 gallons per minute) (2.55 cubic meters of loose sand per minute or 3.33 cubic yards of loose sand per minute).

To initiate a pass across the cap, sand was supplied to the pump at a rate of 2.55 cubic meters per minute (3.33 cubic yards per minute). When sand reached the discharge box, the box was moved along the guide system at a rate of approximately 3.7 meters per minute (12 feet per minute), spreading approximately 15.2 centimeters (6 inches) of sand over the 4.6 meter (15 feet) width of the discharge box. At the end of a run/pass, the sand feed was stopped prior to reaching the end (60 to 90 seconds required to empty the pipeline), the two ends of the guide moved 4.6 meter (15 feet), and the process repeated.

Figure 1. Sub-capping operations.

A Trimble GPS receiver on the sand spreader barge constantly monitored the location of the spreader box. The Trimble system fed the location signal to a Hypack software system on the spreader barge so that the operator knew his rate of travel along the guide system. The Hypack software also sent the location signal to a separate computer located near the feed conveyor weight belt scale. This quality control computer monitored both the conveyor feed rate and the location signal from Hypack to determine the rate of movement that should have occurred to evenly spread the sand. The quality control computer also provided a signal to the spreader barge indicating the required travel rate the spreader operator should have made as he traveled along the guide system, and provided notice to the operator whenever the feed to the dredge pump started or stopped.

Every 24 hours, the database on the quality control computer was used along with the positioning control from the Hypack software to produce a map showing the area of the cap layer placed in the last 24-hours and the concurrent statistics showing the rate of placement and rate of travel.

Once sub-aqueous capping operations were complete, Envirocon began surcharge placement (above the water line) utilizing conventional capping methodologies. Material was loaded from the stockpile location(s), trucked to the cap area(s), unloaded, and placed to required lift thickness utilizing a bulldozer. Lift thickness was monitored on a continuous basis via lift thickness survey information.

Once fill placement activities were completed (based upon geo-technical sediment and pore pressure dissipation), the Site was cleaned up and demobilization activities were completed.

CONCLUSIONS

The subaqueous sand cap and surcharge placement program met project objectives due to the following elements:

- Multi-tasking specific operations to consolidate project schedule.
- Fabrication of specialty marine equipment used for RCM deployment and sub-aqueous capping operations.
- Development of a state-of-the art computer program using equipment and procedures to control and confirm the rate of placement of the cap and surcharge material (sub-aqueously). Rate and thickness of sub-aqueous sand cap and surcharge material was calculated and documented using this program and presented to equipment operators and QA/QC personnel on a real-time basis.
- Performing sub-aqueous sand cap and surcharge material placement activities utilizing 24-hour operations on a 7-day per week basis.
- Performing RCM material installation activities utilizing 24-hour operations on a 7-day per week basis.
- Protection of air and water quality and minimization of potential impacts to air and water quality.

Consolidation and pore-pressure dissipation monitoring is still ongoing. If/when subsurface geotechnical conditions warrant, additional and/or final sand cap surcharge lifts will be placed to design depth.