Lessons Learned as the Project Field Engineer During the Remedial Action and Voluntary Betterment Construction in a Milwaukee, WI Waterway
Executive Summary

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Ramboll Americas Engineering Solutions. Inc. (Ramboll) provided environmental engineering and consulting services during the Remedial Action (RA) and Voluntary Betterment (the Betterment) construction at the Burnham Canal Superfund Alternative Site (the Canal or Site) in Milwaukee, Wisconsin. Following a long history of industrial use and the consequent impacts to the Canal sediments, the site was listed as a Superfund Alternative Site within the greater Milwaukee Estuary Area of Concern (AOC). From October 2020 to June 2021 the RA and the Betterment construction was performed. Design and construction of the RA and Betterment are intended to reduce risks to ecological and human health receptors while also installing additional aggregate materials to support the future construction of an urban wetland at the Canal. My internship was completed while working for Ramboll throughout these phases of the project and during the post-construction monitoring phase that is presently on-going. My Final Report in fulfilment of the PSM degree requirements describes Burnham Canal site history; the Milwaukee Estuary AOC; collected and reported project data; unique design elements and considerations; as well as several key lessons learned during the construction and monitoring phases of this project.

Situated in Milwaukee, Wisconsin's Menomonee River Valley, the 4-acre Site has a legacy of intensive industrial utilization during the 19th and 20th century (**Figure 1**). Prior to Burnham Canal being constructed in the 1890's, the area had historically existed as a wild rice marsh

(Gurda 2021). The Site is oriented east-west lengthwise and extends approximately 1,500 feet from its west end to the 11th St. Bridge with bank widths ranging from 95 to 125 feet (USEPA 2011a). At various periods in time tanneries, lumber mills, building material manufacturers, a foundry, and cement companies among others comprised the diverse portfolio of industrial users of the canal. The swing bridge at 11th St. that had allowed ships access into the canal was converted to a fixed street-level bridge in the 1980's. Converting the bridge led the Canal to be delisted from United States Army Corps of Engineers (USACE) navigable waterways jurisdiction and the industrial utility of the Canal was effectively ended with respect to shipping or transportation of goods via the Milwaukee Harbor (Ramboll 2020). The Potentially Responsible Party (PRP) operated a copper wire reclamation furnace at the western bank of the Canal until the mid-1980s that was determined to be a source of elevated copper and polycyclic aromatic hydrocarbon (PAH) concentrations in Canal sediment (USEPA 2011b). The Site was listed as a Superfund Alternative Site (SAS) and the RA was designed to address the concentrations of copper and PAHs in the Canal sediment as defined in the Record of Decision (Ramboll 2020 and USEPA 2011b). The inclusion of the Betterment was a voluntary element added to the design to support long-term goals of local stakeholders to construct an urban wetland at the SAS as well as in parts of the waterway east of the 11th St. Bridge.

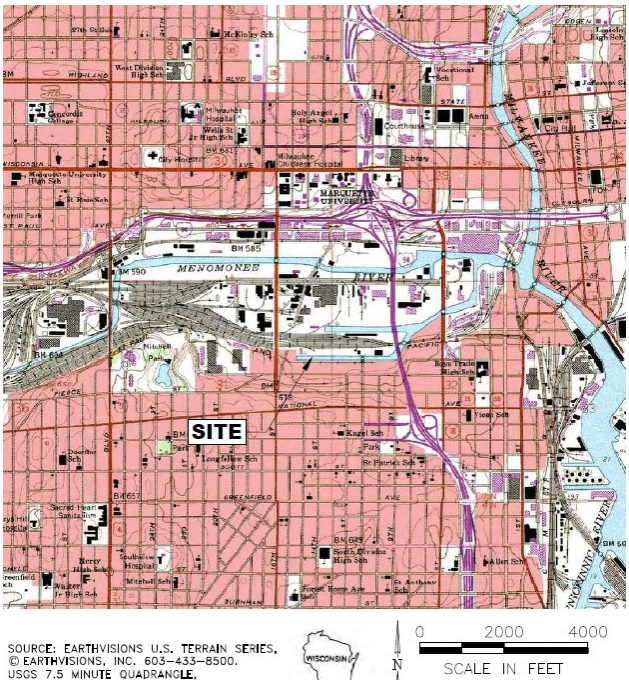


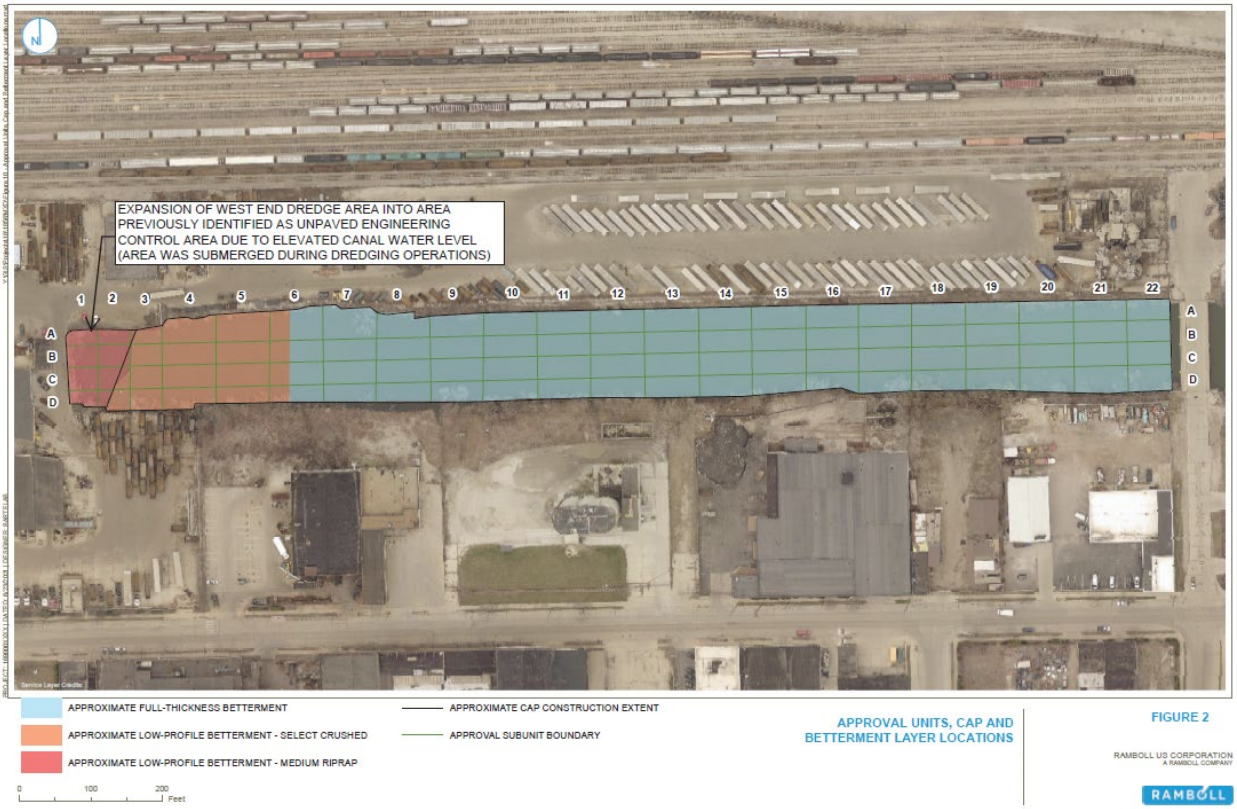
Figure 1. Site location map

RA and Betterment construction commenced in October of 2020 with mobilization of marine construction equipment and the installation of a north-south oriented sheet pile wall and turbidity

controls at eastern limits of the project area (perpendicular to the flow of the waterway). Environmental dredging, stabilization, and disposal of approximately 1,100 cubic yards (CY) of sediments with elevated concentrations of PAHs and copper from the western end of the Canal was performed using a mechanical marine dredge platform following installation of the sheet pile wall. This same marine dredge plant was utilized to re-locate and beneficially reuse approximately 1,400 CY of lesser contaminated sediments within the Canal. The sediments were relocated from isolated high points to create a more level subbase to construct the RA Cap and Betterment upon while maintaining a defined conveyance channel extending from the combined sewer outfall at the western end of the project area (Ramboll 2021).

The marine dredge plant was reconfigured to accommodate the unique spreading system owned by the subcontract marine construction partner, the Broadcast Capping System (BCS™). Using the BCS™, the RA was constructed by spreading imported and pre-qualified aggregates in thin lifts across the project area. The first layer installed was the stabilization layer which was required to prevent mixing of underlying sediments from the subsequently installed aggregates. Once the subbase was stabilized, the average 1-foot thick RA Cap was installed by middle January 2021. Following a winter break caused by frozen surface water conditions, operations resumed with the Betterment installation occurring from March 2021 through May 2021. Most of the Canal received at least 5 feet of additional aggregate atop the RA Cap to comprise the Full-Thickness Betterment. From the western edge of the Canal extending about 300 feet east, geotextile fabric was installed manually by divers on the RA Cap surface followed by the placement of approximately 2 feet of aggregate atop the fabric to comprise the Low-Profile Betterment (**Figure 2**). These layers atop the RA Cap further protect the cap, thus further isolating potentially contaminated sediment from ecological or human health receptors, while also creating a substantial base for an urban wetland to be constructed by others in the future.

At the conclusion of the project more than 71,000 tons of imported and pre-qualified aggregate was spread or placed in the Canal to construct the RA Cap and Betterment (Ramboll 2021).



Many quality assurance and quality control (QA/QC) procedures were implemented to demonstrate the placement of required thicknesses of aggregates across the Canal for each of the distinct layers. While working as the Field Engineer for the project, I performed many of the required procedures in accordance with approved documents and standards. These include but is not limited to the tracking and management of aggregate importing and pre-qualification; collection of chemical samples from post-dredge sediments and the RA Cap; QA/QC catch cylinder collection and documentation; and continuous project turbidity monitoring.

Notable lessons learned during the project include: 1) the need for the project team to adapt as-built construction elements with consideration to increasing surface water elevations and 2)

developing multiple lines of evidence using QA/ QC procedures to demonstrate compliance with construction specifications.

Following successful completion of the construction phase of the project in May 2021, the monitoring phase has since ensued. Annually or after significant rainfall events as determined by the *Cap Operations, Maintenance and Monitoring Plan*, I have supported monitoring data collection events performed by Ramboll to confirm the condition of the RA Cap and Betterment (Ramboll 2023).

This project has significantly contributed to my professional development and improved the level at which I am able to contribute to Ramboll. Through collaboration with colleagues at Ramboll and the teaming partners outside the firm, I was able to support the successful construction of relatively large remedial and wetland base design. The project itself included elements of sustainable and adaptive design that will benefit the Milwaukee Estuary AOC and the surrounding communities.

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