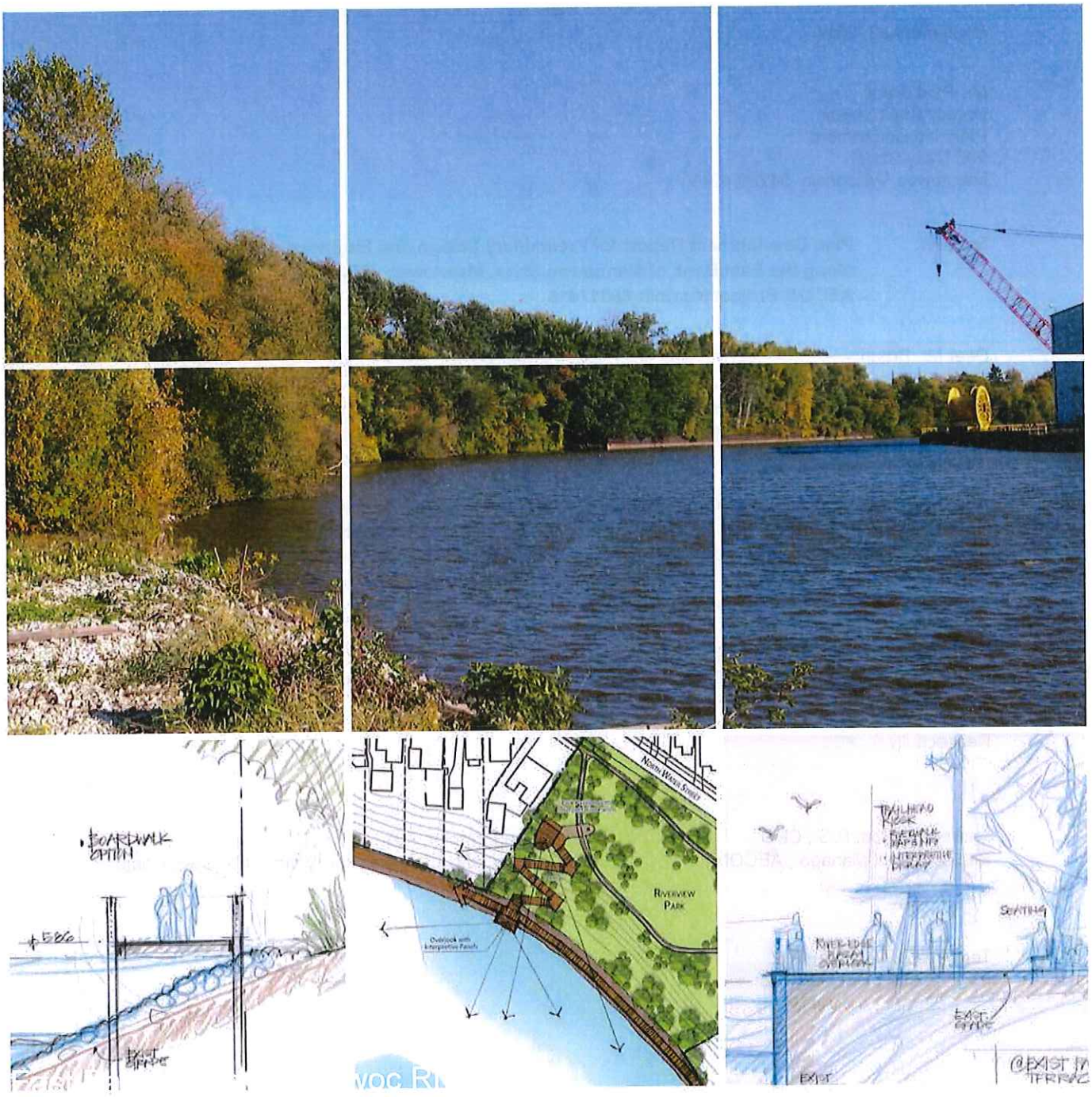
PRELIMINARY DESIGN AND ENGINEERING STUDY FOR SHEET WALL AND RIVER WALK

East Bank of the Manitowoc River

MANITOWOC, WISCONSIN

AUGUST 2014



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September 24, 2014

Mr. Paul Braun
Deputy City Planner
Planning Department
900 Quay Street
Manitowoc, Wisconsin 54220-4543

Subject: **Plan Development Report for Preliminary Design and Engineering Study – River Walk along the East Bank of Manitowoc River, Manitowoc, Wisconsin**
AECOM Project Number 60317415

Dear Mr. Braun:

Enclosed is the Plan Development Report for the Preliminary Design and Engineering Study for the River Walk along the east bank of the Manitowoc River. This Report compiles information developed during the four phases of the study, and follows the Scope of Services described in our proposal dated December 19, 2013.

AECOM Technical Services (AECOM) and Vandewalle & Associates (Vandewalle) have worked hand-in-hand with the City and the project stakeholders, with the goal of delivering a practical, constructible, and permittable plan, which incorporates and encourages a variety of public uses, and maximizes funding opportunities. River Walk projects have been shown to generate an inherent sense of civic pride, and create a great selling point for economic development potential.

We welcome any comments or questions you may have. We look forward to continuing our working relationship with the City during implementation of the River Walk and are ready to assist with grant applications, permit applications, final design, and construction management.

Respectfully,

Andrew G. Mott, P.G., CPG
Senior Project Manager, AECOM

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1 Introduction

1.1 Project Goals

In 2013, the City of Manitowoc was awarded a grant from the Wisconsin Coastal Management Program to prepare a Preliminary Design Report to determine the design, location, and feasibility for constructing a sheet wall (or other shore stabilization technique) and adjacent river walk for pedestrian and bicycle traffic along the east bank of the Manitowoc River (River). This river walk would follow approximately 2200 lineal feet of shoreline extending from the Wisconsin Public Service (WPS) property on the south (402 N. 10th Street) to the former Consumer Steel Property on the north (near Spring Street). Figures 1 and 2 show the general location of the proposed river walk and study area.

As identified in the City's November 21, 2013 Request for Proposal, this study is intended to be the first in a multi-step process to:

a. Stabilize the shoreline of the River;
b. Improve storm water run-off and the water quality of the River;
c. Enhance and/or create wildlife habitat;
d. Provide additional public access to the River;
e. Create an additional pedestrian and bicycle link;
f. Develop a vastly underutilized area of the City in a manner which builds upon the city's strong nautical heritage.

AECOM Technical Services (AECOM) teamed with Vandewalle & Associates (Vandewalle) to deliver:

- Engineering designs of shore treatment options and associated riverbank stability to support a river walk system;
- Opinions of construction cost to help select the option which optimizes project benefits in relation to project cost;
- Funding mechanisms and approaches to maximize the ability to obtain construction dollars and minimize the use of general tax revenues; and
- A detailed timetable to serve as a roadmap for follow-up actions to implement the project.

The end deliverable, (this Plan Development Report), consists of an implementation plan which recommends the layout, preliminary design, and features of the river walk; presents opinions of construction cost; funding sources; and a timeline for follow-on actions. Selected portions of this report were presented to the Manitowoc City Council for formal adoption of the river walk program.

1.2 Issues/Constraints

The following issues and constraints were identified during the Kick Off meeting at the onset of the project. For a full summary of this meeting, see Appendix A.

- The river walk will traverse an area that is officially mapped as "Erosion Hazard Area" due to steep banks and on-going erosion.
- This river walk is considered a transition corridor in an industrial area of the City between the downtown and outlying area to the west. Connections to the Ice Age Trail are important. Mariners Trail along the Lake shoreline has been very well received, and should be connected to the study area in the plan. Tie-ins on each end of the river walk should conform to previous river walk and port plans. North 10th St. currently has a designated bike lane.

- Features should be incorporated which will enhance funding approvals (i.e. Storm water management, bike/pedestrian designations, and signage), and will also interest local grassroots groups. Look for opportunities to provide fishing, and canoe/kayak areas.
- Design Standards should be selected for the final plan (i.e. lighting, pathway surfaces, markings, amenities) to provide consistency and recognition by the public.
- No winter use (or plowing) of this river walk is presently intended.
- Shore protection may consist of steel sheet pile wall, but other options should be considered. A floating river walk may be an alternative, but passage of large commercial vessels on the river, along with high maintenance and operations costs (removal and reinstallation each year), would likely make this impractical.

1.3 Phased Study Approach

This Study was approached in four distinct phases, each with a clearly defined goal:

1. Preparation Phase – Bring City staff, interested Stakeholders, and the AECOM/Vandewalle team together to verify the end deliverable, identify significant issues both physical and regulatory, and plan the schedule of activities. Key elements of this phase were to address preliminary concerns from the regulators for permitting, and scheduling review meetings so that key stakeholders and general public could be updated as the study progressed.
2. Investigation Phase – Perform an assessment of the site's existing conditions. This included a visual observation of the shoreline characteristics, a subsurface exploration and geotechnical evaluation, and a desk-top review of environmental conditions. This phase developed engineering parameters for the preliminary design work.
3. Concept Development Phase –Evaluate various options for incorporating the river walk into the shoreline, and options for controlling the ongoing bank erosion. Recommend those options that are workable, practical, and able to be permitted.
4. Plan Development Phase – Prepare the implementation plan to include an alignment, typical sections, opinion of costs, funding sources, breakdown of riverwalk into fundable segments, and a planning-level schedule to identify milestones for funding applications, permitting, further engineering, and eventual construction.

2 Site Investigation

2.1 Shoreline Assessment and Site Features

2.1.1 Shoreline Assessment

Mr. David Atkins, P.E. of AECOM performed an observation of the east shoreline of the Manitowoc River in the subject area on May 5, 2014. The stationing noted in these descriptions is shown on Figure 3. A photo log, photo log summary, and photo location map are included in Appendix B.

In general the shoreline can be characterized as heavily wooded, with trees and other vegetation overhanging the riverbank. Erosion of the riverbank, and upper slopes is evident along almost the entire subject area. There are remnants of concrete debris and old deteriorated timber bulkheads, and a standing section of steel sheet pile bulkhead.

For the purposes of describing the shoreline, it has been broken into five sections:

1. The tie-in at the south terminus of the river walk adjacent to the WPS property (402 North 10th St), (Station 0+00 to 1+00),
2. South and Middle South section (Station 1+00 to 9+50),
3. Middle North section (Station 9+50 to 13+50)
4. North section (Station 13+50 to 22+00),
5. The tie-in at the north terminus of the river walk to Spring Street through the Consumers Steel Property (Station 22+00 to 30+50)

Section 1 (Station 0+00 to 1+00) – The shoreline consists of an existing bulkhead of vertical steel sheet piling with a horizontal, steel sheet pile waler located just above the waterline. The sheet piling and waler are corroded, and large portions of the waler are missing. The bulkhead appears to be failing—at some locations, the top of the bulkhead has moved outward (toward the river), while at other locations, the bottom of the bulkhead (near the waterline) has moved outward.

The concrete walk on top of the bulkhead exhibits numerous areas where the walk has settled or moved, creating tripping hazards. The walkway is presently barricaded to restrict public access.

Section 2 (Station 1+00 to 9+50) – The shoreline bank is steeply sloped and covered by vegetation, trees, and shrubs. A severely decayed timber retaining wall is partially visible above the waterline in two locations. A large, precast concrete storm water outfall pipe was observed near station 4+50 (State Street Right of Way). The riverbank around the end of this pipe is protected by riprap.

Section 3 (Station 9+50 to 13+50) – This section consists of an existing steel sheet pile bulkhead, date of construction is unknown but is likely pre-1970's. The bulkhead consists of vertical steel sheet piling with a steel channel cap, and a horizontal, steel sheet pile waler located just above the waterline. The sheet piling, channel cap, and waler are corroded, but the bulkhead does not appear to be failing. At the north and south ends of the bulkhead, the backfill behind the wall has eroded away; however, near the center of the bulkhead, backfill is still present. Steel anchor rods and timber dead man piles are exposed at the ends of the bulkhead; these provide lateral support for the bulkhead return. The timber bulkhead return and dead man piles are severely decayed, and the steel anchor rods are corroded and bent.

Section 4 (Station 13+50 to 22+00) – The sloped bank is covered by vegetation, trees, and shrubs. A severely decayed timber retaining wall is partially visible above the waterline. In the area of Station 22+00, the sloped bank is partially protected by construction debris (broken concrete and concrete masonry blocks).

Section 5 (Station 22+00 to 30+50) – Beginning at station 22+00, the river walk alignment moves onto the former Consumers Steel property. This part of the alignment is on a relatively open, gently sloping area that has existing unoccupied buildings, with paved/graveled access roads and parking areas.

2.1.2 Site Features

Figure 3 also illustrates a number of important Site Features which were considered during selection of the river walk alignment, and for incorporation of necessary shoreline improvements. Each of these features is shown on drawings of the various plan elements found later in this study report.

These features include:

Pierhead/Bulkhead Line – This line defines the limits of the Manitowoc Harbor. This line was established on April 2, 1941 by the US War Department, and is documented on Drawing File No. 2-G-36. This drawing is on file with the City of Manitowoc.

Channel Line – This is the limit of the navigational channel of the Manitowoc River, as established by the US Army Corps of Engineers (COE). This navigational channel is maintained by the COE on a regular basis, and is authorized to be dredged to a depth of -21 ft. below Low Water Datum (elevation 556.5 IGLD85 datum) in the subject area. Soundings are performed by COE on a yearly basis to check the depth of the channel and identify if dredging is needed. Bathymetric information (river bottom elevations) from the April 2013 COE sounding have been used in the preliminary designs included in this plan. These elevations were taken from Map No. maw031304c, on file with the City of Manitowoc.

Property Limits of City-Owned property – With the exception of a small section around station 0+00 which is owned by Wisconsin Public Service (402 North 10th Street), the City owns the shoreline from approximately station 0+00 to approximately station 22+00. The width of their property varies. Much of their shoreline ownership is less than 50 feet wide, but increases significantly where streets abut the river (State Street, Park Street, North 13th Street), and at Riverview Park. Property adjacent to the City-owned strip along the river is privately-owned residential or commercial. The portion of the river walk alignment on the Consumers Steel property from station 22+00 to 30+50 is privately-owned by City Centre LLC. Parcel limits were provided via GIS information provided by the City. This information was reviewed by a local survey firm (SMI Associates), but no field confirmation or property boundary survey was performed.

Flood Level – The 100-year flood level of this stretch of the Manitowoc River is elevation +585 NAVD88 datum. This flood level was obtained from current Federal Emergency Management Agency (FEMA) mapping and flood studies.

2.2 Geotechnical Evaluation

The full report of the subsurface exploration and geotechnical evaluation with boring logs, is included in Appendix C. The following is a brief summary.

A geotechnical exploration program consisting of three (3) soil borings was performed to assess the subsurface conditions along the proposed river walk alignment. Locations of the borings are shown on the Soil Boring Location diagram in the report attachments, and are also shown on Figure 3. The borings were extended to depths ranging from 75.5 to 110.2 feet below ground surface.

At borings B-1 and B-2, the subsurface profile was similar. In general, borings B-1 and B-2 encountered topsoil and fill in the upper 1.5 feet underlain by alternating layers of sandy silt, sand, and silt. A very dense layer, termed hardpan, was encountered in boring B-1 at an approximate elevation of 557.0. The soil profile was significantly different in Boring B-3. Boring B-3 encountered topsoil and fill to a depth of 10 feet underlain by sand and gravel to the termination depth of the boring. Groundwater was encountered in borings B-2 and B-3. The site is adjacent to the Manitowoc River. The water level of the river varies but tends to match the water level of Lake Michigan due to its proximity to the lake. Lake Michigan's Low Water Datum is elevation +577.5 feet in reference to the International Great Lakes Datum (IGLD) 1985.

Based on the topographic mapping provided by the City, the existing slopes along the eastern shore of the Manitowoc River are very steep in certain areas. Site observations and photos confirm on-going erosion. A slope stability analysis was performed on the existing site conditions, which was intended to determine the Factor of Safety (FOS) for global stability of the riverbank area. Stability analysis was performed for both short-term, undrained loading conditions, and long-term, drained loading conditions. Short-term analyses indicate FOS ranged from 1.3 to 1.7. Acceptable FOS for short term conditions is 1.3. Therefore the FOS for the short-term existing conditions are generally acceptable. Long-term analyses indicate FOS ranged from 0.8 to 1.7. Acceptable FOS for long-term conditions is 1.5. Therefore the FOS for the long-term conditions are not acceptable and indicate the slope has a high risk of failure in some areas. Based on site observations, the existing root mass of the heavily vegetated slope is likely aiding in the stability of the slope. Bare soils on these steep slopes indicates continuing erosion. Figure 4 illustrates the riverbank areas of "High", "Moderate", and "Low" stability concern. The slopes with "High" stability concern should be addressed to prevent future failures from occurring. Section 3.2 of this report describes various means to stabilize the slopes.

Recommendations to be used in the preliminary design of slope stabilization, sheet wall retaining systems, rip rap revetments, pile supported boardwalks, and general design and construction considerations are provided in the Geotechnical Report.

2.3 Environmental Conditions

2.3.1 Environmental Review

Historic records reviewed for the proposed Manitowoc river walk project included the Wisconsin Department of Natural Resources (WDNR) Bureau of Remediation and Redevelopment Tracking System (BRRTS), the WDNR Remediation & Redevelopment (RR) Sites Map, Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) storage tank database, and historic Sanborn Maps.

The project area was historically used for mixed purposes. Residential dwellings were generally located in the central and northern portions of the subject area with industrial and manufacturing locations along the southern portion. The 1906 Sanborn Map shows the Manitowoc Gas Co with gas holder and coke yard. The 1919 Sanborn Map shows the Manitowoc River was widened to allow for a turning bay for ships, which were typically docked along the banks of the river when not in use.

Existing conditions are comparable to historic uses. Industrial and manufacturing facilities are located in the southern portion of the subject area, and residential in the central and northern portions. A steep, wooded bluff exists along the Manitowoc River in the central and northern portions of the segment; a few commercial properties and Riverview Park are also located in these portions.

2.3.2 Results of Environmental Review

Based on a review of the historic records noted above, the project area is located on or near several sites that may have contamination including, but not limited to:

1. **402 North 10th Street and North 11th Street & Chicago Street** – Open Envrionmental Repair Program (ERP) site, (BRRTS #02-36-000219): Wisconsin Fuel & Light Co (WPCS), VOCs - groundwater contamination, soil contamination, vapor intrusion pathway (potential) on and off-site; closed/removed 1,000 gallon leaded gasoline underground storage tank (UST); closed/removed 1,000 gallon unleaded gasoline UST; Manitowoc Gas Co (Coal Gas) and gas holder, coke yard noted on 1906 Sanborn Map.
2. **West of North 11th Street at Buffalo Street** – Wisconsin Central Railroad noted on 1900 Sanborn Map; Northern Elevator Co. No. 1 and Standard Oil Co. with multiple Tanks noted on 1919 Sanborn Map; Stphani-Strupp Oil Co. with

multiple tanks noted on 1927 Sanborn Map; Wingfield Oil Co with Oil House and multiple tanks and Sinclair Refining Co. Bulk Oil Station with Oil House and multiple tanks noted on 1956 Sanborn Map.

3. **620 North Water/610 North 10th Street** – Closed (August 20, 2004) ERP Site, BRRTS (#02-36-182657): Mobil One-Stop, Volatile Organic Compounds (VOCs) - soil contamination, groundwater contamination; Closed (March 23, 1998) Leaking Underground Storage Tank (LUST) Site, BRRTS (#03-36-002046): Mobil One-Stop, Gasoline and VOCs - soil contamination; closed/removed 8,000 gallon unleaded gasoline UST; two closed/removed 6,000 gallon unleaded gasoline USTs.
4. **414 & 430 North Main (10th) Street** – Machine shops noted on 1906 Sanborn Map.
5. **420 North 10th Street** – Paints building noted on 1956 Sanborn Map.
6. **500 Block North Main (10th) Street** – Goodrich Transit Co. Repair Shops with Electric Shop, Paint Shop, and Store Room noted on 1919 Sanborn Map.
7. **533 North 10th Street** – 300 gallon abandoned without product fuel oil UST; 550 gallon abandoned without product diesel UST; 8,000 gallon abandoned without product unleaded gasoline UST; 10,000 gallon abandoned without product leaded gasoline UST.
8. **North 10th Street and Buffalo Street** – Filling Station, Autos, and Oil Warehouse noted on 1927 Sanborn Map.
9. **North 10th Street and Chicago Street** – Filling Station and Battery Service noted on 1956 Sanborn Map.

Based on the age of the sites and/or distance to the project limits, the above identified sites do not constitute a recognized environmental concern to the project area. The sites above are further summarized in the table and located on the figure in Appendix D. However, the WPCS property or commonly called the WPS property located adjacent to the east end of the project site will need additional environmental planning if the project extends to the WPS property. More detailed mapping of this property is included in Appendix D.

The primary WPS site contaminants are Polynuclear Aromatic Hydrocarbons (PAHs), hazardous organic chemicals commonly found at Manufactured Gas Plant (MGP) sites. PAHs were introduced to the WPSC Manitowoc site through the disposal of waste created during fuel production. Most of the PAH contamination from MPG sites is in the form of coal tar buried under soil and does not pose a direct health risk; however, if coal tar residues come in contact with skin, it can cause redness or a rash. In some people, the coal tar can cause a sunburn effect on skin. Eye irritation is another hazard if coal tar residues get in the eyes.

Ground water and soil sampling as part of a study called the "remedial investigation" has been ongoing since the early 2000's. Contractors have been collecting groundwater samples from the existing monitoring well network by opening up the wells and drawing samples using a mechanized water pump. They also took soil gas samples nearby and inside a building on property where former MGP structures once stood.

WPS, the company determined to be responsible for the contamination, surveyed the terrain and contours of the Manitowoc River in December 2011. A year later, contractors also took sediment samples to get a better idea of where PAH contamination is located. Results from the 2011 survey and the 2012 sediment samples are being used to start developing a more detailed river sampling plan for spring 2014. The initial results and newly collected information will be included in a remedial investigation report. This report is expected to be completed in mid-2016. Another document, called the feasibility study, will follow. The feasibility study will list several possible ways to clean up the site. It is estimated sediment removal and final up land remedial efforts will be performed in 2017 – 2018. Some impacted material will be encountered if the river walk extends upon the WPS property. Additional planning will be required at that time.

2.3.3 Wetland Review

The WDNR Surface Water Data Viewer mapping application was reviewed for any mapped wetlands or wetland indicator soils within the Manitowoc river walk project area. No wetlands are mapped within the project area. A small portion of the south end of the project area near Chicago Street and 10th Street is mapped with wetland indicator soil ShA, Shiocton very fine sandy loam, 0 to 3 percent slopes, which is a hydric component soil in Manitowoc County with wetlands generally forming in depressions. This area is currently paved or on a steep slope leading down to the Manitowoc River; it is unlikely that wetlands are present within the project area.

2.4 Regulatory Issues

Shoreline improvements along the Manitowoc River will require regulatory permits and approvals from both the WDNR and the COE. To identify likely permitting issues, a meeting was held on March 26, 2014 with Ms. Carrie Webb of the WDNR. A complete summary of this meeting is included in Appendix A. The key highlights of this meeting are as follows:

- Mapping of the shoreline was presented to the WDNR which showed existing topographic features, property ownership, the location of the Navigation Channel within the river, and the recorded Harbor Line. A portion of the shoreline along this section of the river consists of an old steel sheet pile wall. The entire shoreline area is considered in the City's Erosion Hazard zone.
- WDNR acknowledged the validity of the Harbor Line and indicated no Chapter 30 permit would be needed for installation of a sheet pile wall or bulkhead structure landward of this Harbor Line. However, if grading > 10,000 square feet is done along the river walk (even if upland of the Harbor Line), a Grading Permit would be needed. COE does not recognize the Harbor Line for their regulatory review, and therefore a permit application would be needed with them (local contact is Joey Shoemaker in the COE Green Bay, Wisconsin office).
- The City emphasized that nearly all portions of the river walk would be on City-owned land. Non-City owned parcels are the WPS property at the south end of the proposed river walk, and the Consumers Steel property on the north end of the proposed river walk. City contacts with these owners prior to initiation of the study indicates a positive working relationship for siting of the proposed Riverwalk. WDNR emphasized that riparian rights cannot be conveyed to the City by an easement from land not owned by the City. However a letter from the landowners approving the project is acceptable to WDNR. The City may need more formal agreement than this for its own protection.
- A Historical/archeological database search of the river walk area would be done by WDNR at time of a permit application. This could lead to a request for a formal on-site historical/archaeological investigation.
- WPS is planning on dredging part of the river near their parcel at 402 North 10th St. to remediate impacted sediments from a historic MGP site. WDNR staff provided available information following this meeting, which is summarized in Section 2.3 of this report.

3 Potential River Walk Options

3.1 River Walk

This section describes options considered for support or incorporation of the walkway alignment along the shoreline. Appendix E contains cross-section drawings and sketches which illustrate each of these options at selected locations (Stations 3+00, 7+00, 12+00, and 18+00); these stations represent various portions of the river walk alignment, as described in Section 2.1. These options should be considered preliminary design-level only; final design must confirm the size, geometry, and material selection. Pros and Cons are also listed for each option. These options are not applicable to the ends of the river walk (Station 0+00 to 0+75, and 22+00 to 30+50). At these locations the river walk proceeds on land to their terminus. Section 4 of this report provides further discussion on these areas.

An opinion of cost was developed for each option on a Lineal Foot (LF) basis for comparison purposes. These cost opinions are included in Appendix F. Unit prices used to produce these cost opinions were taken from RS Means (2014), WisDOT Average Unit Price List (2014), or AECOM local bidding experience.

Common elements for each option:

- 12 foot wide walkway for shared pedestrian/bicycle use.
- Walkway to be situated above the 100-year flood level of the river (elevation +585 or higher).
- Walkway surface to be crushed gravel suitable for both pedestrian and bicycle use. Concrete to be used at selected locations as described in Section 4.5.1. Alternately, asphalt or concrete surface can be considered for the entire walkway surface, at a higher cost.
- Lighting will consist of bollard lights at 50 foot intervals, with overhead lights at the four trailway nodes and at the Spring Street trail entry.
- Restoration will consist of topsoil placement, and seeding of disturbed areas adjacent to the walkway.
- Erosion control during construction will consist of turbidity curtain along the shoreline area being disturbed, silt fence and tracking pads at selected access locations.
- Upper bank stability is not improved using these walkway options. Remedial action to provide long-term erosion control and acceptable factors of safety for slope stability must also be employed, as described in Section 3.2.

3.1.1 At-Grade Cut/Fill

This option would provide the walkway support by simply cutting into the riverbank or placing fill on the riverbank to form a "shelf" for the walkway. Sheet 1 in Appendix E illustrates this option. Shallow fills can be placed at a few selected locations, notably the existing seawall along station 9+50 to 13+50 and the more gently sloping riverbank area along Station 6+00 to 8+00. As noted in the geotechnical evaluation (Section 2.2), the soil characteristics and steepness of the riverbanks make much of the shoreline a high concern for long-term slope stability issues. Cutting into this bank would further lower the factor of safety. Using At-Grade Cutting is not recommended. Accordingly, no cost opinion for this option has been included for comparison purposes.

Pros: At river walk locations where shallow fills can be constructed on the riverbank above the 100-year flood level (i.e. minor grading of the subgrade and placement of the walkway surface), this option would present the least cost.

Cons: Cutting into the riverbank at most locations further decreases the factor of safety against slope failure; exposes additional riverbank area to erosion.

3.1.2 Rockfill Embankment

This option would provide the walkway support by placing rockfill along the riverbank to an elevation above the 100-year flood elevation of the river. Sheet 2 and Sheet 2A in Appendix E illustrate this option. Rockfill would be placed on a slope of 2H/1V with a minimum 15 feet wide crest for the walkway. Clearing of the existing vegetation and overhanging trees will be necessary to incorporate the rockfill embankment. The rockfill is expected to consist of quarry stone with a gradation conforming to Heavy or Extra Heavy Riprap per the WisDOT Standard Specifications (generally stone > 1.5 to 2 feet in dimension). Final design will appropriately size the rockfill to protect against river flood flows and large vessel traffic on the river.

The rockfill embankment would be quite substantial along the south portion of the alignment (Stations 0+75 to 3+50). This rockfill (if constructed as shown on the typical Section 3+00 on Sheet 2), can also provide improvement of the lower steep slope stability. This rockfill would extend beyond the bulkhead line, and its toe may come quite close to the approved channel line. Future dredging by the COE has the potential to undermine this toe. In the central portion of the walkway alignment (Stations 3+50 to 9+50) the rockfill would be much less substantial and mostly confined to the riverbank area as erosion protection. No rockfill would be placed along the existing seawall section (Station 9+50 to 13+50). The rockfill embankment along the north portion of the alignment (Station 13+50 to 22+00) can be situated upland of the bulkhead line.

The cost opinion for this option (Appendix F) indicates an average cost of $1,501 per LF of shoreline. However as the cross-sections on Sheet 2 show, the volume of rockfill varies considerably depending on which portion of the shoreline is being constructed. The cost opinion for this option does not include any costs associated with the existing seawall section of the alignment (Station 9+50 to 13+50). The costs for retrofitting the existing seawall are described in Section 3.1.3.

Pros: Provides adequate support for the riverwalk, and provides riverbank erosion protection from river flows and vessel traffic. Can also improve stability of the steep lower riverbank slope along station 0+75 to 3+50. Protective railings may not be needed on either side of the walkway.

Cons: Users will be separated from the river by the rockfill slope. River walk surface placed on top of the rockfill will be greater than 20 feet in horizontal distance from the water's edge. Some areas of shoreline require a large volume and footprint of rockfill that will extend beyond the bulkhead line and may come close to the navigation channel.

3.1.3 Seawall

This option would provide the walkway support by retrofitting the existing steel sheet pile seawall (Station 9+50 to 13+50), and installing a new steel sheet pile seawall along the remainder of the alignment. Sheets 3, 3A, and 3B in Appendix E illustrate this option.

As shown on the detail on Sheet 3A, the new seawall would consist of PZ22 steel sheet piles, with anchorage consisting of a waler and soil anchors. The sheet pile wall would have a concrete cap, and a steel pipe/cable railing. This seawall section was preliminary designed to embed the sheet pile a minimum of 3 ft into the hardpan soils, as encountered in boring B-1. Additional soil borings are recommended to verify the depth to this hardpan layer along the driving line during final design. It should be noted that this new seawall does not include provisions for mooring of large commercial vessels, per direction of the City during the study.

As noted on the cross-sections on Sheet 3, the new sheet pile seawall is sited along the bulkhead line. For the south portion of the river walk alignment (Station 0+75 to approximately 5+00), this will require only a moderate amount of fill behind the wall. However, for the middle portion of the river walk (Station 5+00 to 9+00) and north portion (Station 13+50 to 22+00), placing the seawall at the bulkhead line will require a considerable amount of backfill behind the wall. Placing the new seawall at the bulkhead line will provide a greater extent of usable space landward of the wall, but represents a higher cost and a narrowing of the river from its present condition. Placing the new seawall at the bulkhead line also brings the wall much closer to the Navigation Channel; therefore the authorized dredge depth of the channel (-21 ft LWD) must also be considered in final design.

The cost opinion for the New Sheet Pile Seawall option (Appendix F) indicates an average cost of $3,887 per LF of shoreline.

Based only on the limited field observations made for this study, a preliminary evaluation of the existing seawall indicates it may be possible to retrofit the existing seawall with additional steel structural members to provide adequate support for a river walk. Prior to final design, additional investigation of the seawall structural elements are warranted to verify their existing condition and integrity. For the purpose of this study, we have assumed the steel sheet pile section is adequate for long-term use, but new anchorage behind the wall may be needed. As shown on the detail on Sheet 3B in Appendix E, retrofitting of the existing seawall is anticipated to include:

- Excavating soil behind the seawall for installation of new helical anchor tiebacks.
- Installing helical anchors at 4 feet on center and installing a new structural waler.
- Replacing excavated soil behind the seawall.
- Backfilling behind the seawall in areas that had previously eroded away due to river flows (generally Station 8+50 to 9+50).

The cost opinion for Retrofit of the Existing Seawall option (Station 9+50 to 13+50) is estimated to be $1,385 per LF.

Pros: Seawalls will provide both a stable base for the river walk and protection against further erosion of the riverbank. Mooring of small boats could be accommodated along much of the river walk alignment. Low relative cost for retrofitting of the existing seawall section.

Cons: High relative cost for new seawall. Placement of the seawall will narrow the width of the river; this could require a study to determine potential changes in the flood level of the river that could impact upstream properties. Large commercial vessels that move outside the defined navigation channel of the river could cause damage to the seawall.

3.1.4 Pile-Supported Boardwalk

This option would provide the walkway support by installing a series of driven piles with structural support elements to form an elevated boardwalk. Sheets 4 and Sheet 4A in Appendix E illustrate this option. The typical detail on Sheet 4A for this preliminary design shows pairs of timber or pipe piles driven to adequate bearing stratum on 10 foot centers, connected with timber beams and cross members to support wood joists spanning between the piles. A 12 foot wide walking surface comprised of composite decking materials would be installed on the joists; the deck would be lined with railing on both the water-side and land-side. Riprap would be placed on the riverbank for erosion protection beneath the boardwalk. This riprap is anticipated to be a minimum of three feet thick consisting of Heavy or Extra Heavy Riprap per the WisDOT Standard Specifications. No boardwalk would be placed along the existing seawall section (Station 9+50 to 13+50).

The cross-sections on Sheet 4 in Appendix E show the boardwalk to be placed along the recorded bulkhead line. This will place the river walk out away from the shoreline and give the users the greatest access to the water. This alignment will however put the walkway nearer the navigation channel and could run the risk of some damage from large vessels that happen to move outside the channel. Ice movement on the river could create conditions which would require greater structure. During final design, it is recommended this alignment be revisited to satisfy both these concerns.

The cost opinion for this option (Appendix F) indicates an average cost of $2,542 per LF.

Pros: Gives walkway users greatest access and proximity to the river. Can be situated so that much of the existing riverbank vegetation can remain in-place. Most construction could be done from barge-mounted equipment minimizing riverbank disturbance.

Cons: Relatively higher cost than the Rockfill Embankment option. Potential damage from large commercial ships and large ice floes on the river.

3.2 Slope Stability Remediation

As described in Sections 2.1 and 2.2, the existing riverbank consists of numerous areas exhibiting steep, highly eroded slopes. Incorporation of a new river walk system along the shoreline should also include provisions to improve the long-term stability and reduce continuing erosion potential of the slopes both adjacent to, and above the river walk.

Based on the existing topography and soil conditions encountered, areas requiring slope stability improvement are noted on the cross-sections included in Appendix H. We recommend stabilizing steep lower slopes near Stations 1+50 to 3+50, and stabilizing steep upper slopes near Station 8+00 and Stations 12+50 to 22+00.

The Rockfill Embankment option noted in Section 3.1.2 appears to be a cost-effective solution to provide adequate slope stability and erosion protection for the steep lower slope conditions found near Stations 1+50 to 3+50.

The following four alternatives can be considered for stabilization of the steep upper slopes of high stability concern; Appendix G includes general information and illustrations of these alternatives:

- Cut-Back Bank,
- Soil Nailing,
- Slope Reinforcement Technology (SRT),
- Living Wall.

A combination of these alternatives could be used depending on site geometry, soil conditions, and access. It should be pointed out that there are portions of the steep eroded upper slopes which require slope stability improvement but are not within City owned property. To implement these improvements, the City will need to work with owners of these properties for access and construction easements, as well as agreement on cost apportionment.

An opinion of cost was developed for each alternative on a LF basis for comparison purposes. These cost opinions are included in Appendix G. Unit prices used to produce these cost opinions were taken from Vendor quotations, RS Means (2014), WisDOT Average Unit Price List (2014), or AECOM local bidding experience. Each estimate includes costs for necessary clearing, and restoration consisting of re-vegetation using seed, fertilizer, and erosion matting. More elaborate landscaping such as special trees, shrubs, plantings, or special products would be in addition to these costs.

Section 3.2.5 presents a "Do-Nothing" alternative that outlines the risks and consequences of constructing the riverwalk without upper slope stabilization.

3.2.1 Cut-Back Bank

A slope stability analysis was performed to determine the angle at which the upper riverbank slope exhibits an acceptable factor of safety of 1.3 or greater under short term conditions, and an acceptable FOS of 1.5 or greater under long term conditions. Based on this stability analysis, the upper slope should be cut back to 2H:1V (at a minimum). In some areas, approximately 50 to 60 vertical feet of the existing upper slope are as steep as a 1H:1V. Cutting to 2H/1V would therefore remove approximately 50 to 60 feet of land at the top of the slope. See Figure G-1 in Appendix G for an illustration of the Cut-back bank option. Re-vegetation and/or terracing of the cut bank would be necessary to achieve long-term erosion control. Along part of the river walk alignment, this cutting would encroach upon privately-owned property. Therefore, this Cut-Back Bank may only be a solution in areas owned by the City, such as Riverside Park. In this instance the city would lose park space.

The cost to excavate and remove the upper slope soils, dispose of these soils offsite, and provide a re-vegetated slope is estimated to cost $1,480 per LF of bank to be remediated. Note that this estimate includes trucking the excavated soils to a disposal site within 20 miles, and paying a nominal disposal fee. This option could potentially present the least expensive solution if all landowners agree to its implementation, and a nearby area for disposal of excavated soils can be located.

3.2.2 Soil Nailing

Soil nailing is an earth retention technique using long tension-resisting steel rods (nails) which are drilled into the slope and then grouted. Figure G-2 in Appendix G includes illustrations of Soil Nailing. Soil nails would be installed by drilling near-horizontal holes into the slope on a grid pattern, inserting tension-resisting steel bars into the holes, and grouting. Once the nails are grouted, a drainage system installed on the face of the slope followed by a decorative shotcrete facing. Bearing plates are then fixed to the heads of the soil nails and post-tensioned. Soil nails can be installed directly beneath existing structures and utilities; however extreme care must be exercised to avoid conflicts and damage.

Due to the steep slopes along the shoreline and limited working area near the toe of the slope, we anticipate the soil nails would be installed from a crane-suspended platform working from a barge. The estimated cost to install soil nails provided by a local contractor is roughly $36.00 per square foot of slope reinforcement. Additional costs will include clearing and grubbing the slope, erosion control during construction, and restoration at completion. For an average slope height of 55 feet, this would result in a cost of $2,641 per LF of bank to be remediated.

3.2.3 Slope Reinforcement Technology (SRT)

SRTs are a proprietary system of Geopier; see Figure G-3 in Appendix G for information relative to this system. The SRT system utilizes a plate pile to stabilize shallow slides or steep slopes by capturing downslope forces and providing resistance through shear and bending of the steel plate piles. The non-displacement steel plate pile elements are driven in a staggered array of uniformly spaced rows below the ground surface. The sections do not require post-tensioning. The system is best suited for a slope inclination up to 45 degrees (1H:1V), potential failure surfaces up to 15 feet thick, and most soil types. The system is not suitable to stabilize deep-seated failures greater than 15 feet and cannot be installed into hard rock or soil with large boulders or other obstructions without pre-drilling or completing other site preparation.

Based on the existing conditions slope stability analyses, the failure surface under drained conditions is anticipated to be within 15 feet deep. Installation of SRTs will require some clearing of the slope, and then re-vegetation for long-term erosion control.

The estimated cost to install SRTs as provided by Geopier is roughly $13.00 per square foot of slope reinforcement. Additional costs will include clearing and grubbing the slope, erosion control during construction, and restoration at completion. For an average slope height of 55 feet, this would result in a cost of $1,133 per LF of bank to be remediated.

3.2.4 Living Wall

Living walls are a green alternative to conventional slope retention. These walls use vegetated Mechanically Stabilized Earth (MSE) systems. See Figure G-1 for a typical section and Figure G-4 in Appendix G for illustrations of this system. Living walls are built onsite, using a continuous polypropylene sock filled with a combination of compost, sand, soil, and even gravel to match the existing soil conditions. Each sock is stacked against the slope and planted with the Owner's choice of a wide range of plant materials to mimic the natural site. The system is reinforced with geotextiles or geogrids. Living walls can be built in a nearly vertical fashion, similar to a pre-cast, man-made material, because the majority of the slope stabilization occurs behind the face of the wall.

Excavation into the existing slope would be needed to install both the wall base and the controlled backfill behind the wall. A level base buried 10 percent or more of the wall height may be necessary for support. Excavation into the slope will be required to place controlled fill soils (granular or crushed stone) along with lateral anchorage (geogrids) to provide the slope reinforcement against global failure modes. The backfill and lateral anchorage could extend in a horizontal dimension as much as 70 percent of the slope height. For a 60 foot high slope, the excavation could extend as much as 35 to 40 feet back into the slope, and therefore a temporary earth retention system would likely be necessary in order to stabilize the excavated slope during construction. Even though the final configuration of the slope could be designed to mimic the existing slope conditions and top of slope location, the extent of excavation needed to install the necessary backfill and reinforcing would make this impractical in areas where there are existing structures.

Alternately, some elements of the Living Wall could be utilized in combination with the Cut-Back Bank, or SRT Reinforcement, to function only as the final landscape feature of the remediated slope.

The estimated cost to install a Living wall as provided by an experienced contractor is roughly $40.00 to $50.00 per square foot of slope protection. Additional costs will include clearing and grubbing the slope, excavating soils to be replaced by controlled backfill, disposing of these excavated soils offsite, and temporary earth retention of the excavated slope. For an average slope height of 55 feet, this would result in a cost of $4,711 per LF of bank to be remediated.

3.2.5 Do-Nothing

Site observations and the topography represented on the cross-sections in Appendix H indicate that most of the steep slopes are likely the result of the erosive nature of the river over time causing continued loss of soils at the toe of the unprotected slopes. This loss of soil causes the slopes to fail and steepen to their natural angle of repose. Continuing erosion at the toe and on the face of the slope causes further loss of soils and recession of the bank. The River Walk Options noted in Section 3.1 include provisions against riverbank erosion using rockfill riprap materials or steel sheet pile seawalls to armor the bank. However, this bank protection does not improve the existing condition of the steep upper slopes that exhibit less than adequate FOS in relation to slope stability. Even with minimal to no further erosion, these steep upper slopes have the potential to fail in slides or rotational failures, especially if subjected to prolonged periods of wet weather or extreme freeze-thaw exposure.

If no improvements are made, the inherent risks include:

- Small surficial slides or erosion requiring regular removal of "washed-out" soils from the walkway and river channel.
- Larger, deeper slides or failures that could cause blockage of the walkway, potentially destroy structural elements of the walkway and structures at the top of the slope, or block portions of the river channel.
- Continued loss of land at the top of the steep slopes, both on privately-owned and publicly owned property. Loss of this land area could affect existing structures, including buildings, city streets, utilities, and existing storm outfalls.

"Do-Nothing" is not recommended. If this option was selected by the City as a cost-saving measure provisions must be made for control of storm water that flows down and over the upper slopes (see Section 3.3), regular monitoring and evaluation of slopes for movement should be programmed, and an action plan should be prepared for relatively quick implementation in the event movement is observed, or slope failures occur.

3.3 Storm water and Erosion Control

A number of storm water outfalls were observed along this section of the river during the site investigation for this study. Prior to implementation of the river walk system, it is recommended that a detailed site walkover be performed in concert with available city mapping to locate all existing storm water outfalls or utilities. As part of the final river walk design, existing active storm water outfall pipes should be extended to the river (under the river walk) and given adequate riprap protection to minimize erosive scour. To reduce slope erosion, interception of runoff at the top of the slope should be investigated. This could be done by using shallow swale conveyance or French drain arrangements that lead to controlled storm outfalls. These methods would collect and convey storm water away from the slope face. Further, the City should encourage residents to take an active role in maintaining vegetation on the face of the slope that is on their property, and refrain from dumping grass clippings or other yard waste onto the slope.

Given the high slopes (50 to 60 vertical feet) along much of the riverbank, armoring or vegetation of the remediated slope will be critical to minimize long-term erosion. Terracing of the slope should be included in final design, along with selection of hardy and deep-rooted plants and vegetation. An arrangement similar to the "Living Wall" presented in Section 3.2.4 should be highly considered.

3.4 Alternative Plan Costs

Opinions of probable construction costs were developed for each of the river walk support and slope remediation options described in Sections 3.1 and 3.2. The following table lists the average cost per LF for each option. Spreadsheets listing the various line items and unit costs are included in Appendix F (River Walk) and Appendix G (Slope Remediation).

It should be emphasized these should be considered relative costs only, and are intended only to compare the options. Actual costs may vary due to modifications made during final design, conditions encountered in the field during construction, and the bidding climate prevailing at the time of construction. Therefore these average costs include a 20% contingency.

Table 3.4 – Average Cost of Options

Riverwalk Option	Preliminary Design Cost per Lineal Foot (LF)
1 – At-Grade Cut/Fill	**Not Recommended**
2 – Rockfill Embankment	$1,501
3A – New Steel Sheet Pile Seawall	$3,887
3B – Existing Seawall Retrofit	$1385
4 – Boardwalk with Riprap Shoreline	$2,542

Slope Stability Remediation Option	Preliminary Design Cost per Lineal Foot (LF)
A – Cut-Back Bank	$1,480 (May not be possible in many locations)
B – Soil Nailing	$2,641
C – SRT	$1,133
D – Living Wall	$4,711 (May not be possible in many locations)
E – Do Nothing	**Not Recommended**

The following paragraphs describe various combinations of the above noted river walk and slope remediation options, for comparison purposes. Estimated costs are included for four trailway interpretive stations (as described in Section 4.4), and two floating fishing platforms with gangways (locations To Be Determined). Each alternative includes a 15% allowance for Engineering, Bidding, and Construction Management fees.

3.4.1 Alternative 1 – "Concept Plan" - Combination of Boardwalk with Riprap Shoreline, Existing Sewall Retrofit, and Rockfill Embankment River Walk with SRT Upper Slope Remediation

- Option 4 Boardwalk with Riprap Shoreline from station 0+75 to 5+50, 13+50 to 22+00 (1225 LF)
- Option 2 Rockfill Embankment from station 5+50 to 9+50 (400 LF)
- Option 3B Existing Seawall Retrofit from station 9+50 to 13+50 (400 LF)
- Gravel Path Walkway with lighting from station 22+00 to 30+50 at Spring St. terminus (750 LF)
- Option C SRT Upper Slope Remediation from Station 7+50 to 8+50, 12+50 to 22+00 (1050 LF)

Option	Average LF Cost	Length (LF)	Cost Extension
Option 4	$2,542	1225	$3,113,950
Option 2	$1,501	400	$600,400
Option 3B	$1,385	400	$554,000
Gavel Path with Lighting Only	$131	750	$98,250
Interpretive Stations (4)	$500,000	LS	$500,000
Fishing Platforms	$75,000	2	$150,000
Option C SRT Slope Remediation	$1,133	1050	$1,189,650
Subtotal of Construction			$6,206,250
Engineering, Bidding, Construction Management (15%)			$930,900
Total			**$7,137,150**

3.4.2 Alternate 2 – Combination of Rockfill Embankment and Existing Seawall Retrofit River Walk, with SRT Upper Slope Remediation

- Option 2 Rockfill Embankment from station 0+75 to 9+50, 13+50 to 22+00 (1725 LF)
- Option 3 Existing Seawall Retrofit from station 9+50 to 13+50 (400 LF)
- Gravel Path Walkway with lighting from station 22+00 to 30+50 at Spring St. terminus (750 LF)
- Option C SRT upper slope remediation from Station 7+50 to 8+50, 12+50 to 22+00 (1050 LF)

Option	Average LF Cost	Length (LF)	Cost Extension
Option 2	$1,501	1725	$2,589,225
Option 3B	$1,385	400	$554,000
Gavel Path with Lighting Only	$131	750	$98,250
Interpretive Stations (4)	$500,000	LS	$500,000
Fishing Platforms	$75,000	2	$150,000
Option C SRT Slope Remediation	$1,133	1050	$1,189,650
Subtotal of Construction			$5,081,125
Engineering, Bidding, Construction Management (15%)			$762,200
Total			**$5,843,325**

3.4.3 Alternate 3 – Combination of New Seawall and Existing Seawall Retrofit River Walk with SRT Upper Slope Remediation

- Option 3A New Seawall from station 0+75 to 9+50, 13+50 to 22+00 (1725 LF)
- Option 3B Existing Seawall Retrofit from station 9+50 to 13+50 (400 LF)
- Gravel Path Walkway with lighting from station 22+00 to 30+50 at Spring St. terminus (750 LF)
- Option C SRT upper slope remediation from Station 7+50 to 8+50, 12+50 to 22+00 (1050 LF)

Option	Average LF Cost	Length (LF)	Cost Extension
Option 3A	$3,887	1725	$6,705,075
Option 3B	$1,385	400	$554,000
Gavel Path with Lighting Only	$131	750	$98,250
Interpretive Stations (4)	$500,000	LS	$500,000
Fishing Platforms	$75,000	2	$150,000
Option C SRT Slope Remediation	$1,133	1050	$1,189,650
Subtotal of Construction			$9,196,975
Engineering, Bidding, Construction Management (15%)			$1,379,500
Total			**$10,576,475**

3.4.4 Alternate 4 – "Bare Essentials – Least Cost" – Combination of Rockfill Embankment with Existing Seawall Retrofit River Walk with SRT Upper Slope Remediation

This alternate does not include Interpretive Stations, Fishing Platforms, or Lighting

Option	Average LF Cost	Length (LF)	Cost Extension
Option 2	$1,501-86*	1725	$2,440,875
Option 3B	$1,385-86*	400	$519,600
Gravel Path Only	$131-86*	750	$33,750
Interpretive Stations (4)	$500,000	0	$0
Fishing Platforms	$75,000	0	$0
Option C SRT Slope Remediation	$1,133	1050	$1,189,650
Subtotal of Construction			$4,183,875
Engineering, Bidding, Construction Management (15%)			$627,600
Total			**$4,811,675**

* Average LF cost has been reduced by $86 per LF which represents average overhead and bollard lighting cost. Cost for conduit installation is included so that lighting can be added in the future.

4 Overall River Walk Plan

4.1 Introduction

This segment of the Manitowoc River Walk is a continuation of past planning efforts. The river walk conceptual alignment was proposed in *The Port of Manitowoc Downtown & River Corridor Master Plan*, prepared by Vandewalle & Associates in 2009. In this 2009 plan, recommendations were made to construct a river walk along the water edge linking Riverside Park with future development on the CN Peninsula site. Providing connections from adjacent neighborhoods was emphasized in this plan. Further schematic design and river walk recommendations were made in the *Manitowoc Riverwalk Master Plan and Design Guidelines*, prepared by Kindness Architecture & Planning in 2009. The Kindness plan recommended a typical river walk cross section, materials, gathering spaces, phasing, and preliminary cost estimates for the river walk. These past studies were used as a guide for this preliminary design.

This segment of the Manitowoc River Walk is unique in that it's a natural setting in the middle of the City. With steep wooded river bluffs, maritime remnant features, and a strong maritime history, the river walk segment offers many assets to create a destination space for surrounding neighborhoods, city residents, and visitors. The river walk plan presented in this section of the study report was designed to:

- Provide physical and visual access to the river
- Protect the character of the natural setting
- Reveal the site's history and stories (natural and cultural)

The proposed river walk design provides public access by:

- Connecting the river walk to the City, downtown, and adjacent neighborhoods
- Creating trailheads that attract, direct, and inform visitors
- Creating (destination) places and their (connecting) pathways
- Developing overlooks and platforms that provide access to the river's water and provide views
- Develop a river-edge boardwalk
- Integrate wayfinding and interpretive information

To preserve the natural character of this river walk segment, reduce future river bluff erosion, and improve river water quality, the following is proposed to protect the shoreline:

- Use boardwalk construction methods that minimize the impact on the shore, river, and slopes
- Locate the walkway up over water and steep slopes
- Construct the walkway on grade only where little or no grading is needed

4.2 Connections

The area of the proposed river walk, located in the inner harbor of Manitowoc on the east bank of a dramatic bend in the Manitowoc River, is currently relatively inaccessible. This area, now a sloped wooded area with views to the City Centre Peninsula, has the potential to offer the city, the downtown, and neighborhood residents a natural setting and good views to the unique peninsula to the west where Manitowoc industry made history.

Enhancement of this area and existing Riverview Park and construction of the river walk could connect users to the far-reaching Manitowoc River watershed and the immediate river environment as well as the cultural history of the working river, the bluffs and park, the City Centre Peninsula, and other past and more recent cultural history. This investment would create a recreational and educational asset for the City of Manitowoc and its guests as well as a valuable attraction and amenity for potential riverfront development.

The proposed concept includes a river edge pathway connecting the Canadian National Peninsula development site with Riverview Park and four interpretative stations communicating the stories for numerous themes.

4.3 Interpretive Features

4.3.1 Historic Interpretive Features

This river walk is envisioned to be more than just a walkway. This plan proposes a public space that will reveal the stories of this place through the installation of interpretive displays, historic artifacts, interactive features and story boards. These stories include natural resource history including that of the Manitowoc River, site geology and past and present river ecology. The stories also include cultural history including the area's unique ship manufacturing past, role in World War II, industry, submarine building, and Native American history. These stories will be shared at specific interpretative stations along the river walk to provide interest along the entire stretch of this subject area.

4.3.2 Potential Interpretive Themes

- Manitowoc Grows a Ship-Building Industry: Schooners and Other Ships

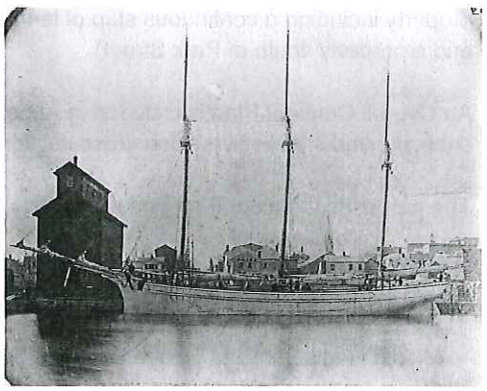
  Manitowoc made a major contribution to the beginning of and ongoing building of Great Lakes schooners. Later efforts built fishing boats, tugs, steamers, merchant ships, and freighters.

- Manitowoc's Unique Contributions During WWII: Navy Ships and Submarines

  Manitowoc played a large role in supporting the American war effort. 28 submarines were built on the peninsula site.

- Reshaping the River

  The natural river was shaped, dredged, and its edged hardened to accommodate the ship building industry and allow large ships to move into harbor and up river.



- Riverview Park: Window to the Valley and its Industry

  An historic Manitowoc park which has afforded views over the last miles of the Manitowoc River and its natural beauty and industry.

- Native Americans and the Manitowoc River

  The Manitowoc River and its meeting of Lake Michigan was first home to native peoples who gave it its name. Mascoutins, Ottawas, Menominees, Winnebagoes, and Potowatomies lived here. They gathered wild rice along the river's shorelines and marshes and fished the river and Lake Michigan.

- Manitowoc River Watershed
- *The Manitowoc River flows easterly for approximately 36 miles to Lake Michigan. The watershed includes a wide, marshy upper portion and a shallow, but faster lower portion until it slows into pools near Lake Michigan.*
- Manitowoc River Ecology Today
- *The river today still has wonderful natural attributes and good quality habitats while also facing many challenges affecting its water quality. Numerous state agencies and "Friends" groups work to protect and improve the rivers quality and habitat.*

4.4 Concept Plan

Based on evaluations of the riverbank slopes, river bank elevations, and high water levels, this concept plan proposes the river walk as primarily boardwalk. A boardwalk, used in conjunction with riprap, protects the river bank and allows river walk users to be close to the river edge. Where existing conditions allow, portions of the river walk are proposed as on-grade, crushed granite walkways, and walkways adjacent to the restored seawall. The boardwalk river walk is located within city-owned property including a continuous strip of land adjacent to the river and larger city-owned open space properties (Riverview Park and a property south of Park Street).

An Overall Concept Plan is included in Appendix H, along with renderings of interpretative stations and typical walkway sections, and station-by-station cross-sections.

The proposed Concept Plan and renderings are broken into four general sections along the riverwalk alignment:

- South Section (Station 0+00 to 6+00)
- Middle South Section (Station 6+00 to 9+50)
- Middle North Section (Station 9+50 to 13+50)
- North Section (Section 13+50 to end)

Each section contains a "node" comprised of gathering spaces, interpretative stations, and site features, connected by river walk.

South Section (0+00 to 6+00)

The southern end of the river walk begins at a trailhead node (Canadian National Peninsula), which connects to North Tenth Street to the east, and can connect to future development on the peninsula via an on-grade path. This station would introduce users to the river walk's route and experience and act as a transition from the development-oriented walkways to the natural river edge, sloped and wooded section of the Manitowoc River walk.

- Amenities: Overlook at existing seawall, small paved plaza gathering area in the shape of a submarine conning tower, kiosk with map and guide, and seating.
- Interpretive features: Interpretive panels along railing at seawall
- Interpretive themes: Reshaping the River, The Working River

It should be noted the sheet pile bulkhead at this location exhibits signs of failure (see Section 2.1.1) and will need repairs prior to implementation of these plaza improvements. This concept plan assumes WPS will repair the existing bulkhead as part of their environmental cleanup efforts, and no costs for repair are included herein. If this bulkhead is not repaired by WPS, an alternate siting of the trailhead would be needed, or costs would have to be budgeted for repairs as part of this river walk.

The river walk north of this first interpretative station is proposed as wooden boardwalk with rip-rap, to protect and stabilize the river edge.

Middle South Section (6+00 to 9+50)

The river walk is proposed as an on-grade crushed granite pathway once the riverbank slope becomes less steep, just north of the intersection of State Street and North 10th Street, on a City-owned property that extends from the river edge to 10th Street.

The second interpretative station (River Edge) is proposed as an at-grade walkway with an outdoor classroom focal feature. Located at a relatively low and level location along the river walk, this station would provide a place for rest, gathering, education, and an opportunity to gain physical access to the river. This station would inform users of the Manitowoc River and its ecology.

- Amenities: Wooden walkways, a floating river edge platform, seating, and teaching area
- Interpretive features: Interpretive panels in teaching area and on platform, hands-on experiment and demonstration stations
- Interpretive themes: Manitowoc River Ecology Today

The curved seating area provides space for children to sit while being taught and also provides seating when not used for instruction. The flexible space may also be used for small gatherings. On the water-side of the outdoor class room is a floating wooden platform that allows visitors the experience of direct contact with the river. The platform also provides opportunities for local schools to use the area as a demonstration or experiment station, in conjunction with the outdoor classroom. The interpretative station may also be connected to North 10th Street via a crushed granite trail, providing another access point to the river walk. Interpretive features in this area may focus on river ecology to compliment this learning opportunity node.

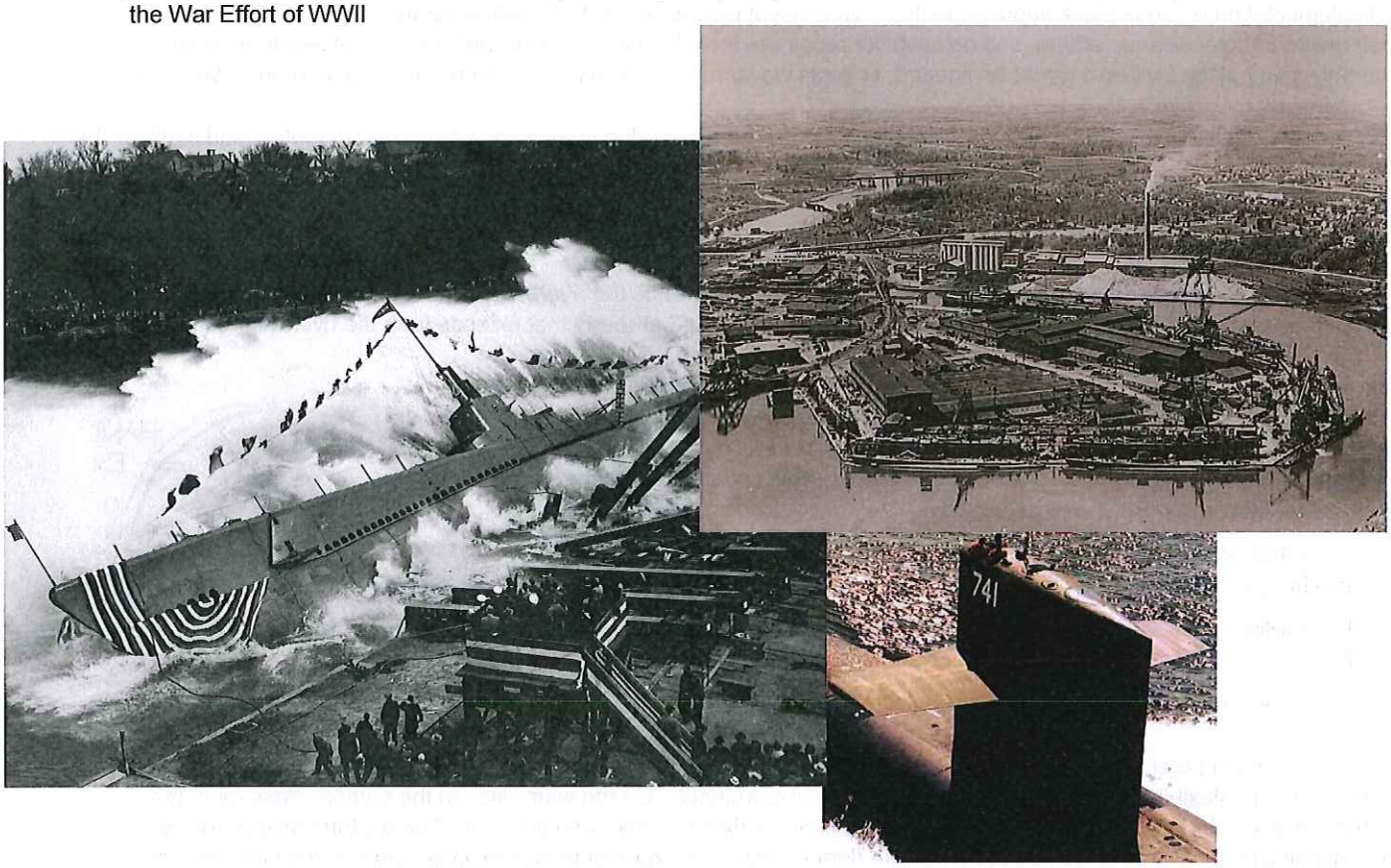
The river walk to the north of this interpretative station continues to be at-grade crushed granite leading to the existing seawall.

Middle North Section (9+50 to 13+50)

As the riverwalk reaches the existing seawall, it will continue to be an at-grade walkway, and will be located directly adjacent to the seawall edge.

The third interpretative station (Industrial History Overlook) is proposed as an at-grade walkway using the seawall for historic interpretation and as an overlook as the focal features. Located at the narrowest section of the river in the inner harbor area, this station offers a close and direct view of the City Centre Peninsula and tells the story of its unique ship-building history.

- Amenities: Overlook and platform structure (inspired by submarine tower), linear viewing "deck"
- Interpretive features: Interpretive panels (along the railing and seawall edge), three-dimensional model of a WWII-era, Manitowoc-built submarine, periscope with photos of sub launches.
- Interpretive themes: Inner Harbor Industry: Building Navy Ships and Submarines, Manitowoc's Unique Contributions to the War Effort of WWII

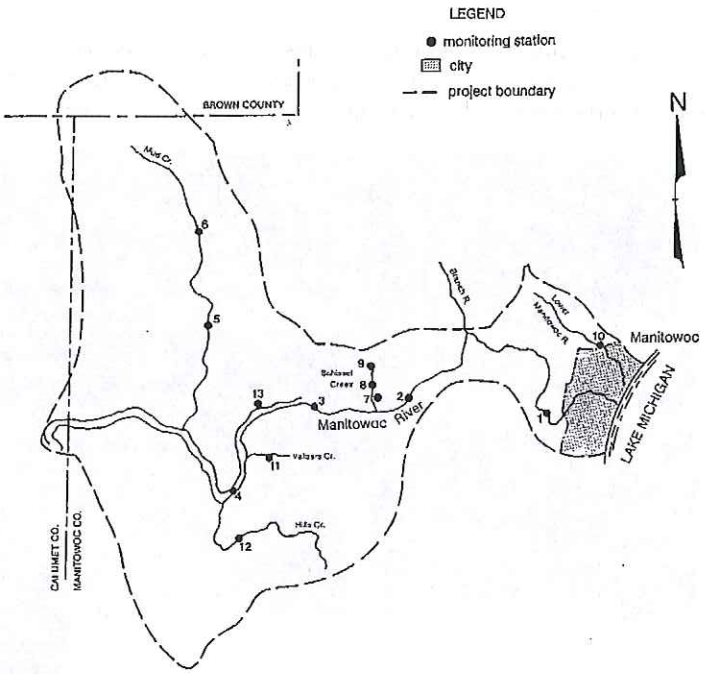


Three dimensional models of the submarines that were constructed across the river are proposed to be installed on top of the seawall. Each submarine would have an associated interpretive panel explaining the history of the submarine and the people who made them. The overlook, on the north end of this station, is proposed as a wooden deck with a vertical structure in the shape of a submarine conning tower. The space cantilevers over the river edge and serves as an overlook up and down river. Within the tower is a periscope for viewing across the river. Another alternative to a working periscope would be to add historic images of submarines and factories within the periscope viewfinder. The images would change as the user moved the periscope to various points across the river. Interpretive features in this area focus on inner harbor industry and boat manufacturing. An old wooden seawall is located in the river just north of the proposed overlook. This feature is proposed to remain to serve as a maritime artifact providing a hint of past use.

North Section (13+50 to End)

North of station 13+50, the at-grade river walk will transform to a boardwalk, with rip-rap to protect the river edge.

The boardwalk will continue to the fourth interpretative station (Riverside Park) which also serves as a trailhead. Located in the north section of the Manitowoc Riverwalk, in existing Riverview Park on the edge of the bluff, this station would introduce users to the historic Riverview Park and to the route and experience of this section of the Manitowoc river walk. Interpretation would give users an overview of the Manitowoc River watershed and the natural and cultural history of the river and urban land they are about to experience.



- Amenities: Viewing deck
- Interpretive features: Interpretive panels at viewing deck railings
- Interpretive themes: Riverview Park: Window to the Valley and its Industry, Manitowoc River Watershed

This station is proposed as boardwalk with an elevated viewing deck and water edge overlook as the primary features. Located below historic Riverside Park, this northern trailhead is a primary river walk entrance. Paths are proposed to run from North 10th Street to a viewing platform that is in the form of a ship hull/conning tower. This wooden platform would be set on pilings and rise above the steep slope, providing a dramatic viewing platform, offering vistas of the river. A trailhead kiosk is proposed on top of the slope. The platform connects down to the river walk through stairs, terminating at a wooden overlook platform at the river edge. Both of these structures provide spaces for interpretive features explaining the history of Riverside Park and the Manitowoc River watershed.

The boardwalk will then continue to the northwest to the Consumers Steel property at which point the river bank slope flattens and allows for an at-grade path. This crushed granite path connects to Spring Street, which is the planned Ice Age Trail route. Property owner cooperation will be needed to make this connection.

4.5 Riverwalk Amenities

4.5.1 Walkway Surface

Three walkway materials are recommended for the distinct river walk segments. All on-grade path segments are proposed as decomposed granite and crushed stone screenings (typically 1/4-inch stones with fines). This natural material will provide a solid trail surface for users, while still allowing storm water infiltration.

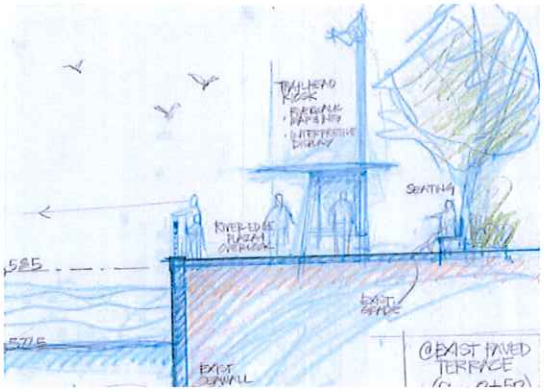
Trail activity nodes (interpretative stations) and gathering spaces are proposed as concrete to provide a long-lasting ground plane for high activity areas.

The boardwalk is proposed as either recycled composite material or natural hard wood such as Ipe. Both are long lasting materials. The wood provides the users with a natural material, which would require minimal maintenance. The composite material will last longer and require less maintenance, but is not natural.

4.5.2 Wayfinding

4.5.2.1 Kiosks

Two kiosks are planned; one at the northern trailhead (Riverside Park) and one at the southern trail head (CN Peninsula). The kiosks may provide trail maps and information, as well as river, community or other event information. The northern kiosk is planned adjacent to the viewing platform and the southern kiosk is located in the overlook with a design representing a submarine conning tower.

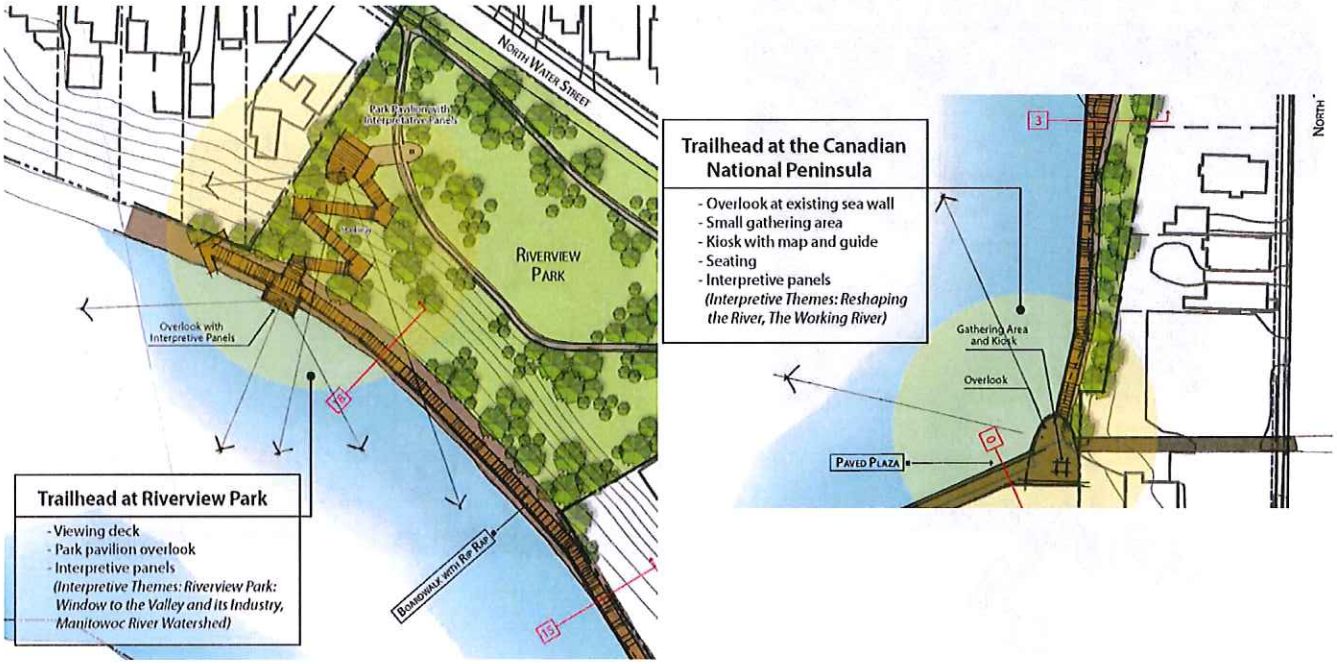


4.5.2.2 Signage

Wayfinding signs should be installed to direct people from the adjacent neighborhoods and downtown to the river walk and its two trailheads.

4.5.2.3 Trailheads

Two trailheads are planned on each end of the project area. The northern trailhead is located within Riverview Park and the southern is adjacent to the Canadian National Peninsula. Each trailhead provides a river walk entrance from North 10th Street and an overlook gathering space at the river edge. The gathering spaces contain interpretive features and panels, seating areas, and trash receptacles. The Riverview Park Trailhead contains a large viewing platform at the top of the steep slope to provide visitors with vistas up and down river. Both trailheads will have a unique kiosk with Manitowoc River Walk map, including the connection to the Ice Age Trail.



4.5.3 Lighting and Associated Amenities

Since this is a natural area along the river, lighting should be low level bollard lighting and downward casting fixtures. Trailheads may contain overhead lighting, though this should be minimal to reduce insect issues associated with sites adjacent to bodies of water.

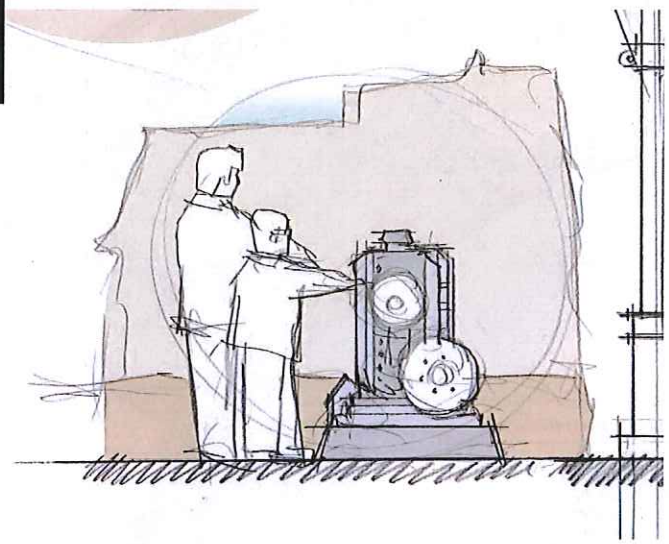
For on-grade granite path sections, bollards should be located on land (non-river) side of the path, spaced every 100+ feet. For the boardwalk path sections, the lighting should be integrated into the railing system, directing light onto the boardwalk surface. Whenever possible, lighting should be located at transition areas between the on-grade granite path and concrete node or wooden boardwalk sections.

An alternative lighting option is to only illuminate trailhead and node areas, which would provide safe areas for the public to access the river edge and reduce the overall project cost.

4.5.4 Other Amenities

The railings along the boardwalk are envisioned as a stainless steel cable railing system. The system would contain metal railing and metal railing supports with stainless steel cables running horizontally. A wooden railing system may be preferred, due to cost, though would require more maintenance than a steel cable system.

Installing maritime artifacts along the river walk is an opportunity to create a unique visitor experience. These artifacts could be reclaimed manufacturing pieces from ships made across the river. Spacing these artifacts along the path provide an educational experience for visitors. Providing a plaque describing the piece, its origin, and how it fits into the history of Manitowoc create a strong sense of place for the river walk.



5 Implementation

5.1 Funding Sources and Application/Award Schedule

The following sub-sections describe the more widely-used grant programs. Many other funding sources such as the U.S Army Corps of Engineers – Emergency Stream Bank and Shoreline Protection Grant or Great Lakes Restoration Initiative Program are available. Due to the limited funds associated with these smaller grant programs, we recommend focusing on the below grants at this time. However, it is recommended to reevaluate all grant programs once the project moves forward.

Meetings were held with grant coordinators for these programs to introduce them to the proposed Riverwalk project and gauge the suitability and potential for successful grant awards. These meetings indicated a willingness by the grant coordinator to fund the necessary slope stability improvements as a key part of the project.

5.1.1 Stewardship Grant

Stewardship Grants are intended for nature-based recreation, environmental protection, wildlife conservation, habitat restoration and water quality protection. Local governments and tribal governments are eligible if they have a WDNR-approved comprehensive outdoor recreation plan, a master plan that has been approved by the local governing unit or if they fall under a plan developed by a higher unit of government.

Activities funded under the Stewardship Grant Program include:

- Acquisition of property – Development/rehabilitation of nature-based, recreational areas.
- Urban Green Space – To buy land or easements in urban areas to preserve scenic and ecological values for nature-based recreation, including non-commercial gardening.
- Urban Rivers – To buy land on or adjacent to rivers flowing through urban or urbanizing areas to preserve or restore scenic and environmental values for nature-based recreation.
- Aid for Acquisition and Development of Local Parks (ADLP) – To buy land or easements and to develop or renovate local park and recreation facilities.
- Acquisition of Development Rights (ADR) – To buy development rights (easements) for protection of natural, agricultural, or forestry areas to enhance nature-based.

Award amounts range from $40,000 to $500,000 with a 50 percent match. Applications are due May 1st every year and are awarded in fall.

5.1.2 Coastal Management Grant Program

Approximately $1,500,000 is available through the Wisconsin Coastal Management Program (WCMP) to enhance and restore coastal resources within the state's coastal zone-all counties adjacent to Lakes Superior and Michigan, with their 1,000 miles of shoreline.

2015-2016 WCMP Grants are available for

- Coastal Wetland Protection and Habitat Restoration
- Nonpoint Source Pollution Control
- Coastal Resource and Community Planning
- Great Lakes Education
- Public Access
- Community Planning

Award amounts range from $60,000 to $1,000,000 with a 50 percent match. The 2015-2016 Coastal Management Grant Program application is due November 3, 2014.

5.1.3 Transportation Alternatives Program

The Transportation Alternatives Program (TAP) allocates federal funds to transportation improvement projects that "expand travel choice, strengthen the local economy, improve the quality of life, and protect the environment." TAP combines three programs that were separate under previous legislation (SAFETEA-LU): Safe Routes to School, Transportation Enhancements, and the Bicycle and Pedestrian Facilities Program. The categories of eligible TAP projects are:

- Trail facilities for non-motorized transport
- Constructing safe routes for non-drivers
- Converting abandoned railroad corridors for non-motorized transportation
- Constructing turnouts, overlooks and viewing areas
- Community improvement activities
- Any environmental mitigation activity
- The Recreational Trails Program
- The Safe Routes to Schools program
- Projects in the right of way of former Interstate System routes or other divided highways

All TAP projects are funded 80% federally, with a 20% local match. The minimum project cost is $50,000 for non-infrastructure and $300,000 for infrastructure projects. New TAP projects will contain a sunset clause stating that projects must be completed within approximately six years or risk loss of funding. Applications are due in June on a two year cycle and are awarded in the fall of the following year.

5.1.4 Congestion Mitigation and Air Quality Improvement Program

Congestion Mitigation and Air Quality Improvement Program (CMAQIP) is a program to provide federal funding for transportation projects that improve air quality and reduce traffic congestion in counties classified as air quality non-attainment or maintenance areas for the federal criteria pollutants ozone and fine particulate matter. (Manitowoc County is in this area.) CMAQIP funds are available to counties, local units of government, transit operators and state agencies. Private entities interested in applying for funds must find a public sponsor with taxing authority to sponsor a project application. Examples of eligible CMAQIP projects include:

- Capital and operating assistance for new transit services
- Rideshare promotion, vanpool purchases and park & ride lots
- Pedestrian and bicycle facilities
- Alternate/clean fuel vehicles and fueling facilities
- Diesel engine idling reduction and retrofit projects
- Marketing programs designed to increase the public's awareness of air quality and transportation issues

Applicants must provide at least a 20% match of the project's total cost. Project sponsors must pay project costs and then seek reimbursement through WisDOT. Construction projects costing $200,000 or more are eligible for funding, as are non-construction projects costing $50,000 or more.

Projects are typically solicited in odd-numbered years. Multiple years of funding is made available to projects in the fiscal years that follow the calendar year of project approval. For example, in 2013 the CMAQ selection committee will recommend projects for state fiscal year 2014-2018 funding. Approximately, $10.7 million is available for fiscal year 2015.

5.2 Segment Breakdown

As noted in Section 3.4, the opinions of cost for this river walk project range from approximately $4.8M (Bare Essentials – Least Cost) to approximately $10.5M (New Seawall). None of the funding programs described in Section 5.1 would likely cover this magnitude of cost at one time. In addition, each fund requires a match from the City that ranges from 20% to 50%. These matching funds would likely need to be budgeted into the City's Capital Improvement Program (CIP), or financed through other means (TIF districts, private donations, etc).

As a means to obtain grants and appropriately budget costs, we recommend breaking the project into smaller segments. Past experience indicates segments of $1M or less in cost are a reasonable approach and can help provide a committed pipeline for funding once the project is initiated.

Figure 5 shows a recommended breakdown. Budgeting zones are color coded and listed in priority. This plan begins the project at Station 0+75 (just north of the WPS bulkhead), and builds northward segment by segment to the Spring Street terminus. Using the "Bare Essentials – Least Cost" alternative (see Section 3.4.4), individual segment cost of construction would range from $554,000 to approximately $1.1M.

Should other alternatives be selected, the segment zones will be similar, but the construction costs will differ.

5.3 Implementation Timeline

Appendix I contains a spreadsheet entitled "Implementation Timeline". This spreadsheet utilizes the river walk zones as described in Section 5.2 and illustrates the various time frames associated with each in regard to:

- Obtaining easements;
- Applying for and obtaining grants;
- Preparing permit applications and obtaining approval(s);
- Final design and bidding;
- Construction.

As this timeline shows, the first segment is expected to take 1 1/2 years to implement. After the first segment has been initiated, ensuing segments are programmed so that construction can occur on a yearly basis. Following this timeline indicates the river walk and slope stability remediation can be completed in an approximate 8 year time frame. This will require judicious and aggressive pursuit of grants, and a commitment of matching funds over this period.

5.4 Actions Required Prior to Implementation

Due to the potential lag time between issue of this study report and the actual implementation of the river walk plan, the following actions are recommended as the plan is put into motion:

- Revisit the Wetland Inventory mapping and field verify that no wetlands exist that will require special permitting or mitigation efforts.
- Prepare permit applications to the WDNR and COE well in advance of the planned timeframes for construction.
- Confirm availability and obtain written documentation for routing of the river walk across the former Consumers Steel Property.
- Perform additional investigation of the existing seawall along Station 9+50 to 13+50 to confirm the necessary structural upgrades required for adequate support of the walkway section.
- If the "New Seawall" Option is selected for implementation, perform additional soil investigation along the seawall alignment to confirm soil characteristics for final design.
- Obtain working agreements with landowners along the river walk route for stabilizing the upper portions of slopes identified in this study as being of "High Concern".
- Coordinate remediation work progress at the WPS site (402 N. 10th St) with this study plan. Confirm WPS commitment to repair the failing bulkhead at station 0+00.

6 Qualifications/Limitations

This report has been prepared in general accordance with normally accepted engineering practices to aid in the evaluation of this site and to assist our Client in the design of this project. We have prepared this report for the purpose intended by our Client, and reliance on its contents by anyone other than our Client is done at the sole risk of the user. No other warranty, either expressed or implied, is made.

The scope is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects relevant to the general engineering characteristics. In the event that any changes in the design or location of the facilities as outlined in this report are planned, we should be informed so that the changes can be reviewed and the conclusions of this report modified, as necessary, in writing by the project engineer.

We recommend that we be authorized to review construction documents, if prepared by others, to confirm the recommendations contained in this report have been interpreted in accordance with our intent. Without this review, we will not be responsible for the misinterpretation of our data, our analysis, and/or our recommendations, nor how these are incorporated into the final design.

Opinions of Construction Cost included in this report have been prepared using the assumptions and unit price sources listed herein. The actual construction costs may vary due to modifications made during final design, conditions encountered in the field during construction, and the bidding climate prevailing at the time of construction.

Figures

Figure 1 – Area of Project

Figure 2 – Area of Preliminary Design Study for Sheet Wall and Riverwalk Construction

Figure 3 – Stationing and Site Features

Figure 4 – Areas with Slope Stability Concerns

Figure 5 – Riverwalk Budget Zones

Appendix A.

Summaries of Meetings

Appendix B.

Photographic Log

Appendix C.

Geotechnical Report

Appendix D.

Environmental Information

Appendix E.

Riverwalk Options Drawings, Sheets 1, 2, 2A, 3, 3A, 3B, 4, and 4A

Appendix F.

Cost Opinions for Riverwalk Options

Appendix G.

Upper Bank Stability Information and Cost Opinions

Appendix H.

Overall Concept Plan, Typical Section Renderings, Cross-Sections

Appendix I.

Implementation Timeline

About AECOM

AECOM (NYSE: ACM) is a global provider of professional technical and management support services to a broad range of markets, including transportation, facilities, environmental, energy, water and government. With approximately 45,000 employees around the world, AECOM is a leader in all of the key markets that it serves. AECOM provides a blend of global reach, local knowledge, innovation, and collaborative technical excellence in delivering solutions that enhance and sustain the world's built, natural, and social environments. A *Fortune 500* company, AECOM serves clients in more than 130 countries and has annual revenue in excess of $8.0 billion.

More information on AECOM and its services can be found at www.aecom.com.

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1035 Kepler Drive
Green Bay, Wisconsin 54311

920.468.1978 tel
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Meeting Minutes

Client:	City of Manitowoc
Project Name:	Manitowoc Riverwalk Preliminary Design
AECOM Project Number:	60317415
Date:	March 7, 2014 at 10:00 am
Location:	Manitowoc City Hall, Manitowoc, Wisconsin
Meeting Purpose:	Client Kick-Off Meeting
Prepared By:	Katie Crotteau

In Attendance		
Name	**Company**	**Title**
Dave Less	City of Manitowoc	City Planner
Paul Braun	City of Manitowoc	Deputy City Planner
Dan Koski	City of Manitowoc	Department of Public Infrastructure
Jim Muenzenmeyer	City of Manitowoc	
Chris Allie	City Center, LLC	Owner, Consumers Steel Property
Terry Peterson	AECOM	Project Manager
Andrew Mott	AECOM	Backup Project Manager
Paul Timm	AECOM	
Jeff Maloney (via teleconference)	Vandewalle & Associates	

Action Item Number	**Action Item**	**Responsibility**
0001	Revise Study Schedule (attached)	AECOM
0002	Begin scheduling site investigation work, as weather allows. AECOM to propose locations of geotechnical borings in relation to available access	AECOM
0003	Setup meeting with WDNR for permitting issues. Date TBD.	AECOM
0004	Review existing information provided by City. Advise if further information is needed.	AECOM
0005	Provide CD with GIS Parcel and topographic information (provided at time of meeting)	City of Manitowoc
0006	Provide scans of USCOE soundings, bulkhead information, and Sanborn Maps (Provided via email on 3/7/14)	City of Manitowoc
0007	Provide copies of other proposals (provided at meeting)	City of Manitowoc
0008	Provide photos of the site	City of Manitowoc
0009	Attend meeting with WDNR in Green Bay regarding permit issues. Date TBD.	City of Manitowoc
0010	Arrange for Steve Corbeille, Finance Director, to attend selected study meetings. Dates TBD.	City of Manitowoc
0011	Contact Coastal Zone Management for extension of grant deadline.	City of Manitowoc

Summary

Discussion – Follows Agenda

1. Introductions and Project Background

- City of Manitowoc, AECOM/Vandewalle Team, and City Centre LLC introduced themselves and their roles/interest on the project.
- City of Manitowoc has retained AECOM team to perform site investigation and preliminary engineering analysis for siting a river walk along the Manitowoc River extending from the WPS property on the south to the Former Consumer Steel Property on the north. Project will include identifying funding sources and developing an implementation plan.

2. Communications Protocol

- Terry Peterson is the AECOM Project Manager (PM) and will be main point of contact for AECOM Team. Andrew Mott will be backup PM, and can be contacted as well.
- Paul Braun will be point of contact for City of Manitowoc.

3. Information Available/Needed

- Parcel and Topography – City provided on CD (GIS), City to provide USCOE soundings, and bulkhead information via scanned documents. City to provide site photos from 2013 site walkover.
- Brownfields database – City to provide Sanborn maps, aerials, via scanned documents.
- Historical Information – Use previous river walk and port studies. West Foundation from Manitowoc County may be a resource/potential donor.
- Other Proposals – City to provide copies for potential ideas to be incorporated.

4. Deliverable Expectation and Intended Use

- As proposed in AECOM proposal: Final Submittal to consist of a report including preliminary design information for the river walk, cost opinions, funding sources, and timeline for follow-on actions to implement the river walk. Presentation graphics to be delivered with drawings depicting existing conditions, walkway layout, proposed plan, typical cross-sections, and illustrations of appropriate special features.
- City agreed with proposed deliverable and requested the report identify items that may be time sensitive and may need updating if implementation is delayed (example further checking of wetlands, environmental conditions, permitting, etc.).
- Study will be broken into 4 phases- Preparation, Investigation, Concept Development, and Plan Development. Separate reports will not be prepared for each phase, but will be included in the final report. Executive summaries will be provided to demonstrate progress. Meetings (and resulting summary minutes) are intended to provide updates throughout project.
- Presentation graphics will be used for Council Approval presentation. Preliminary graphics will be developed and used for various meetings with stakeholders.
- Concepts should include a range of quality/cost options for City choice => from Cadillac plans to more modest options.

5. Schedule

- Due to weather conditions and finalization of contract, study is starting approximately one month later than planned. Weather conditions may require further delay of field site investigations (site/shoreline visual assessment, geotechnical soil borings, and survey work).

- City confirmed that study could go on past the June 31, 2014 deadline, subject to Wisconsin Coastal Management approval for extension. City will apply for extension of their Coastal Management Grant.
- Revised study schedule is attached. Revised study includes the following:
  - Meeting with WDNR for preliminary discussion of permitting issues will be scheduled as soon as possible– City to attend with AECOM.
  - Meeting with Grant coordinators for WDNR and WDOT will be held after concepts have been developed to a greater extent.
  - Meeting with stakeholders and potential river walk backers/donors will be held after site investigation has been completed to get them involved and on-board with the project early on.
- City Capital Improvement Plan (CIP) is generally developed in June/July timeframe. City's current annual debt obligation is quite burdensome through 2017 or 2018. 2017 or 2018 timeframe may be where matching funds could be committed. Steve Corbeille, the City's Finance Director, should attend one or more study meetings to provide advice for financial planning and timing.
- Grant applications occur during various times of the year. Intent of study will be to identify those sources that can be used, their deadlines for applications, approval, and availability for use.

6. Concept Considerations -- Various Ideas

- Features/Design Standards should be considered as the study progresses so these can be selected for final plan. AECOM recommends standard details be used for consistency and recognition by the public.
- This river walk is considered a transition corridor in an industrial area of the City between the downtown and outlying area to the west. Connections to Ice Age Trail are important. Mariners Trail along the Lake shoreline has been very well received, and should be connected to the study area in the plan.
- River walk will traverse an area that is officially mapped as "Erosion Hazard Area" due to steep banks and on-going erosion.
- Shore protection may be sheet wall, but other options are open for discussion.
- River walk can be located next to sheetwall or further shoreward.
- Fishing, canoe/kayak areas.
- Asphalt vs concrete vs gravel pathway
- No winter use (or plowing) of river walk is presently intended.
- Floating river walk? High maintenance and operations costs (removal and reinstallation each year).
- Tie ins on each end of the river walk should conform to previous river walk and port plans, connect to Ice Age Trail; N. 10th St. has a designated bike lane.
- Incorporate features that have good chance of providing funding approvals (i.e. Storm water management, bike/pedestrian designations, and signage) and will interest local grassroots groups. Consider means to obtain non-traditional funding matches.
- Sheetwall may need to consider emergency tie-up for Great Lakes Vessels (HAP grant?), and ladders for personal safety.

End of Summary

Attachments:- Attendance List,- Agenda, - Revised Study Schedule

3-7-14

KICKOFF MTNG

Name	Representing	Phone No	E-mail address
Terry Peterson	AECOM	920-406-3167	terry.peterson@aecom.com
Christopher Allie	City Centre	920-684-1545	CCAllie@Comcast.net
Jim Muenzenmeyer	City of Manitowoc	920-686-6511	JMuenzenmeyer@manitowoc.org
Paul Braun	City of Manitowoc	920-686-6930	PBraun@manitowoc.org
David Less	"	920-686-6931	dless@manitowoc.org
Dan Koski	City of Manitowoc	920-686-6911	dkoski@manitowoc.org
Paul Timm	AECOM	920 236 6718	Paul.Timm@aecom.com
Andrew Mott	AECOM	920 236 6713	Andrew.Mott@aecom.com

on phone

Jeff Maloney	Vandewalle Assoc	608-255-3988

PRELIMINARY DESIGN AND ENGINEERING STUDY –
SHEET WALL AND RIVERWALK

KICKOFF MEETING
Friday, March 7, 2014 at 10:00am

1. **INTRODUCTIONS**

2. **COMMUNICATION PROTOCOL**

   - POC: City and AECOM

3. **INFORMATION AVAILABLE/NEEDED**

   - Parcel and topo
   - Brownfields database
   - Historical Information/Book
   - Other Proposals

4. **DELIVERABLE EXPECTATION AND INTENDED USE**

   - Final Submittal
   - Phase Summaries
   - Meeting Minutes
   - Council Approval
   - Funding Applications

5. **SCHEDULE**

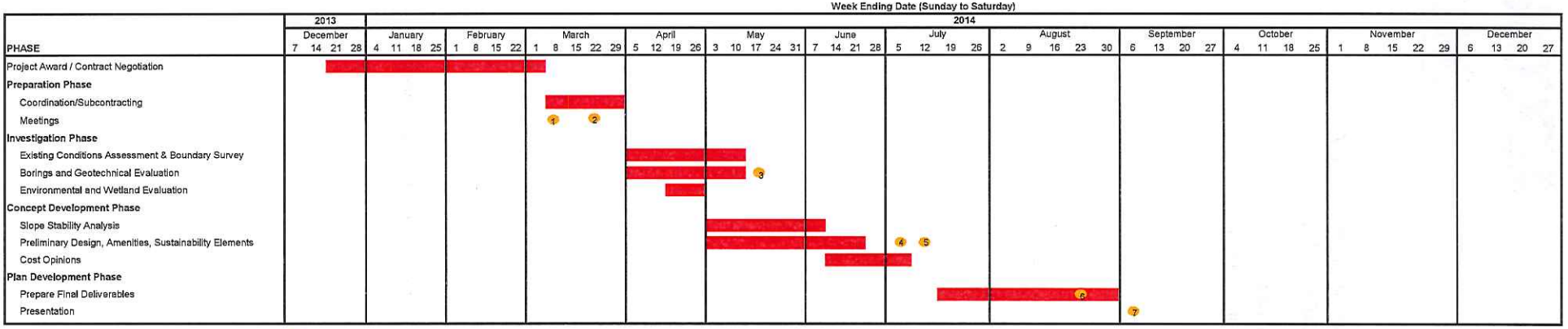
   - Revise Study Timeline
   - Associated Critical Dates: CIP, Grant Applications, Workshops, Public Reviews

6. **CONCEPT CONSIDERATION**

   - Features – Design Standards
   - Maintenance
   - Segmentation

Materials for Meeting:
AECOM: Project Schedule City: Mapping/Aerials of Site

Project Schedule (Revised 3/7/14)
River Walk East Bank of the Manitowoc River
City of Manitowoc Planning Department
Manitowoc, Wisconsin



Meetings:

1. Kick Off with City (3-7-14)
2. Regulatory Orientation (Date TBD, March 2014)
3. Investigation Summary (Include other stakeholders & Council members for project orientation)
4. Concept Development Review
5. Grant Coordination Orientation
6. Plan Development Review
7. Plan Development Presentation

Note: This schedule reflects discussions at 3/7/14 Kick Off meeting with City. Schedule assumes City will extend deadline for Coastal Management Grant.

AECOM
1035 Kepler Drive
Green Bay, Wisconsin 54311

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Meeting Minutes

Client:	City of Manitowoc
Project Name:	Manitowoc Riverwalk Preliminary Design
AECOM Project Number:	60317415
Date:	March 26, 2014 at 10:00 am
Location:	WDNR Service Building, Green Bay, Wisconsin
Meeting Purpose:	Discuss Permit Issues Associated with Riverwalk
Prepared By:	Terry Peterson

In Attendance		
Name	**Company**	**Title**
Dave Less	City of Manitowoc	City Planner
Paul Braun	City of Manitowoc	Deputy City Planner
Dan Koski	City of Manitowoc	Department of Public Infrastructure
Terry Peterson	AECOM	Project Manager
Carrie Webb	WDNR	Water Management Specialist

Action Item Number	**Action Item**	**Responsibility**
0001	Transmit information on conveyance of riparian rights pertaining to Chapter 30 permit to AECOM and City	Carrie Webb, WDNR (sent 3-31-14), see attached
0002	Information on WPS dredging of river	Carrie Webb, WDNR (sent 3-31-14, three separate e-mails to Paul Braun), see attached.

Summary

Discussion

1. Project Background & Meeting Goal

- The City of Manitowoc is interested in constructing a riverwalk along the east shoreline of the Manitowoc River from approximately 10th and Chicago Street intersection to N. Water Street. Prior to this meeting, the WDNR was furnished with maps of existing Harbor Line and USCOE soundings along this stretch of the river. A map of parcel locations and ground photos of the shoreline conditions were brought to this meeting for reference. The riverwalk segment will be approximately 2200 LF in length. 98% of this length would be on City-owned land. Non-City owned parcels are WPS property at the south end of the proposed riverwalk, and Consumers Steel property on north end of the proposed riverwalk. The City contacted these owners, and indicates a positive working relationship for siting of the proposed Riverwalk. A portion of the shoreline along this section of the river has an old steel sheetwall. The entire section is considered in the City's Erosion Hazard zone.

- The goal of this meeting was to describe the project in a preliminary manner, and inquire on any potential permitting issues for eventual construction.

2. Issues

- WDNR acknowledged the validity of the Harbor Line. The location of this line will be shown on plans of the proposed riverwalk to be developed by AECOM. WDNR indicated no Chapter 30 permit would be needed for installation of a sheet wall or bulkhead structure landward of this Harbor Line. However, if grading > 10,000 square f eet is done along the riverwalk (even if upland of the Harbor Line), then a Grading Permit would be needed. USCOE does not recognize the Harbor Line for their regulatory review, and therefore a permit application would likely be needed with them (local contact is Joey Shoemaker in Green Bay).
- Historical/archeological search of the riverwalk area would be done by WDNR at time of a permit application.
- Carrie Webb of the WDNR emphasized that riparian rights cannot be conveyed to the City by an easement from land not owned by the City. However a letter from the landowners approving the project is acceptable to WDNR. The City may need more formal agreement than this for its own protection. Carrie to send information on the riparian ownership issue to AECOM and City.

3. Information on WPS Dredging

- WPS is planning on dredging part of the river near their parcel to remediate impacted sediments from a historic MGP site. Information is likely available on the sediment sampling that has been done, and the dredge plan. Carrie Webb will contact WDNR staff to provide this information.

End of Summary

Attachments: 3-31-14 e-mail concerning Riparian Rights conveyance
3-31-14 e-mails (3) with WPS dredging information.

From: Webb, Carrie A - DNR
To: Peterson, Terry A.; Dan Koski (dkoski@manitowoc.org); Paul Braun; dless@manitowoc.org;
Subject: Riverwalk
Date: Monday, March 31, 2014 3:22:21 PM

Hello, thank you for meeting with me regarding the proposed riverwalk along the Manitowoc River last week. I believe Annette is following up with you on the maps/ survey we discussed. As shown below, no one can convey riparian rights by any means, including a license. You can get an easement to protect the city, but for Ch. 30 purposes all you need is a letter signed by the property owner saying they are ok with the project. Please let me know if you have any further questions.

30.133 Prohibition against conveyance of riparian rights.

30.133(1)**(1)** Beginning on April 9, 1994, and except as provided in s. 30.1335, no owner of riparian land that abuts a navigable water may grant by an easement or by a similar conveyance any riparian right in the land to another person, except for the right to cross the land in order to have access to the navigable water. This right to cross the land may not include the right to place any structure or material, including a boat docking facility, as defined in s. 30.1335 (1) (a), in the navigable water.

Quality Customer Service is important to us, please tell us how we are doing:
https://www.surveymonkey.com/s/WDNRWater

Carrie Webb
Water Management Specialist
Door, Kewaunee, & Manitowoc Counties
Wisconsin Department of Natural Resources
(☎) **phone:** (920)662-5453
http://dnr.wi.gov/topic/waterways

From: Peterson, Terry A.
To: "Paul Braun";
cc: Mott, Andrew;
Subject: RE: WPS former Manufactured Gas Plant, Manitowoc
Date: Monday, March 31, 2014 12:49:00 PM

Thanks for the information Paul.

Andrew - see attached for info on WPS site.

Terry

-----Original Message-----
From: Paul Braun [mailto:PBraun@manitowoc.org]
Sent: Monday, March 31, 2014 11:38 AM
To: Peterson, Terry A.
Subject: FW: WPS former Manufactured Gas Plant, Manitowoc

An email regarding the WPS area for your information

-----Original Message-----
From: Weissbach, Annette E - DNR [mailto:Annette.Weissbach@wisconsin.gov]
Sent: Thursday, March 27, 2014 3:33 PM
To: Margaret Gielniewski (Gielniewski.Margaret@epamail.epa.gov)
Cc: Paul Braun; Dave Less; Webb, Carrie A - DNR; Bougie, Cheryl - DNR; Chronert, Roxanne N - DNR
Subject: WPS former Manufactured Gas Plant, Manitowoc

Hello Margaret, I just had a telephone conversation with Paul Braun and Dave Less of the City of Manitowoc . They had a meeting recently with Carrie Webb, WDNR Water Management Specialist, to discuss a proposed Riverwalk in the area of the WPS property in Manitowoc. They are interested in knowing the areas of contamination in soil and sediment at the WPS property and to the north that may be in the path of their proposal. I told them we should be getting a Remedial Investigation Report in the new few weeks that should have maps that show the degree and extent of soil/groundwater/ sediment/vapor contamination.

In the meantime is there a map that you or Integrys/NRT could send to the City to show the extent of contamination in the City's area of interest?

In addition, the city owns a portion of the land that is subject of the WPS MGP site in Manitowoc. Can you please introduce yourself and let them know how EPA intends to keep them in the loop with regard to any work on their property?

Thanks,
Annette~

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From: Peterson, Terry A.
To: Mott, Andrew;
Subject: FW: WPS former Manufactured Gas Plant, Manitowoc
Date: Monday, March 31, 2014 12:50:00 PM

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fyi

From: Paul Braun [mailto:PBraun@manitowoc.org]
Sent: Monday, March 31, 2014 11:42 AM
To: Peterson, Terry A.
Subject: FW: WPS former Manufactured Gas Plant, Manitowoc

Terry another email for the WPS site.

Paul

From: Gielniewski, Margaret [mailto:gielniewski.margaret@epa.gov]
Sent: Friday, March 28, 2014 10:17 AM
To: Weissbach, Annette E - DNR
Cc: Paul Braun; Dave Less; Webb, Carrie A - DNR; Bougie, Cheryl - DNR; Chronert, Roxanne N - DNR
Subject: RE: WPS former Manufactured Gas Plant, Manitowoc

Salutations!

I've spoken to Naren about providing the City a better map with delineation of upland wastes.

The City already contact Brian Bartoszek on this matter; WPSC is working on the map and should have something ready by the end of next week.

I'll keep you posted on the progress.

Best regards,
Margaret

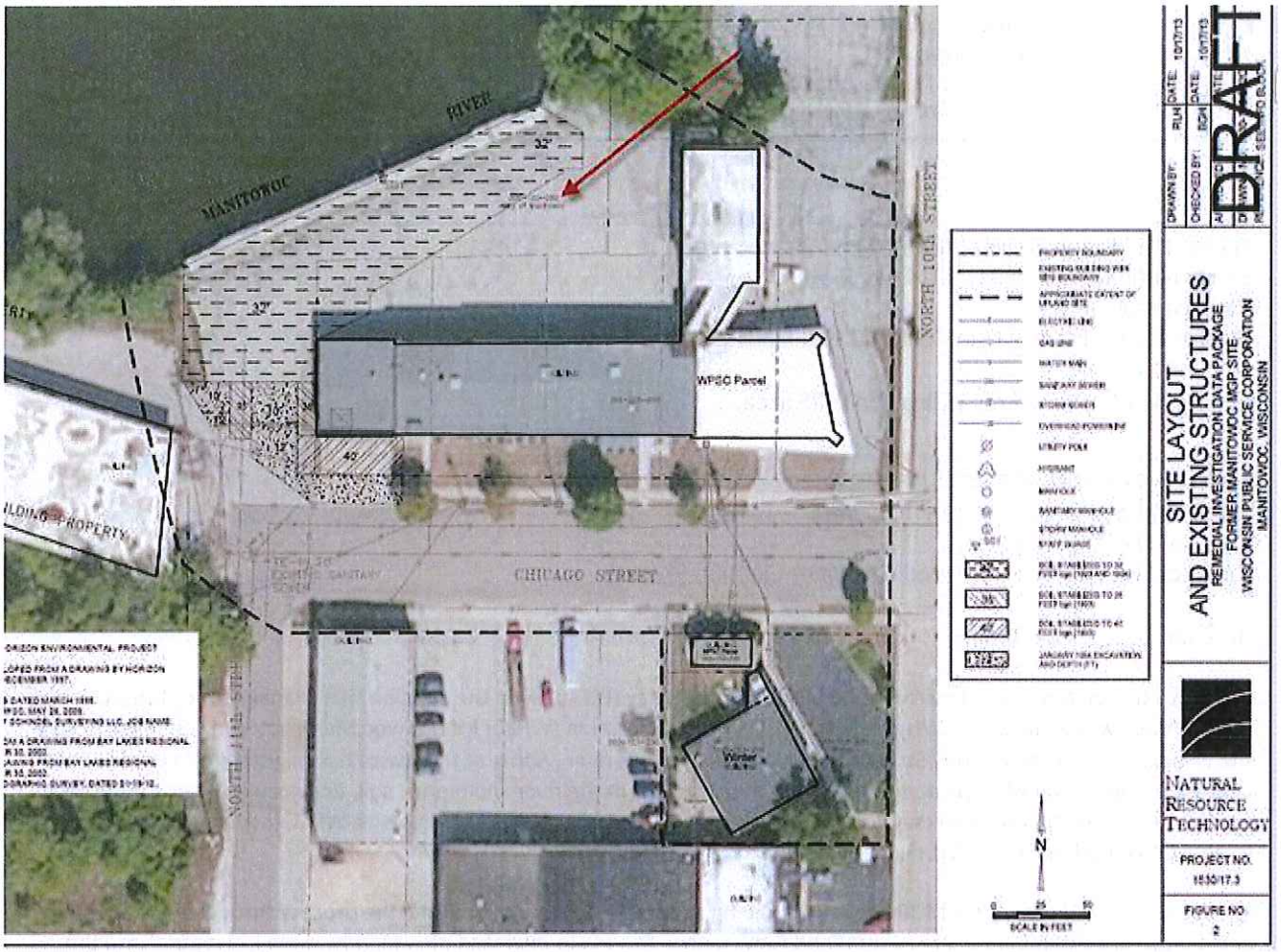
From: Weissbach, Annette E - DNR [mailto:Annette.Weissbach@wisconsin.gov]
Sent: Thursday, March 27, 2014 3:34 PM
To: Gielniewski, Margaret
Cc: Paul Braun; Dave Less (dless@manitowoc.org); Webb, Carrie A - DNR; Bougie, Cheryl - DNR; Chronert, Roxanne N - DNR
Subject: WPS former Manufactured Gas Plant, Manitowoc

Hello Margaret, I just had a telephone conversation with Paul Braun and Dave Less of the City of Manitowoc . They had a meeting recently with Carrie Webb, WDNR Water Management Specialist, to discuss a proposed Riverwalk in the area of the WPS property in Manitowoc. They are interested in knowing the areas of contamination in soil and sediment at the WPS property and to the north that may be in the path of their proposal. I told them we should be getting a Remedial Investigation Report in the new few weeks that should have maps that show the degree and extent of soil/groundwater/ sediment/vapor contamination.

In the meantime is there a map that you or Integrys/NRT could send to the City to show the extent of contamination in the City's area of interest?

In addition, the city owns a portion of the land that is subject of the WPS MGP site in Manitowoc. Can you please introduce yourself and let them know how EPA intends to keep them in the loop with regard to any work on their property?

Thanks,
Annette~



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From: Peterson, Terry A.
To: Mott, Andrew;
Subject: FW: Former Manufactured Gas Plant Cleanup Process
Date: Monday, March 31, 2014 12:50:00 PM

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fyi

From: Paul Braun [mailto:PBraun@manitowoc.org]
Sent: Monday, March 31, 2014 11:45 AM
To: Peterson, Terry A.
Subject: FW: Former Manufactured Gas Plant Cleanup Process

Here is another email regarding the WPS area.

From: Gielniewski, Margaret [mailto:gielniewski.margaret@epa.gov]
Sent: Friday, March 28, 2014 10:50 AM
To: Dave Less; Paul Braun
Subject: Former Manufactured Gas Plant Cleanup Process

Hello Mr. Less and Mr. Braun,

I work for the United States Environmental Protection Agency (U.S. EPA) in the Division that manages/facilitates cleanup of hazardous waste sites. The Wisconsin Public Service Corporation (WPSC) Manitowoc Manufactured Gas Plant (MGP) site is located at 402 North 10th Street (Manitowoc)—near the river. Some of the waste has migrated off the physical address of the former MGP plant and has come to be located in the river sediments, soil, and groundwater. Some waste may be located in the area you may try to redevelop as a river walk. EPA is working with WPSC (now known as Integrys) to get you an updated map that delineates the extent of waste.

The former WPSC Manitowoc MGP site is undergoing a remedial investigation (RI)—the process through which the extent and degree of contamination are determined (how far has the waste migrated off site; how deep has it gone into the groundwater; what are the concentrations found in the sediment—some questions that will be answered in this report).

After the RI, EPA will oversee WPSC perform a Feasibility Study (FS)—where all the possible remedies (for groundwater, soil, and sediment) to achieve cleanup for the site will be listed and evaluated.

EPA will issue a Record of Decision (ROD) after the RI/FS process is completed. Before the ROD is finalized, there will be a minimum of 30 days comment period where the community (including the City) will have an opportunity to comment on the ROD and EPA will formally respond to those comments.

EPA will keep you updated if any portion of the proposed cleanup will be on City property (which it probably will be). In the meanwhile, please do not hesitate to contact me with additional questions, comments, concerns, or requests (such as the updated map of extent of contaminants).

Best regards,

Margaret Gielniewski, Remedial Project Manager
U.S. EPA Region 5, Superfund Division
ph. 312-886-6244

AECOM
1035 Kepler Drive
Green Bay, Wisconsin 54311

920.468.1978 tel
920.468.3312 fax

Meeting Minutes

Client:	City of Manitowoc
Project Name:	Manitowoc Riverwalk Preliminary Design
AECOM Project Number:	60317415
Date:	May 28, 2014 at 5:30 pm
Location:	Manitowoc City Hall, Manitowoc, Wisconsin
Meeting Purpose:	Site Investigation Review Meeting
Prepared By:	Shannon Allen

In Attendance		
Name	**Company**	**Title**
Paul Braun	City of Manitowoc	Deputy City Planner
Dan Koski	City of Manitowoc	Department of Public Infrastructure
Jim Muenzenmeyer	City of Manitowoc	Plan Commissioner, Director of Building and Grounds, Transit Manager
William Jindra	City of Manitowoc	City Plumbing Inspector
Peter Allie	City Center, LLC	Owner, Consumers Steel Property
Chris Allie	City Center, LLC	Owner, Consumers Steel Property
Terry Peterson	AECOM	Project Manager
Andrew Mott	AECOM	Backup Project Manager
Paul Timm	AECOM	Construction Manager
Jeremy Thomas	AECOM	Senior Geotechnical Engineer
Shannon Allen	AECOM	Assistant Project Engineer
Mike Huck		Ex Director Lakeshore CAP and Chair of the River Corridor Group (Former City Business Manager and Harbor Master)
Dennis Steinbrenner		Plan Commission Member
Ted Jennejohn	McMullen & Pitz Marine Contractors	Project Manager
Tony Fodden		River Corridor Group member
Able		Alderman
Dave Diedrich		Plan Commissioner
Jamie Zastrow		Ex Director of Mainly Manitowoc – Main Street group
Rolf Johnson		Ex Director Wisconsin Maritime Museum
James Anderson		Harbor Commission member

Action Item Number	Action Item	Responsibility
0001	Proceed with Concept Design Phase. Evaluate riverwalk design options and their impact on the shoreline geometry and slope	AECOM

	stability. Evaluate potential means to improve stability of steep upper slopes. Define shoreline options that are workable, practical and able to be permitted.	
0002	Schedule meeting with community involvement at conclusion of Concept Design phase.	City of Manitowoc

Summary

Discussion – Follows Agenda

1. Introductions and Review of Project

- City of Manitowoc and AECOM representatives introduced themselves to the audience in attendance, and their roles on the project.

- Project purpose: City of Manitowoc has retained AECOM team to perform site investigation and preliminary engineering analysis for siting a river walk along the Manitowoc River extending from the WPS property on the south to the Former Consumer Steel Property on the north. Project will include identifying funding sources and developing an implementation plan.

- Goals and approach: Paul Timm (AECOM) explained how a similar Riverwalk System has been successful in the City of Oshkosh. He suggested the City of Manitowoc should reach out to residents and potential stake holders to provide input on what the Riverwalk uses should be, (i.e. – fishing, walking, biking, etc.), what type of system the city would want (i.e. – concrete pathway, boardwalk, gravel path, etc.) and start looking for possible forms of donations (i.e. – benches, material, money, etc.). Conceptual design information and budgeting spreadsheets from the Oshkosh Riverwalk program were provided as examples of the deliverables for this Manitowoc project. Paul suggested the overall Riverwalk should be broken into multiple segments to maximize grant dollars and provide a smooth flow of riverwalk implementation. For example, while one segment is being constructed, another segment should be in the permitting/funding stage, and another segment should be in the design stage.

- Schedule: This study/design project is being performed in four phases (Preparation, Site Investigation, Concept Design, Plan Development). AECOM has now completed the second phase, Site Investigation. This meeting was held to present the findings. The project is currently on the schedule that was agreed to at the March 7, 2014 kick off meeting. The next phase of the project will be to develop concept plans. Two meetings will be held at the completion of the Concept Design phase; one meeting will review the concept development, the second meeting will provide orientation on grant coordination.

2. Environmental Aspects

- Andrew Mott (AECOM) explained the desktop study that was performed for this segment of the Riverwalk. The purpose of the desktop study was to identify potential sources of contamination in soil and groundwater, locate potential archeological sites, and identify potential wetlands that may affect the design and construction of the project. Sanborn maps from 1906, 1919, and 1956 did not show any major sources of potential contamination or archeological sites. In general, the shoreline has been occupied by residential or vacant properties. The Manitowoc Gas Company was located on the south end of the project in the 1906 and 1919 Sanborn Maps and changed ownership by 1956 to Wisconsin Fuel and Light Company. The Goodrich Transit Company Repair Shop was shown in the 1919 map and includes an electric shop, a paint shop, and storage room, but by 1956, this shop is no longer existent. The Sanborn maps also show areas of fill along the river and how the river channel has changed. A map from 1941 depicts the bulkhead line establishment.

- A review of the WDNR wetland surface data suggests wetlands are not within the project area. This cannot be interpreted to guarantee wetland vegetation isn't present on site.

- Information was presented on the WPS property located on the southern end of the project, as provided

by WDNR and WPS. A figure was presented illustrating stabilized areas and areas of potential soil and groundwater impacts.

- Based on the desktop study and discussions with the Wisconsin Department of Natural Resources, it is less likely that a Chapter 30 will be required if construction is on the upland side of the Bulkhead Line. Due to the size of the project (greater than 1 acre of disturbance), a General Grading Permit will be required. An application will also need to be submitted to the Army Corp of Engineers.

3. Physical Aspects

- As part of the site investigation, AECOM performed 3 soil borings, our sub-consultant (SMI) verified parcel mapping of the shoreline area and the historic bulkhead line to supplement topography provided by the City, AECOM performed a limited bathymetric survey along the shoreline to supplement USCOE soundings, and AECOM performed a visual observation and assessment of the shoreline from the vantage point of a boat in the river.

- Using the City-supplied topography, AECOM created cross sections at the soil boring locations perpendicular to the river. The cross section geometry and the soil information from the borings were used to run stability analyses at the three different cross sections.

  1) The first cross section indicates steep slopes (close to 1H/1V) on the upper part of the section. This steep upper slope exists along an approximately 700 ft. long stretch of the river shoreline. Based on the geometry of the slope and the soils encountered, the slope stability exhibits a lower than recommended factor of safety. This confirms field observations that indicate the slope shows signs of continuing erosion and possible shallow slope failures. The existing stand of vegetation is likely helping to stabilize the slope. Disturbance of this slope and the existing vegetation during construction should be minimized, to lessen the chance of a failure. This steep slope will require slope stabilization efforts, even though the riverwalk will be located at lower elevations close to the river.

  2) The second cross section was cut through the portion of the river shoreline that contains an existing sheet pile wall. The slopes are less steep than the first cross section and this section exhibits a more favorable slope stability factor of safety.

  3) The third cross section was located on a more gentle slope section of the shoreline, just north of the WPS parcel. This section exhibited an acceptable factor of safety. The boring at this cross section encountered fill material and then sand and rock.

4. Next Phase – Concept Design

- Using cross section 1, AECOM presented sketches of three concept ideas for the riverwalk:

  1. Use of a sheet pile wall to support the walkway along the river,
  2. Use of a rip rap revetment to support the walkway along the river,
  3. Use of a pile-supported boardwalk.

Each option sketch included COE project depth dredge elevation in the navigation channel of the river, the bulkhead line, and channel line. It was mentioned that the riverwalk could incorporate various designs along the riverwalk.

1) Members from the audience had questions about the stability of the slopes and what types of stabilization could be performed. Jeremy Thomas (AECOM) discussed multiple solutions; the lowest cost may be re-grading the slope. This may not be a desired nor feasible option due to loss of green space and the presence of residences/private ownership along the top of the slope. Alternatives could include soil nailing the slope, or driving sheet piling within the slope. The city will need to decide what type of look they would prefer, i.e. – is an exposed wall something they would

be ok with from an aesthetics, safety, and maintenance standpoint? It was mentioned that if this project was proposed as a slope stabilization project, grant funding could be more favorable. The proposed alignment of the river walk will traverse an area that is officially mapped as "Erosion Hazard Area" due to steep banks and on-going erosion.

2) Members from the audience asked if the proposed and existing sheet pile wall would be designed to support mooring loads for emergency tie-ups for Great Lakes Vessels, and include ladders for personal safety. It was mentioned that designing the walls for mooring loads may be important for securing grant funding (HAP) and is something the design team should look into further.

- As AECOM moves forward with the concept designs, consideration should be given to the following:

1) Trail connectivity to existing trails, such as the Ice Age Trail will be important for funding. The city should consider corridors going from the river walk up to the top of the bank at intervals

2) The city should incorporate features that have a good chance of providing funding approvals (i.e. Storm water management, bike/pedestrian designations, and signage) and will interest local grassroots groups. Consider means to obtain non-traditional funding matches.

5. Key Take Away Items

- Aside from the WPS property to the south of the project, there appear to be no major environmental issues
- More simplified and favorable permitting if construction is upland of the bulkhead line
- The topography indicates deep water along the shoreline
- The topography indicates existing steep upper slopes
- There is a slope stability concern based on the topography

End of Summary

Attachments:- Attendance List,- Agenda

AECOM
1035 Kepler Drive
Green Bay, Wisconsin 54311

920.468.1978 tel
920.468.3312 fax

Meeting Minutes

Client:	City of Manitowoc
Project Name:	Manitowoc River Walk Preliminary Design
AECOM Project Number:	60317415
Date:	July 30, 2014 at 5:30 pm
Location:	Manitowoc Public Library, Manitowoc, Wisconsin
Meeting Purpose:	Concept Design Review Meeting
Prepared By:	Shannon Allen

In Attendance		
Name	**Company**	**Title**
Paul Braun	City of Manitowoc	Deputy City Planner
Dan Koski	City of Manitowoc	Department of Public Infrastructure
William Jindra	City of Manitowoc	City Plumbing Inspector
Terry Peterson	AECOM	Project Manager
Paul Timm	AECOM	Construction Manager
Shannon Allen	AECOM	Assistant Project Engineer
Dean Proctor	Vandewalle & Associates	Principal Designer

Note: See attached attendance list for resident attendance.

Action Item Number	**Action Item**	**Responsibility**
0001	Proceed with Plan Development Phase: • Identify fund availability and application timeframes • Breakdown the River Walk into fundable segments each with an appropriate cost budget • Prepare a master timeline defining permit applications, fund applications, final design, and construction • Prepare the final deliverables (summary report, presentation graphics)	AECOM
0002	Incorporate fishing platforms/areas into the River Walk design	AECOM / Vandewalle
0003	Research Native American history and early ship building history (pre-WWII) and incorporate into the design or historical features.	Vandewalle
0004	Schedule meeting with WDNR to discuss Grant Coordination.	AECOM / City of Manitowoc
0005	Schedule meeting near the end of August/beginning of September to discuss the plan development review	AECOM / City of Manitowoc
0006	Schedule meeting in September for the Plan Development Presentation to City Council	City of Manitowoc

Summary

Discussion – Follows Agenda

1. Introductions

- Project purpose: City of Manitowoc has retained AECOM team to perform site investigation and preliminary engineering analysis for a river walk along the Manitowoc River extending from the WPS property on the south to the Former Consumer Steel Property on the north (approximately 2200 LF). Project includes identifying funding sources and developing an implementation plan.

- Introduction of Design Team: Design Team members were introduced (see "In Attendance" list at beginning of memo)

2. Review of Project

- Project Area Background: Dean Proctor (Vandewalle & Associates) gave a background of the area; set the stage for the opportunity to have a River Walk along this stretch of shore; the urban setting and history of the area (Maritime Museum and Industry). Selected graphics were shown of the River Corridor plan and how this section of the River Walk will connect to other trails (Ice Age Trail, Mariners Trail). The project area is close to Union Park Neighborhood, so it is anticipated people from the neighborhood could easily access the River Walk. Additionally there is the opportunity for others outside the City to visit the city to use this riverfront trail.

- Phased Approach of Project: Terry Peterson (AECOM) briefly described the four phases of this study: preparation, site investigation, concept development, and plan development. This presentation was part of the Concept Development Phase and was intended to illustrate potential walkway layout and how the trail could be incorporated into the project site physical features.

- Shoreline/River Characteristics: Shannon Allen (AECOM) summarized the riverwalk site's physical features, ownership extents, location of the navigational channel and bulkhead line, and flood levels all of which are key features of the project area. A map depicting the bulkhead line, channel line, shore line, and property lines in relationship to the River Walk alignment was shown. Photographs were provided to further explain the existing conditions. The photos showed overgrown and toppling vegetation, deteriorated old timber bulkheads, an existing sheet pile wall, and steep riverbank slopes. A map was shown depicting locations along the riverbank with varying degrees of concern for slope stability, based on geotechnical analysis of the site soils and topography. The steep slopes (nearly 1H/1V along a significant portion of the alignment present a high concern for long-term stability. Placement of a riverwalk system near the shoreline should include consideration of methods to stabilize these slopes to minimize potential for future erosion, loss of bank, and possible damage to the riverwalk. Removal of vegetation in these areas should be limited because the root system is providing some stability. The area with existing sheet pile walls is of moderate concern. These sheet pile walls have been in-place for a number of years and backfill has eroded out behind the wall on both ends. Preliminary evaluation of tis sheet pile wall indicates it has the potential to be used for riverwalk support, but will need further evaluation in final design to verify its integrity. Areas of low slope stability concern are those with shallow slopes (3H/1V or less), these may not require specific stabilization features.

- Regulatory: Terry Peterson (AECOM) explained that during the Site Investigation phase, there were limited environmental issues identified, other than at the WPS property. In terms of permitting, if most construction occurs landward of the Bulkhead Line, the WDNR would have less involvement. In addition, an application must also be submitted to the Corps of Engineers.

3. Concept Design

- Manitowoc History: Dean Proctor (Vandewalle) described the unique setting of the project and history of the area. The goals of the project are to provide access to the river, protect the character of the natural setting, and reveal the stories of the nature and culture. Features of the River Walk will include

connection to other walkway systems, trailheads, overlooks and platforms, and information areas. School groups could use this information area as a location to study ecology and history of the area. Dean mentioned the area currently has a working harbor, and played a unique role in WWII, (submarine building - which would be incorporated into the informational stations).

- Concept Plans: Drawings were displayed depicting the River Walk alignment and usage of pile supported boardwalk and on-grade trails. Cross sections were provided to show how the river walk could be situated into the riverbank area, and illustrated key areas (trailhead, educational area, floating platform, etc.).

4. Questions and Comments from Attendees

- A neighboring landowner brought up two concerns he had for this project. One is safety – will there be railings installed along the path for safety of bikers, and other walk way users? He is concerned children biking will go too fast and ride off the edge of the walkway. His other concern is cost. The design team acknowledged these comments.

- A citizen asked if we could explain the Bulkhead Line. AECOM described this as a line in along the river that was established back in the early 1900's by the US Government, and is recognized by the WNDR as the limit for riverward construction. The citizen was further concerned that large vessels moving on the river wouldn't have adequate room if the riverwalk was built out to that line. She lives along the shore and has witnessed vessels coming close to the shoreline when maneuvering.

- A resident asked if there is any Native American history to this area. Dean mentioned he would look into this and could incorporate his findings in the design.

- A resident mentioned that Schooners were being built in the harbor well before submarines were built for WWII. Would there be any history on the Schooners that were built here? Dean mentioned he would look into this to incorporate in the design.

- Will there be designated areas for fishermen? A citizen commented that a fisherman with a tackle box would most likely be in the way of someone biking along the path. The design team will look into adding a few locations for designated fishing platforms.

- How will this River Walk connect to other trails in the City? The City showed the plan of how the trail will connect to the Ice Age Trail and Mariners Trail. In addition, the City has been in discussion with the Ice Age Trail about redirecting the trail onto a portion of the River Walk once the project is complete because it currently is on city sidewalks going through downtown.

- As a side note, there is a current trail that ends near 9th street and doesn't appear to connect to anything. The resident was wondering if this walkway connects to anything, such as the proposed River Walk? The City explained that the trail near 9th Street is supposed to connect with sidewalks on the street and that better signage could be used to indicate this.

- What is the timeline for the River Walk completion? Paul Timm (AECOM) described the process the City of Oshkosh uses in building their River Walk system. The project will be broken up into buildable/fundable segments. Each segment is anticipated to take 3 to 5 years to complete. Each segment will require time for permitting, application and award of grants, final design, bidding, and finally construction. In the City of Oshkosh, their River Walk system (over 4 miles in total length) was programmed to take 15-20 years to construct.

- How much grant money is usually available? Typically the City will need to pay for 50 to 60% of the cost. AECOM and the City of Oshkosh have been successful in acquiring up to $1.3 million in grants for various segments of their River Walk system.

- How much will the project cost? The design team has not yet developed cost estimates. Based on experience, the relative order of costs for various riverwalk support options (going from least expensive to

most costly) is normally: Cutting/filling on the shoreline; placing riprap embankment; installing a pile-supported boardwalk; installing a seawall. However given the site slope stability and ownership challenges, cutting/filling is not considered a feasible option. The concept design approach utilizing a boardwalk and some on-grade walkways is expected to be most cost effective.

- Can you explain the floating platform? The platform rises/lowers with the water level. It would be accessed from the shoreline via a gangway.
- Would it be feasible to have the entire River Walk be a floating platform? Paul Timm (AECOM) has observed successful River Walks in other major cities that were entirely floating platforms. To help extend the life of the floating piers, the sections will most likely need to be removed in the winter. This would require more maintenance on the City's end, which must be a cost consideration.

End of Summary

Attachments: Attendance list

SIGN IN SHEET
SHEET WALL & RIVER WALK MEETING
MEETING DATE: JULY 20, 2014

NAME (print)	ADDRESS	TELEPHONE
1. ABLE	715 N. 5th, MANTY	652-0036
2. B. Jindra	900 quay	— -
3. Mike Huck	702 state st.	682-3737
4. Rick Schwarz		
5. Jeremiah Novak	1320 Washington st.	684-5737
6. Peter Allie	100 Manitowa Dr Stex	684-1545
7. Alex Allie	"	"
8. Christopher Allie	"	"
9. BARRY NELSON	PO BOX 515	
10. Dan Kaski	900 Quay	686-6910
11. JACK RESCH	419 CHICAGO St.	682-0508
12. Kevin Miller	2127 PAUL RD	901-8419
13. Ted Wallis	6573 Hartland Lake	758-3282
14. Jeanne Brown	434 No. 10 St	682-1860
15. Brian Laurent	607 N 7th Waters St	6873932
16. JIM RUFFOLO	1811 SPRING ST.	686.5102
17. Russ Wittenberg	496 N10	6890225
18. Connie Loden	202 N 8th St Manitowoc	682 0540
19. Biff Hansen	1502 Michigan Av	684-5777
20. Jim Hollahan	502 N 5th St.	301502-7722
21. Jennifer Hollahan	" " " "	301-502-8056

PROPOSED RIVERWALK FOR CITY OF MANITOWOC
NOTES ON MAY 5 SITE OBSERVATION VISIT

The location of the photos referenced below are indicated on Figure 1.

Photos 1—3 show the existing shoreline at the northernmost end of the proposed riverwalk. The sloped bank is partially protected by construction debris (broken concrete and concrete masonry blocks). A severely decayed timber retaining wall is partially visible above the waterline (Photo 2).

Photos 4—8 show the existing shoreline north of the existing steel sheet pile bulkhead. The sloped bank is covered by vegetation (trees and shrubs). A severely decayed timber retaining wall is partially visible above the waterline (Photos 5, 6, and 7).

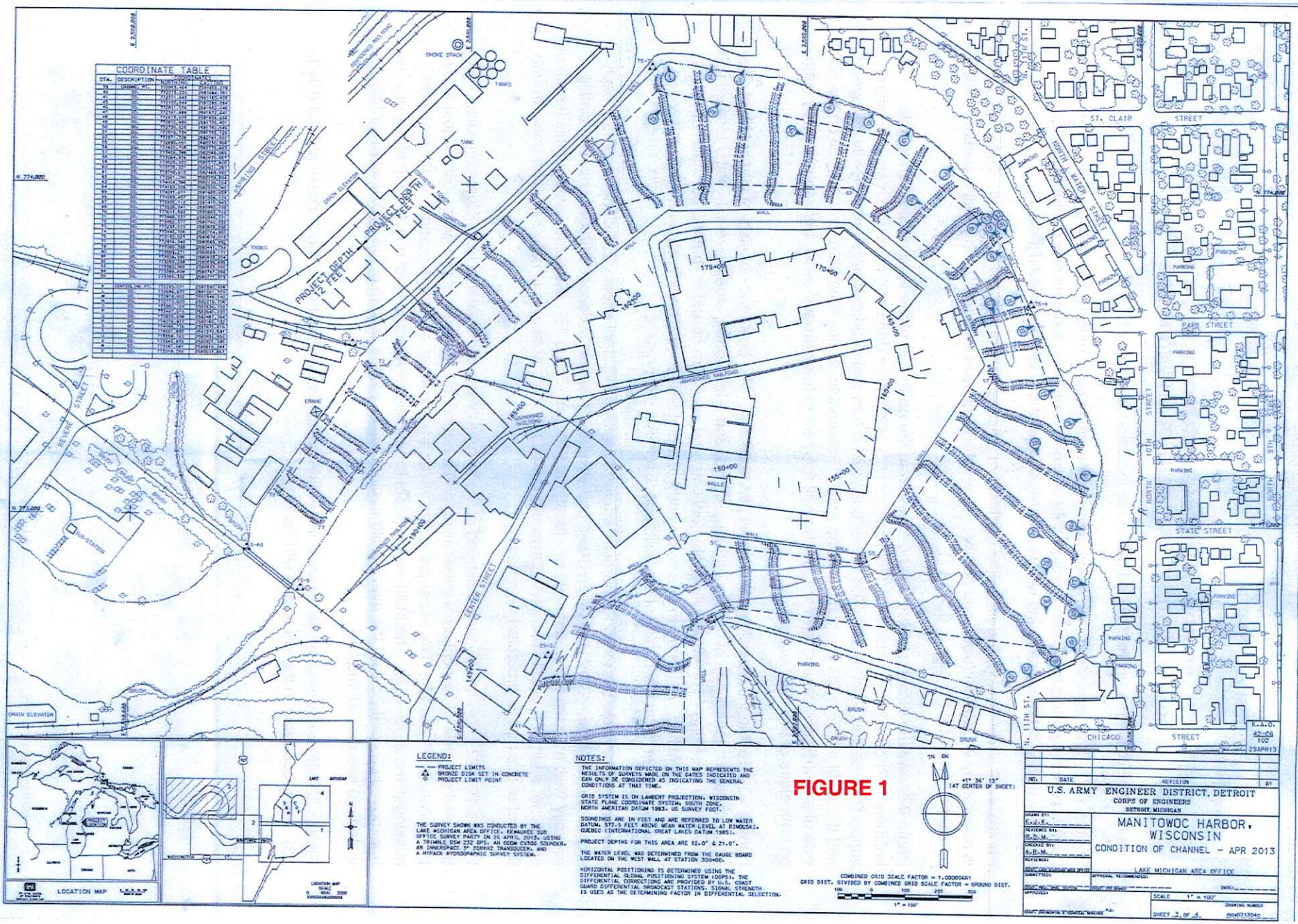
Photo 9 shows the existing timber bulkhead return at the north end of the existing steel sheet pile bulkhead. Photos 31—33 show the steel anchor rods and timber deadman piles which provide lateral support for the bulkhead return. The timber bulkhead return and deadman piles are severely decayed, and the steel anchor rods are corroded and bent. Presumably, at one time there was backfill on the south side of the bulkhead return; however, the backfill appears to have eroded away, and water can be seen on both sides of the bulkhead return.

Photos 10—13 show the existing steel sheet pile bulkhead. The bulkhead consists of vertical steel sheet piling, a steel channel cap at the top of the bulkhead, and a horizontal, steel sheet pile waler located just above the waterline. The sheet piling, channel cap, and waler are corroded, but the bulkhead does not appear to be failing. At the north and south ends of the bulkhead, the backfill appears to have eroded away; however, near the center of the bulkhead, backfill is still present.

Photos 14—19 show the existing shoreline south of the existing steel sheet pile bulkhead. The steeply sloped bank is covered by vegetation (trees and shrubs). A severely decayed timber retaining wall is partially visible above the waterline in two locations (Photos 15 and 19). Near the center of this length of shoreline, a large, precast concrete stormwater outfall pipe was observed (Photo 34). The bank around the end of this pipe is protected by riprap.

Photos 19—22 show the existing bulkhead at the former Wisconsin Fuel and Light Company site. The bulkhead consists of vertical steel sheet piling and a horizontal, steel sheet pile waler located just above the waterline (Photo 22). The sheet piling and waler are corroded, and large portions of the waler are missing (Photos 19—21). The bulkhead appears to be failing—at some locations, the top of the bulkhead has moved outward (toward the river), while at other locations, the bottom of the bulkhead (near the waterline) has moved outward.

Photos 23—30 show wide angle views of the entire existing shoreline, beginning at the north end (Photo 23), and proceeding to the south end (Photo 30).


COORDINATE TABLE
STA. DESCRIPTION COORDINATES
PROJECT DEPTH 21 FEET
PROJECT DEPTH 12 FEET
ST. CLAIR STREET
PARK STREET
STATE STREET
CHICAGO STREET
CENTER STREET
REVERE STREET
10TH STREET
9TH STREET
N. 11TH ST.
NORTH WATER STREET
SPRING STREET
GRAIN ELEVATOR
SMOKE STACK
TANKS
CRANE
PARKING
BRUSH
LEGEND:
PROJECT LIMITS
BRONZE DISK SET IN CONCRETE PROJECT LIMIT POINT
NOTES:
THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATES INDICATED AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITIONS AT THAT TIME.
GRID SYSTEM IS ON LAMBERT PROJECTION, WISCONSIN STATE PLANE COORDINATE SYSTEM, SOUTH ZONE, NORTH AMERICAN DATUM 1983, US SURVEY FOOT.
SOUNDINGS ARE IN FEET AND ARE REFERRED TO LOW WATER DATUM, 577.5 FEET ABOVE MEAN WATER LEVEL AT RIMOUSKI, QUEBEC (INTERNATIONAL GREAT LAKES DATUM 1985).
PROJECT DEPTHS FOR THIS AREA ARE 12.0' & 21.0'.
THE WATER LEVEL WAS DETERMINED FROM THE GAUGE BOARD LOCATED ON THE WEST WALL AT STATION 309+00.
HORIZONTAL POSITIONING IS DETERMINED USING THE DIFFERENTIAL GLOBAL POSITIONING SYSTEM (DGPS). THE DIFFERENTIAL CORRECTIONS ARE PROVIDED BY U.S. COAST GUARD DIFFERENTIAL BROADCAST STATIONS. SIGNAL STRENGTH IS USED AS THE DETERMINING FACTOR IN DIFFERENTIAL SELECTION.
THE SURVEY SHOWN WAS CONDUCTED BY THE LAKE MICHIGAN AREA OFFICE, KEWAUNEE SUB OFFICE SURVEY PARTY ON 26 APRIL 2013, USING A TRIMBLE DSM 232 DPS, AN ODOM CV300 SOUNDER, AN INNERSPACE 31 ZDRMK2 TRANSDUCER, AND A HYPACK HYDROGRAPHIC SURVEY SYSTEM.
LOCATION MAP
TN GN
41° 36' 13" (AT CENTER OF SHEET)
COMBINED GRID SCALE FACTOR = 1.00000661
GRID DIST. DIVIDED BY COMBINED GRID SCALE FACTOR = GROUND DIST.
1" = 100'
FIGURE 1
NO. DATE REVISION BY
U.S. ARMY ENGINEER DISTRICT, DETROIT
CORPS OF ENGINEERS
DETROIT, MICHIGAN
MANITOWOC HARBOR, WISCONSIN
CONDITION OF CHANNEL - APR 2013
LAKE MICHIGAN AREA OFFICE
SCALE 1" = 100'
SHEET 3 OF 4
K.A.O. 42-C6 102 29APR13

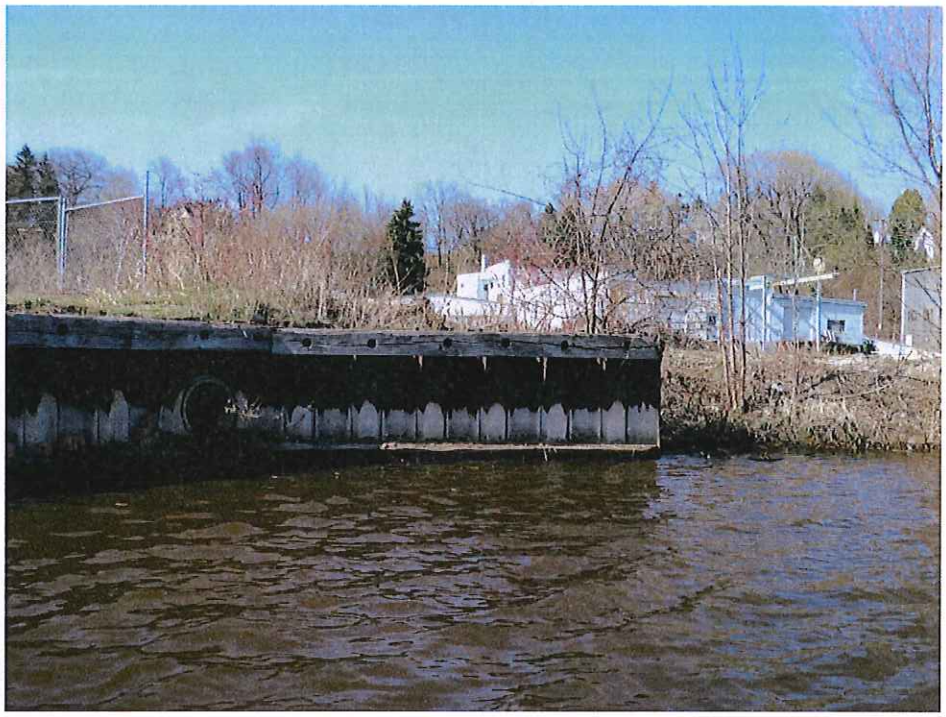


Photo 1

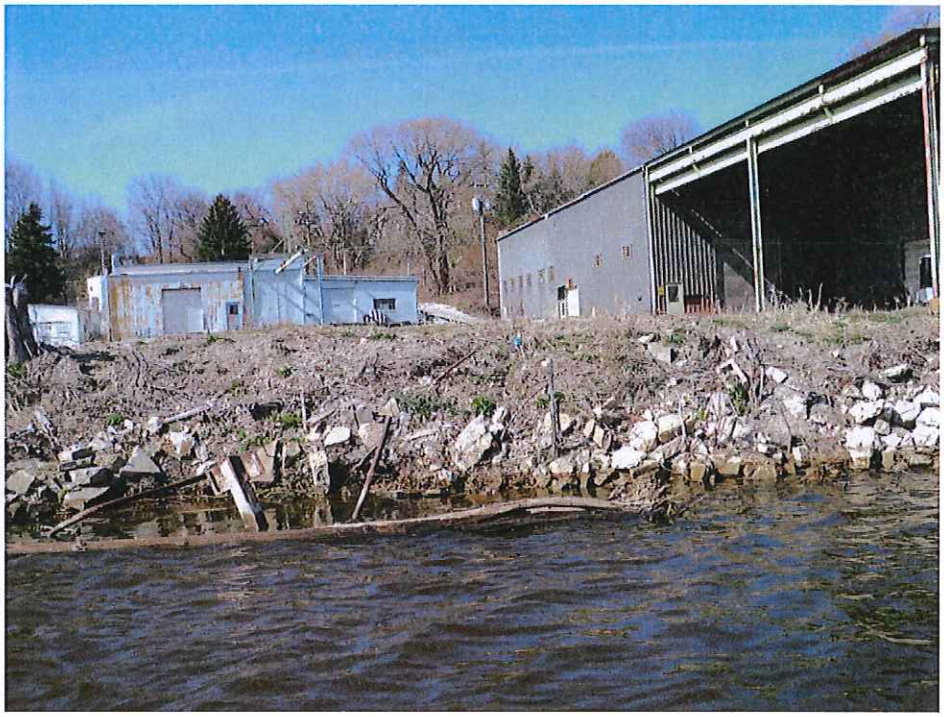


Photo 2

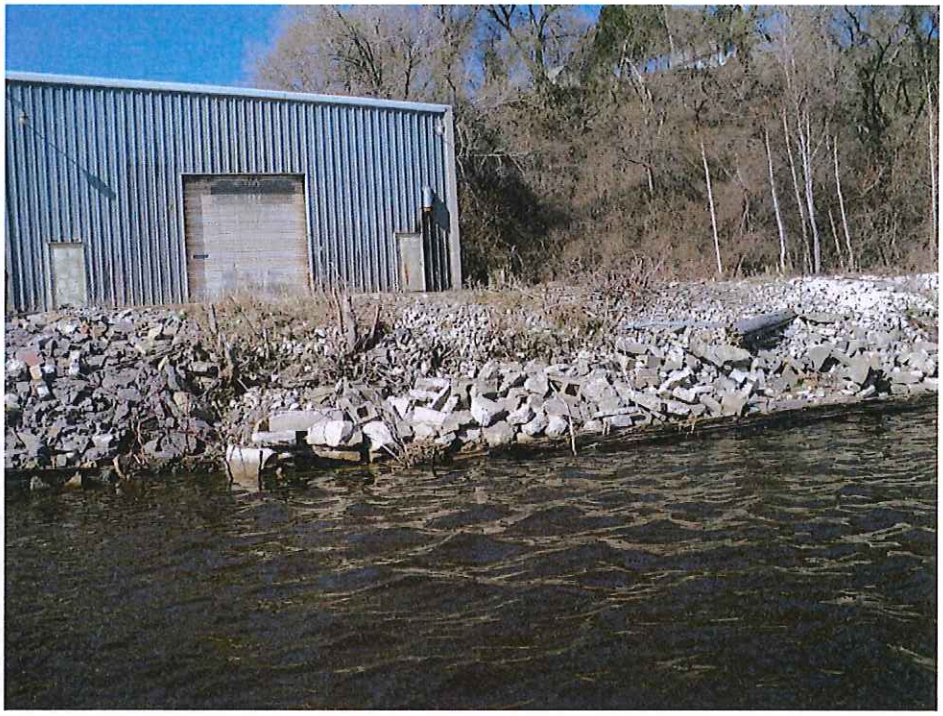


Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9

Photo 10

Photo 11

Photo 12

Photo 13

Photo 14

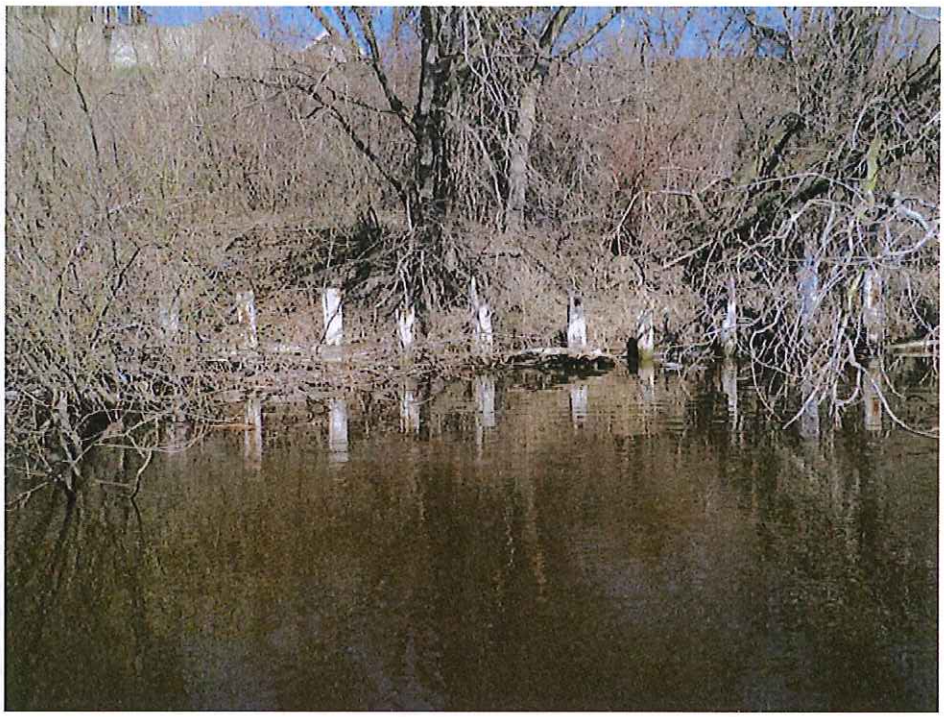


Photo 15

Photo 16

Photo 17

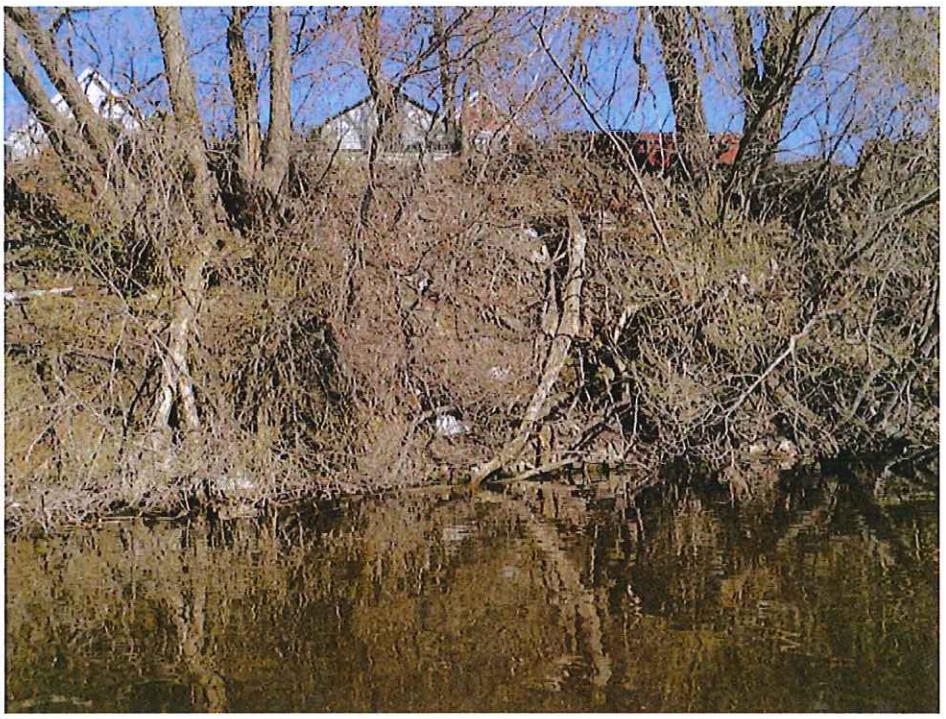


Photo 18

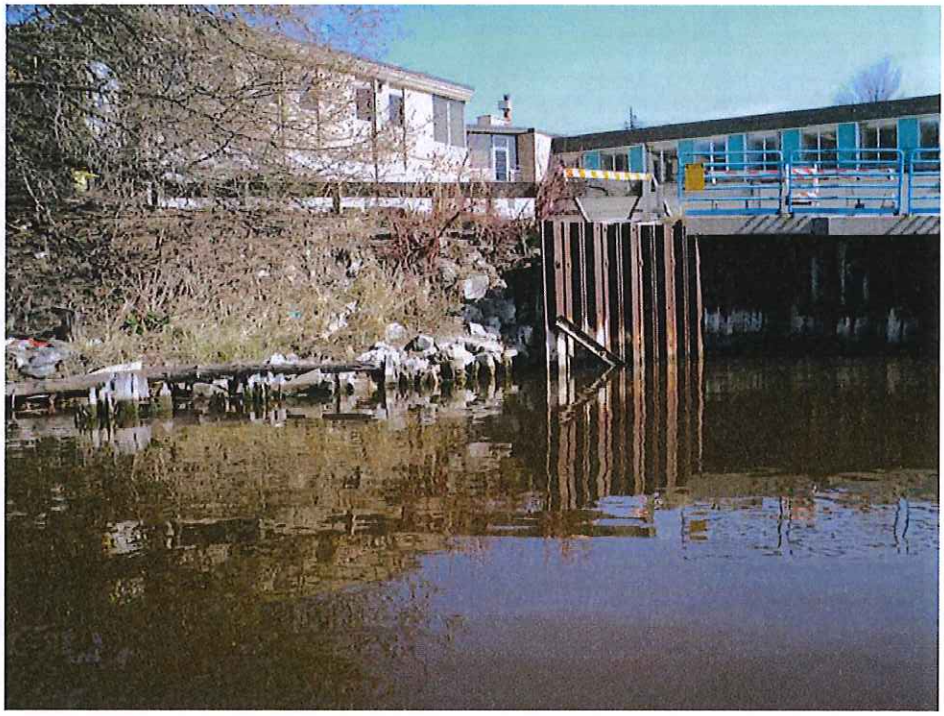


Photo 19

Photo 20

Photo 21

Photo 22

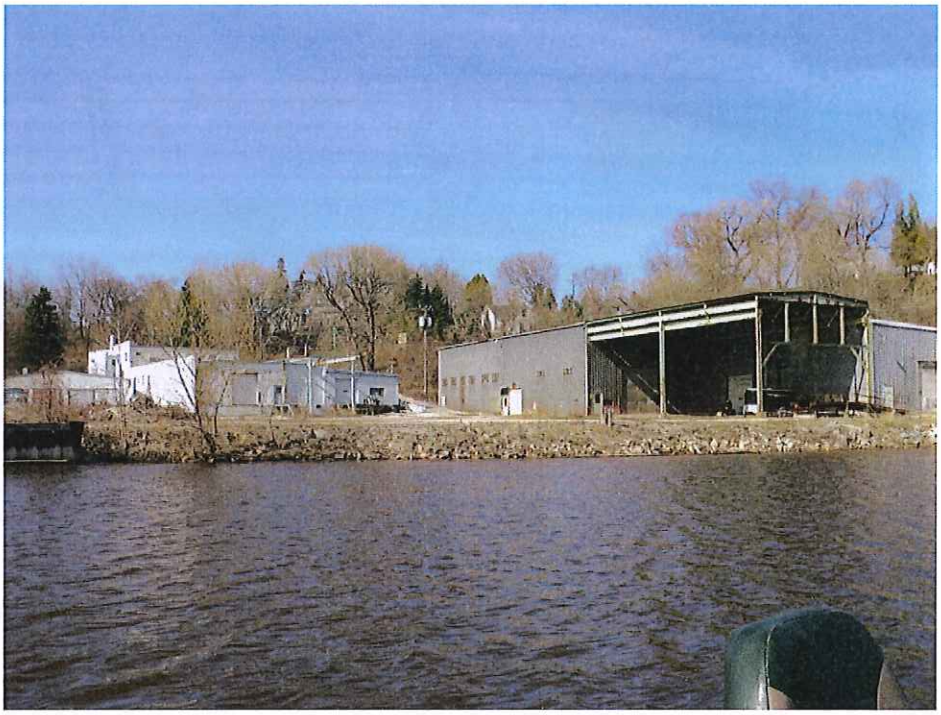


Photo 23

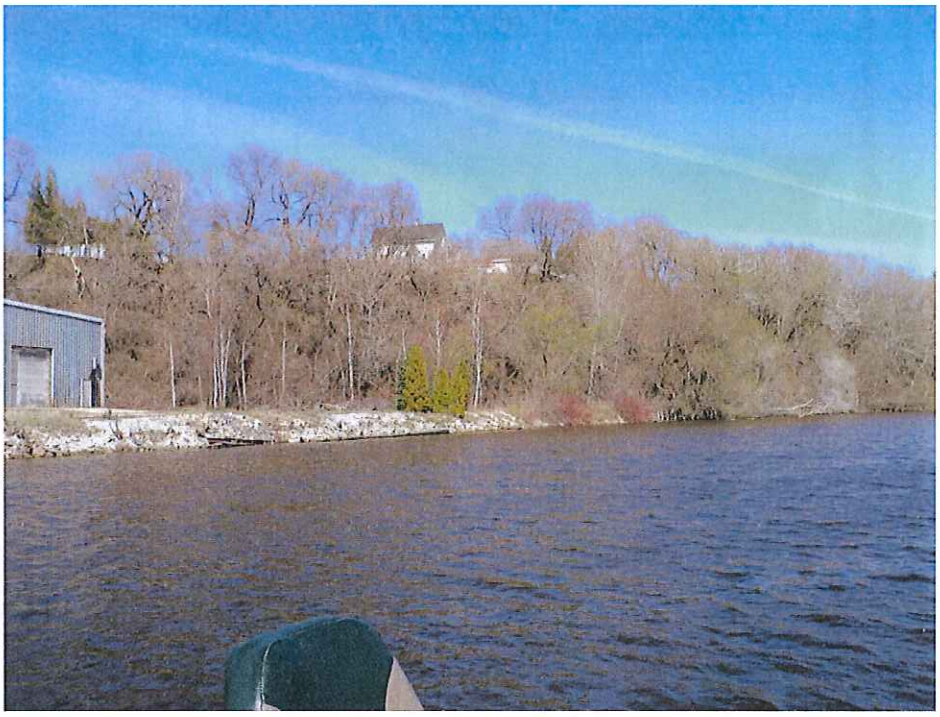


Photo 24

Photo 25

Photo 26

Photo 27

Photo 28

Photo 29

Photo 30

Photo 31

Photo 32

Photo 33

Photo 34

AECOM

Submitted to
City of Manitowoc Planning
Department
Manitowoc, Wisconsin

Submitted by
AECOM
Oshkosh, Wisconsin
September 2014

Subsurface Exploration and Geotechnical Evaluation Report

East Bank of the Manitowoc River
Manitowoc, Wisconsin

AECOM
558 North Main Street
Oshkosh, Wisconsin 54901

920.235.0270 tel
920.235.0321 fax

September 10, 2014

Mr. Paul Braun
Deputy City Planner
Planning Department
900 Quay Street
Manitowoc, Wisconsin 54220-4543

Subject: **Geotechnical Engineering Services for the Proposed Sheet Wall and River Walk, East Bank of Manitowoc River, Manitowoc, Wisconsin - AECOM Project No. 60317415**

Dear Mr. Braun,

AECOM Technical Services, Inc. (AECOM) has completed the subsurface exploration and geotechnical engineering evaluation for the above-referenced project. The attached report contains the logs of three (3) soil borings and the results of field and laboratory testing. Included within this report is our analysis of subsurface conditions and recommended parameters for use in the design and construction of the proposed improvements.

We appreciate the opportunity to provide our services for this project. If you have any questions regarding this report, or if we can provide additional assistance, please contact us.

Sincerely,

AECOM Technical Services, Inc.

Shannon R. Allen
Assistant Project Manager

Jeremy M. Thomas, P.E.
Project Engineer

Elliott E. Drumwright

Elliot Drumwright, P.E.
Associate Engineer

Table of Contents

List of Appendices

1 Project Overview

1.1 Introduction

AECOM Technical Services, Inc. (AECOM) has been working with the City of Manitowoc (City) in planning and designing of the River Walk along the east bank of the Manitowoc River in Manitowoc, Wisconsin. A new walkway will be constructed along with associated bank stabilization and restoration.

1.2 Project Description

AECOM was contracted by the City to provide geotechnical engineering services for the proposed River Walk. We understand that the City is planning to construct a River Walk along the eastern bank of the Manitowoc River. A geotechnical exploration program consisting of three (3) soil borings was performed at the site to assess the subsurface conditions along the proposed River Walk alignment. This report presents the results of the subsurface exploration, laboratory testing, our evaluation of the global stability, and recommendations to be used in the preliminary design of slope stabilization, sheetpile wall retaining systems, rip rap revetments, pile supported boardwalks, and general design and construction considerations. Supplemental information was provided from the nearby City Centre dock wall design and Burger Boat dock wall design.

1.2.1 Subsurface Exploration and Geotechnical Engineering Evaluation

The locations of all soil borings completed for the project are included in the location diagram in Appendix A. The boring logs are included within Appendix B.

This report was prepared under the supervision of a Professional Engineer registered in the State of Wisconsin. The report describes the subsurface exploration program and provides geologic characterization of the subsurface and groundwater conditions encountered at the boring locations. The report provides geotechnical recommendations for use in the conceptual design of the proposed improvements. A more extensive geotechnical program will be needed for final design.

Recommendations in this report are based on preliminary design information available at this time, combined with assumptions regarding unknown conditions. Our recommendations are based upon the soil conditions encountered during our subsurface exploration. As the design of the project continues to develop, a detailed geotechnical investigation program will be developed and implemented for the specific site improvements proposed.

2 Exploration and Testing Procedures

2.1 Drilling and Sampling Procedures

The soil boring locations were selected by AECOM. A total of three (3) soil borings, B-1 through B-3, were completed by Subsurface Exploration Services, LLC (SES) under subcontract to AECOM. The utilities were cleared by SES through the Diggers Hotline system prior to the start of the subsurface exploration. The ground surface elevation at the boring locations was interpreted by AECOM from the previously completed topographic survey.

The borings were advanced by a two-man drill crew from April 16 to April 21, 2014 using a D-50 truck mounted drill rig. The borings were advanced using a combination of solid-stem augers and rotary wash drilling. Soil sampling was generally performed at 2 foot intervals to a depth of 10 feet and at 5 foot intervals thereafter to the boring termination depths. The borings were extended to depths ranging from 75.5 to 110.2 feet below ground surface.

Soil samples were obtained in general accordance with ASTM D 1586 "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils." The Standard Penetration Test (SPT) resistance was based on the blows required to advance a standard diameter sampler over two successive 6-inch intervals after an initial 6-inch set. A more detailed explanation of the drilling and sampling procedures used is presented in Appendix C.

During field operations, the drilling crew maintained a log of the subsurface conditions including changes in the stratigraphy and observed groundwater level. The drill crew made water level observations in the boreholes during the drilling and sampling operations and again upon completion of the drilling operations. These readings are indicated on the lower left hand corner of the boring logs. Upon completion, the boreholes were backfilled with grout, bentonite chips, and bentonite sand slurry.

2.2 Laboratory Testing Program

Soil samples obtained while drilling were logged, labeled, sealed, and returned to the AECOM laboratory. The penetration test samples obtained from the soil borings were visually examined by a geotechnical engineer to estimate the distribution of grain-sizes, plasticity, organic content, moisture condition, color, and presence of lenses and seams. Where granular soils were encountered, the relative density was evaluated in-situ through the Standard Penetration Test (SPT). Calibrated penetrometer tests were performed on cohesive soil samples to estimate their unconfined compressive strength. In the calibrated penetrometer test, the unconfined compressive strength of a cohesive soil is estimated by measuring the resistance of the soil sample to penetration by a small spring calibrated cylinder. The results of the laboratory tests are shown on the individual soil boring logs included in Appendix B.

Soil samples were then classified in accordance with the AECOM Soil Classification System. The estimated group symbol (included in parentheses following soil descriptions on the boring logs) is in general conformance with the Unified Soil Classification System (USCS), which serves as a basis of the AECOM Soil Classification System. A more detailed explanation of testing and classification procedures used is presented in Appendix D. All soil samples were tested for water content.

2.3 Boring Log Procedures and Qualifications

General soil descriptions are noted on the boring logs. The strata contact lines represent approximate boundaries between soil types; the actual transition between soil types in the field may be gradual in both the horizontal and vertical directions. Subsurface conditions and water levels at other locations may differ from the conditions encountered at the boring locations. Furthermore, the subsurface conditions may change over time, mostly in strata with high organic content as those soils are subject to decomposition and large settlement/consolidation. These variables should be considered when utilizing the information presented on the boring logs.

3 Exploration Results

3.1 Existing Site Conditions

The project site is located along the eastern shore of the Manitowoc River in Manitowoc, Wisconsin. The site is heavily vegetated, and the slopes in some areas are very steep. Soil borings for the current work were performed at the top of the slope as indicated on the Soil Boring Location Diagram in Appendix A.

3.2 Subsurface Soil Conditions

Current Borings: The following is a generalized summary of the subsurface conditions encountered in the current borings drilled from near the top of the bluff slope. The soil boring logs should be reviewed to determine the actual subsurface conditions at each location. In the performance of subsurface explorations, specific information is obtained at specific locations and at specific times. However, it is well-known that variations in soil and rock conditions exist on most sites between boring locations and seasonal and annual fluctuations in groundwater levels will likely occur. The nature and extent of variations may not become evident until the course of construction. Variations in the soil profile may occur and should be anticipated throughout the site.

The subsurface profile varied slightly between borings B-1 and B-2 and varied greatly in boring B-3. Topsoil was encountered in borings B-1 and B-3 to a depth of 1.5 feet. Fill soils were encountered at the ground surface in boring B-2 to depth of 1.5 feet. Fine sand was encountered underlying the topsoil in B-1 and fill in B-2 to depths ranging from 5.5 to 6.0 feet. The sand varied in relative density from loose to medium dense based on SPT blow counts. Boring B-1 encountered silty clay underlying the sand to a depth of 16 feet. The clay was classified as stiff, based on the unconfined compressive strength test results. Borings B-1 and B-2 encountered alternating layers of silt (ML), sandy silt (ML), sand (SP), and silty sand (SM) to a depth of 86.2 feet in B-1 and to the termination depth of 76.5 feet in B-2. The relative density generally increased with depth in boring B-1 from medium dense to very dense, and decreased with depth in boring B-2 from very dense to medium dense, based on SPT blow counts. Deep deposits of sandy gravel (GP) and boulders were encountered in boring B-1 at a depth of 86.2 feet to a depth of 95 feet. The gravel was extremely dense. Sandy silt hardpan was encountered underlying the gravel to the termination depth. The hardpan was extremely dense.

Fill soils were encountered underlying the topsoil in boring B-3 to a depth of 10 feet. Gravel and sand were encountered from 10 feet to the termination depth of 75.5 feet. The relative density varied from medium dense to extremely dense based on SPT blow counts.

Bedrock was not encountered in any of the current borings.

Supplemental information from borings performed for other nearby projects: Of importance to the Manitowoc River Walk, prior borings completed by AECOM for other projects in the vicinity (2010 Centre City LLC Dockwall Replacement project and 2008 Burger Boat Dockwall Construction) were drilled beginning at an elevation equivalent to the base of the slope (approximate El. 585 feet). Those borings encountered a few feet of surficial fill over very loose organic silt, clayey sand, or soft peat, to depths on the order of 30 to 35 feet below grade, before encountering deeper sand or clay deposits of moderate to high strength. The significance of those softer deposits is discussed in Section 4.

3.3 Groundwater Conditions

Groundwater was encountered in boring B-2 and B-3 during drilling at a depth of 56 and 26 feet, respectively, below ground surface. The project site is located adjacent to the Manitowoc River. According to the United States Army Corps of Engineers (USACE), the Manitowoc River has a low water level of 577.5 feet in reference to the International Great Lakes Datum 1985. At the boring locations, we assume the groundwater table is at or slightly above the level of the adjacent Manitowoc River. In addition, the 1% annual chance flood (100-year flood) plain elevation is estimated to be at approximately El. 585 feet based on the FEMA Flood Insurance Rate Map (Panel 306 of 450 and Map Number: 55071C0306D)

Groundwater level fluctuations may occur with time and seasonal change due to variations in precipitation, evaporation, surface runoff, neighboring pumping, local dewatering, and especially the level of the adjacent Manitowoc River.

3.4 Historic Subsurface Investigations

Subsurface exploration activities were performed near the project area in 2008 and 2010 for the Burger Boat Dock wall design and the City Centre Dock wall Replacement design, respectively. Soil profiles varied significantly between the borings performed for the Manitowoc River Walk, and the historic borings performed for Burger Boat and City Centre projects. Due to the steep slopes along the eastern bank of the Manitowoc River, accessibility to the planned alignment of the river walk along the shoreline by a drill rig was impractical. The borings performed for the Manitowoc River Walk investigation were performed at the top of the slope at approximate elevations ranging from 612 to 652. The historic soil borings for Burger Boat and City Centre were performed at elevations ranging from 582.3 to 585 feet, which are considerably lower in elevation, and are at or below the 100-year flood plain elevation of the Manitowoc River (585 feet). Although organic material was not encountered in the river walk soil borings, the historic soil borings encountered soft compressible organic material, such as peat and organic silt, below the surficial fill along the river bank. Based on the soil conditions encountered at these adjacent properties, it appears a number of low land swamp areas were infilled during the development of the river front. Fill was placed over the top of organic soils to make developable land. Selected soil borings from these adjacent projects are included in the attachments to this report. A more detailed description of the soils encountered in the historic soil borings follows.

Burger Boat Dockwall Design (2008). Boring 4 was performed by a heritage company of AECOM (STS Consultants, Ltd.). The surface elevation of the boring was 583 feet and it was drilled to 62.5 feet below ground surface. Fill was encountered to a depth of 5 feet and consisted of base course and silty fine sand. Very soft, native organic silt was encountered underlying the fill material to a depth of 24 feet below ground surface (elevation 559 feet). Fine to coarse sand was encountered underlying the organic silt to a depth of 34 feet. The sand was medium dense based on SPT blow counts. Silty clay was encountered underlying the sand to a depth of 43 feet. The silty clay was stiff based on the unconfined compressive strength. Sandy silt hardpan was encountered underlying the silty clay at a depth of 43.0 feet (elevation 540 feet) to the termination depth of 62.5 feet below ground surface. The hardpan was extremely dense based on SPT blow counts. Bedrock was not encountered. Groundwater was encountered 7.5 feet below ground surface while sampling, which roughly corresponds to the Manitowoc River level.

City Centre LLC Dockwall Replacement Design (2010). Borings 1 through 8 were performed by AECOM. Surface elevations of the borings varied from 582.3 to 585.0 feet (IGLD), and the borings were completed to depths ranging from 20 to 77.7 feet below ground surface (boring termination elevations varied from 505.7 to 564.7 feet). Fill, peat, and organic silt layers were encountered to elevations of 549.3 to 564.7 feet in most of the borings, with borings 5 through 8 terminating in organic silt or peat. Underlying the peat and organic silt layers in borings 1 through 4 were layers of medium dense sand and gravel and stiff to very stiff silty clay. Hardpan was encountered in borings 1, 3 and 4 at elevations ranging from 507.8 to 525.2 feet. Limestone bedrock was encountered in borings 2 and 4 at elevations ranging from 508.2 to 509.7 feet. Groundwater was encountered at depths ranging from 3.5 to 11 feet below ground surface.

4 Analysis and Recommendations

We understand the city is proposing to construct a river walk along the eastern shore of the Manitowoc River. Based on the topographic survey mapping provided by the City, the existing slopes along the eastern shore of the Manitowoc River are very steep in certain areas. As part of the geotechnical evaluation, a preliminary slope stability analysis was performed for the existing site conditions. In addition, recommendations on sheetpile wall retaining systems, rip rap revetments, pile supported boardwalks, and general design and preliminary construction considerations are provided.

4.1 Global Stability Evaluation

4.1.1 Critical Failure Surface Definition

Slope failures in embankments are typically characterized as 'rotational', i.e. the failure mass appears to have rotated around an imaginary axis point. Thus, a circular failure, defined by user specified 'entry', 'exit', and radius ranges, was specified to estimate the potential failure surfaces and corresponding Factor of Safety (FOS) in the slope stability analysis. The entry and exit ranges were each defined by 20 possible entry/exit increments over the range. Additionally, the radius range was defined by 20 possible radius increments over the range. This means that each cross section was evaluated for approximately 8000 possible failure surfaces.

The failure surface entry range was located on the upper portion of the slope and the failure surface exit range was located on the river bed. The failure mass was assumed to move from right to left (upslope to downslope). Seismic conditions were not evaluated.

The failure surface with the lowest FOS was chosen as the critical failure surface. The critical failure surface and corresponding FOS is shown on the stability outputs provided in the attachments.

4.1.2 Evaluation of Existing Conditions

The global stability of the existing slope along the river walk alignment was evaluated under short-term and long-term loading conditions and both total and effective stress soil properties. The factors of safety (FOS) against global failure for the loading conditions were estimated using the computer program SLOPE/W (Geo-Slope International, Ltd., GeoStudio 2007, Version 7.13). The SLOPE/W program uses a 2-D limit equilibrium approach as applied to the method of slices to determine slope stability. The FOS was computed using the Morgenstern-Price method which satisfies both force and moment equilibrium.

Three stability analysis models were created based on the existing site conditions. The cross sections were located through the soil borings and perpendicular to the river. The cross section geometries were developed based on topographic contours from the City-supplied site mapping. Bathymetry soundings of the river bottom were obtained from the USACE website and from a limited bathymetric survey performed by AECOM near the river's edge. A groundwater elevation of 577.5 feet was assumed based on information published by the USACE. The cross section locations are shown on the Soil Boring Location Diagram included in Appendix A.

The soil properties used in the stability model were based on the results of the recently completed soil borings, laboratory test results, and other applicable site information. The following table provides the soil properties used in the stability analysis.

Soil Type	Total Unit Weight, γ (pcf)	Long Term		Short Term	
		Friction Angle, ϕ' (deg)	Cohesion, c' (psf)	Friction Angle, ϕ (deg)	Cohesion, c (psf)
Topsoil – ML	110	28	0	28	0
Fill – CL	125	28	0	0	1000
Fill – SP – Loose	115	28	0	28	0
Fill – ML – Loose	115	28	0	28	0

Soil Type	Total Unit Weight, γ (pcf)	Long Term		Short Term	
		Friction Angle, ϕ' (deg)	Cohesion, c' (psf)	Friction Angle, ϕ (deg)	Cohesion, c (psf)
CL – Stiff	125	28	0	0	3000
SP – Loose	115	28	0	28	0
SP – Medium Dense	120	28	0	28	0
SP – Dense	120	32	0	32	0
SM – Dense	120	30	0	30	0
SM – Very Dense	120	32	0	32	0
ML – Medium Dense	120	28	0	28	0
ML – Dense	120	30	0	30	0
ML – Very Dense	120	30	0	30	0
ML (hardpan) – Ex. Dense	125	34	0	34	0
SP-GP – Medium Dense	125	34	0	34	0
GP – Ex. Dense	125	34	0	34	0

4.1.3 Existing Conditions Stability Analysis Results

A minimum FOS of 1.3 for undrained (short-term) loading conditions, and a minimum FOS of 1.5 for drained (long-term) loading conditions are generally accepted standards in engineering practice. The three cross sections were evaluated for global stability under low water conditions (Elevation 577.5 feet) based on short term and long term soil conditions. The following table lists the FOS results for the existing conditions. Accompanying output results are provided in the attachments.

Condition Assessed	Cross Section Location	Undrained FOS	Drained FOS
Existing Condition	Cross Section 1 through Boring 1	1.3	0.9
Existing Condition	Cross Section 2 through Boring 2	1.4	1.4
Existing Condition	Cross Section 3 through Boring 3	1.8	

The existing conditions generally are acceptable under short term, undrained loading conditions, however are generally not acceptable under long term, drained loading conditions. The slopes are currently heavily vegetated and eroded in some areas. Since the slope does not appear to exhibit signs of recent major failures (such as a bare slope with a large soil mass at the toe), we assume the root mass is aiding in the stability of the slope. However, it is evident there has been erosion of the slopes over time, and some of the surficial slopes have moved as evidenced by the fallen or tilted trees. If the slope continues to erode and steepen, a slope failure may occur in the future. The analyses indicate that very shallow failures (sloughing) are likely in most of the natural slopes, since their FS tends to be just above 1.0. To reduce the risk of ongoing shallow sloughing failures, disturbance of existing vegetation should be minimized during construction where feasible. We further recommend stabilizing those areas of the slope with a high stability concern (steep slopes with Drained FOS <1.5).

4.2 Slope Stabilization Solutions

Based on the existing topography and soil conditions encountered, we recommend stabilizing steep lower slopes near stations 1+50 to 3+00 and steep upper slopes near station 8+00 and stations 9+00 to 21+00. A portion of the upper slopes near station 8+00, stations 9+00 to 16+00, and stations 19+00 to 21+00 that require slope stability remediation are not within City-owned property. We recommend the City work with the owners of these specific properties to mitigate slope stability issues. We recommend four solutions for consideration to stabilize the slopes of high stability concern: cut slope, soil nails, SRT, and living wall. A combination of the solutions may be used in different areas of the project depending on site geometry, soil conditions, and feasibility. Descriptions of each optional solution are provided in the following subsections.

4.2.1 Cut Slope

Cut back the existing slope to a flatter, more stable slope, and then revegetate the surface. A slope stability analysis was performed to determine the angle of the slope which would result in a minimum acceptable factor of safety near cross section 1. Approximately 50 to 60 vertical feet of the existing upper slope in some areas are as steep as a 1H:1V. Based on the stability analysis, the upper slope would need to be cut back to a 2H:1V to meet the minimum Drained FOS of 1.5. Therefore, approximately 50 to 60 feet of land at the top of the slope would need to be cut back and would be essentially lost. A majority of property in the top of the slope along the river walk alignment is not owned by the City. Therefore, cutting the slope may only be a solution in areas owned by the City, such as Riverside Park, but in that case, the city would lose park space at the top of the slope. This option would be the least expensive solution, however it is not necessarily the most feasible solution.

4.2.2 Soil Nails

The second option is to install soil nails. Soil nailing is an earth retention technique which uses grouted tension-resisting steel elements (nails). Soil nails would be constructed in a grid pattern along the slope. Near-horizontal holes are drilled into the slope at a spacing determined by the specialty contractor. Tension-resisting steel bars are then inserted into the hole and grouted. Bearing plates are then fixed to the heads of the nails; a drainage system is installed on the face of the slope followed by an application of reinforced shotcrete facing. The shotcrete is sometimes covered with architectural precast panels.

Due to the steep slopes along the shoreline and limited working area near the toe of the slope, we anticipate the soil nails would be installed from a crane-suspended working platform on a barge. Soil nails may be installed directly beneath existing structures and utilities, however care should be exercised when installing soil nails in these locations.

The cost to install soil nails is roughly 50 to 60 dollars per square foot of slope reinforcement. This option is feasible, but the most expensive solution.

4.2.3 SRT System

The third option is to install SRTs. SRTs are a proprietary system of Geopier. The SRT system utilizes a plate pile to stabilize shallow slides or steep slopes by capturing downslope forces and providing resistance through shear and bending of the steel piles. The non-displacement steel plate pile elements are driven in a staggered array of uniformly spaced rows below the ground surface. The sections do not require post-tensioning. Erosion mats can be installed as required. The system is best suited for a slope inclination up to 45 degrees (1:1), slides up to 15 feet thick, and most soil types. The system is not suitable to stabilize deep-seated failures greater than 15 feet and cannot be installed into hard rock or soil with large boulders or other obstructions without pre-drilling or completing other site preparation.

Based on the preliminary slope stability analysis, the failure surface under drained conditions is anticipated to be within 15 feet deep. The cost to install SRTs is roughly 15 to 20 dollars per square foot of slope reinforcement. Therefore, we believe this would be the most feasible solution from a stability, constructability, and cost perspective.

Since this system is a proprietary system of Geopier, slope stabilization would likely be constructed under a design build agreement. The project structural engineer would size the system and determine spacing of SRTs. If this system is desired, AECOM can assist in preparing a performance specification for the subsurface treatment and also provide contact information to Geopier.

4.2.4 Living Wall

The fourth option is to install a living wall. Living walls are a green alternative to conventional slope retention and use vegetated, Mechanically Stabilized Earth (MSE) systems, which are gravity wall systems with variable face treatment. Living walls are built onsite, using a contiguous polypropylene sock extruded with a combination of compost, sand, soil, and even gravel to match the existing soil conditions. Each sock is then stacked against the slope and planted with a range of suitable plant materials. The system is reinforced with vegetation and Geotextile. Living walls can be built in a nearly vertical fashion - similar to a pre-cast, man-made material, because the majority of the slope stabilization occurs behind the face of the wall. Excavation will be required to install the living wall and a level base buried at least 70 percent of the wall height will be necessary. A temporary earth retention system may be necessary in order to stabilize the slope during construction.

As stated previously for option one, the living wall option may not be feasible for privately owned land, especially due to the location of structures. The slope will need to be cut back and temporary earth retention may be needed in order to install the system.

A very important concern for any MSE-type system (gravity structures in general) is the potential addition of significant load at the base of the bluff on potentially very soft organic silt or peat deposits, if those exist. This can create foundation instability, including bearing capacity failure and excessive settlement or lateral movement of such works, and downdrag on the pile-supported river walk structure. We recommend advance probing along the chosen line of these improvements to define the foundation condition prior to selecting a slope stabilization option.

4.3 Shoreline Protection Solutions

It is our understanding that the City is anticipating using a combination of shoreline protection along the river walk alignment based on existing conditions. Recommendations are provided in the following subsections for Rip Rap Revetment, Steel Sheet Pile, and Boardwalk Foundations. According to the FEMA Flood Insurance Rate Map, the 100-year flood plain elevation along this portion of the Manitowoc River is 585 feet. For the three different types of shoreline protection, it is recommended that the actual river walk structure be constructed at or above this elevation.

4.3.1 Rip Rap Revetment

In areas where riprap will be placed, the shoreline should be re-graded to a consistent slope prior to placing riprap stone. Based on our review of the site conditions, the existing shoreline slopes appear to be stable. However, the existing vegetation and root mass is likely assisting in the stabilization of these slopes. We recommend the slope stability analysis be updated for the proposed condition to evaluate the global stability of the shoreline once final slope grades have been determined. In any event, a designed bedding stone or Geotextile fabric filter should be placed between the existing or re-graded slope and the riprap stone. If dredging of the river is done along any of these areas, additional slope reinforcement may be required.

4.3.2 Steel Sheet Pile Wall

An existing steel sheet pile wall is present along a portion of the eastern shore of the Manitowoc River. It is our understanding that the City would like to reuse this wall if feasible. Further investigation should be performed to determine if the wall is structurally sound.

Whether the city installs new retaining wall structures or reuses the existing retaining wall, retaining wall structures should be designed to resist the lateral pressures associated with buildup of hydrostatic pressures with the backfill placed behind them, as well as any surcharge pressures from adjacent structural elements or vertical loads. The walls should be designed using an equivalent triangular stress distribution. The following table contains design parameters for each of the soil types encountered in the borings. The design low water elevation of the Manitowoc River at the site is 577.5 feet, below which buoyant unit weights should be used.

Soil Type	Effective Stress Analysis			Lateral Earth Pressures		
	Total Unit Weight, Y (pcf)	Friction Angle, φ (deg)	Cohesion , c (psf)	Active Ka	At Rest K0	Passive Kp
Topsoil – ML	110	28	0	0.36	0.53	2.77
Fill – CL	125	28	0	0.36	0.53	2.77
Fill – SP – Loose	115	28	0	0.36	0.53	2.77
Fill – ML – Loose	115	28	0	0.36	0.53	2.77
CL – Stiff	125	28	0	0.36	0.53	2.77
SP – Loose	115	28	0	0.36	0.53	2.77
SP – Medium Dense	120	28	0	0.36	0.53	2.77
SP – Dense	120	32	0	0.31	0.47	3.25
SM – Dense	120	30	0	0.33	0.50	3.00
SM – Very Dense	120	32	0	0.31	0.47	3.25
ML – Medium Dense	120	28	0	0.36	0.53	2.77

Soil Type	Effective Stress Analysis			Lateral Earth Pressures		
	Total Unit Weight, Y (pcf)	Friction Angle, φ (deg)	Cohesion , c (psf)	Active Ka	At Rest K0	Passive Kp
ML – Dense	120	30	0	0.33	0.50	3.00
ML – Very Dense	120	30	0	0.33	0.50	3.00
ML (hardpan) – Ex. Dense	125	34	0	0.28	0.44	3.53
SP-GP – Medium Dense	125	34	0	0.28	0.44	3.53
GP – Ex. Dense	125	34	0	0.28	0.44	3.53

Retaining wall structures may be constructed with structural backfill consisting of well-graded sand and gravel with less than 5% weight passing the No. 200 sieve. This fill should be placed in thin lifts, not to exceed 6 to 9 inches in loose thickness, depending on the size and type of compactor used. It is recommended that a light manually propelled compactor, weighing less than 500 pounds, be used within close proximity of the below-grade walls to minimize overstressing of the wall. Density testing should be performed to confirm that the material has achieved an adequate degree of compaction.

4.3.3 Boardwalk Foundation

Due to the existing site topography and site challenges, we anticipate the majority of the river walk could be constructed as a pile supported boardwalk. These piles should be sized to resist downdrag due to the very soft organic silts (where encountered), the anticipated compressive force and uplift force from ice loads as well as impact loadings from boats. It is recommended the piles be driven in pairs perpendicular to the flow of the river and cross braced to help resist the lateral forces of ice and boat loadings.

We recommend that heavy wall steel pipe piles be utilized for this project. The installation of the piles should be easily accomplished by vibratory and/or drop hammers to install the pipe piles to the hardpan. Some hard driving may occur in areas of gravel layers. It is anticipated that the maximum tolerable settlement of the piles is less than one inch.

4.4 Site Preparation for On-Grade Walkway Construction

Based on the existing conditions and site geometry, it is anticipated that a portion of the walkway could be constructed on-grade. It is our understanding the City will ultimately decide to use gravel, asphalt, or concrete surfacing for the on-grade walkway. Since the preliminary soil borings were performed at the top of the slope, it is recommended that additional soil testing be completed in areas of on-grade walkway to determine if fill materials, deleterious materials, or excessively soft or loose areas exist. Pavements placed directly upon soft or loose soils, or on significant thickness of new fill that re-engages the settlement-prone organic deposits, will likely demonstrate poor performance which may require continuous maintenance, thus reducing the life of the pavement. Following the site investigation, the recommendations provided in this report should be refined as necessary.

4.4.1 Gravel Walkway

In this part of the proposed walkway, we recommend that the existing soil be removed a minimum of 1 foot below the design walkway elevation. The exposed subgrade should be compacted to a minimum of 95% of the maximum dry unit weight from the Modified Proctor test (ASTM D1557). A 12 oz/sy non-woven Geotextile fabric should be placed on the exposed subgrade to provide a separation between the existing soils and gravel and to help prevent weeds from growing through the walkway.

4.4.2 Asphalt or Concrete Pavement Design

All pavements should be designed for the types and volumes of traffic, subgrade and drainage conditions that are anticipated. It is anticipated that the walkway will be lightly loaded with predominately pedestrian or bicycle traffic. We recommend that the base course aggregate conform to the 3/4-inch or 1-1/4-inch Dense Graded Base listed in Section 305 of the Wisconsin Department of Transportation (WisDOT) Standard Specifications or a similar approved material. The base course material should be compacted to a minimum of 95 percent of the Modified Proctor density (ASTM D-1557) and within -2 to +4 percent of the optimum moisture content. Graded, crushed concrete, reclaimed asphalt, or other reprocessed materials could also be utilized as base course aggregate provided the material meets the WisDOT requirements for structure backfill as outlined in the WisDOT Standard Specifications for Roadway Construction Section 210.

Prior to placement of fill, all subgrade soils should be visually observed by a representative of AECOM. Soft or loose areas should be undercut and replaced with compacted structural fill. Pavement subgrades should be positively drained. Drainage should be provided at any low areas and along the edges of pavements to prevent the accumulation of free water within the base course, which otherwise can result in subgrade softening and pavement deterioration under exposure and repeated traffic conditions. Good pavement base course and subgrade drainage will help minimize pavement deterioration and extend pavement life.

Pavement maintenance such as crack sealing and seal coating will also be required at the appropriate times, regardless of pavement thickness. At a minimum, the pavement should be monitored on an annual basis and cracks sealed to minimize water penetration into the base course.

Alternatively, the pavement could be designed as a permeable system using pervious concrete, porous asphalt, paving stones, etc. to allow storm water infiltration. Permeable pavement systems are generally considered a more environmentally conscious system as compared to traditional impervious pavement systems; however, considerations for runoff volumes, pollutant loads, accumulation of silt, weight and traffic loading should be addressed when selecting the most appropriate pavement system.

4.5 General Construction Considerations

4.5.1 Existing Utilities

Any existing utilities currently underneath or within the influence of the proposed foundations should be relocated outside the influence of the new foundations. If relocating the utilities is impractical or cost prohibitive, the new foundations should be situated below the utilities or the utility should be bridged by a grade beam.

4.5.2 Excavations

All excavations should comply with OSHA requirements. OSHA has instituted strict standards for temporary construction excavations. These standards are outlined in 29 CFR Part 1926 Subpart P. Excavations within unstable soil conditions or extending 5 feet or more in depth should be adequately sloped or braced according to these standards. The actual stable slope angle of excavation should be determined during construction and will depend upon the loading, soil, and groundwater conditions encountered. Excavation safety is the responsibility of the Contractor. Excavations performed adjacent to existing roadways or structural foundations should be performed with extreme caution to prevent undermining. Material stockpiles or heavy equipment should not be placed near the edge of the excavation slopes.

Excavations performed in the spring and early summer may encounter higher groundwater conditions than excavations performed during drier seasons. Surface water may also temporarily accumulate at some of these locations following periods of extended or heavy rain. Surface runoff from precipitation should be directed away from any excavations. Any water entering excavations should not be allowed to pond on subgrade soils as this may cause softening of the subgrade and a loss of strength.

4.5.3 Dewatering

Some seepage of trapped or perched water may be encountered during the excavations at this site. Depending on the base elevation of the excavation relative to the water level of the Manitowoc River, the amount of seepage would be expected to be minimal (for excavations above river level, we anticipate that the majority of this water can be removed by ditching to sumps and pumping from the excavation. Water should not be allowed to pond in excavated areas as this could cause softening and subsequent loss of strength. A working mat consisting of crushed stone or lean concrete may be necessary to stabilize the base of the deeper excavations where the cuts will extend to a depth near or slightly below the water level of the Manitowoc River. Any groundwater pumped from the site should comply with environmental local and state regulations.

Any subgrade soils which become soft and/or disturbed in areas of excavation should be carefully recompacted or removed prior to placement of concrete or fill material. Concrete and structural fill should not be placed in areas of ponded water or frozen soil.

4.5.4 Backfilling

All backfill should be compacted to a minimum of 95 percent of the maximum dry density determined from the Modified Proctor test (ASTM D1586). Moisture content during placement of the loose lift thickness should be controlled within three percent of

the optimum moisture content determined from the modified Proctor test. Fill should be placed in loose lifts not exceeding 9 inches.

The existing onsite inorganic soils may be reused for general grading assuming it is free of organic materials or other unsuitable materials. Excavated soft to medium clay or organic soils are not suitable for reuse on the site unless they are used in landscaping areas.

5 General Qualifications

This report has been prepared in general accordance with normally accepted geotechnical engineering practices to aid in the evaluation of this site and to assist our Client in the design of this project. We have prepared this report for the purpose intended by our Client, and reliance on its contents by anyone other than our Client is done at the sole risk of the user. No other warranty, either expressed or implied, is made. The scope is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects relevant to the geotechnical characteristics. In the event that any changes in the design or location of the facilities as outlined in this report are planned, we should be informed so that the changes can be reviewed and the conclusions of this report modified, as necessary, in writing by the geotechnical engineer. As a check, we recommend that we be authorized to review the project plans and specifications to confirm that the recommendations contained in this report have been interpreted in accordance with our intent. Without this review, we will not be responsible for the misinterpretation of our data, our analysis, and/or our recommendations, nor how these are incorporated into the final design.

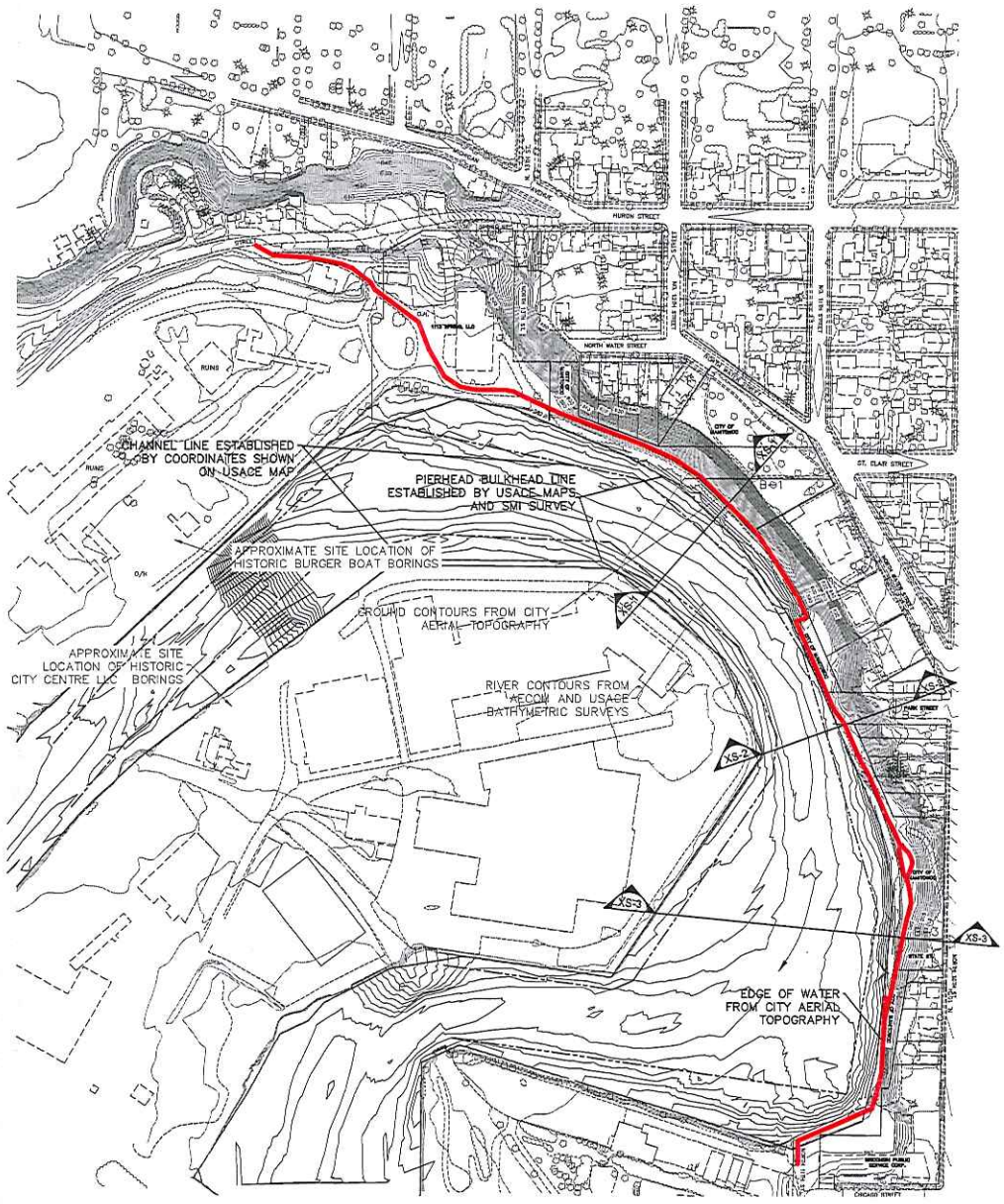
The analysis and recommendations submitted in this report are based on the data obtained from the soil borings performed at the locations indicated on the location diagram and from the information discussed in this report. This report does not reflect any variations which may occur between the borings. In the performance of subsurface explorations, specific information is obtained at specific locations at specific times. However, it is well-known that variations in soil and rock conditions exist on most sites between boring locations, and seasonal fluctuations in groundwater levels will likely occur. The nature and extent of variations may not become evident until the course of construction. If variations are observed, it will be necessary for a re-evaluation of the recommendations contained in this report after performing on-site observations during the construction period and noting the characteristics of the variations.

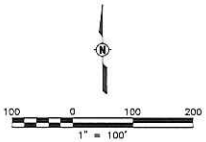
The Geotechnical Engineer of Record is the professional engineer who authored the geotechnical report. It is recommended that all construction operations dealing with earthwork and foundations be observed by the Geotechnical Engineer of Record or the geotechnical engineer's appointed representative to confirm that the design requirements are fulfilled in the actual construction. For some projects, this may be required by the governing building code.

The scope of services for this project does not include either specifically, or by implication, any environmental or biological (e.g., mold, fungi, bacteria, viruses, and the byproducts of such organisms) assessment of the site, or identification of or prevention of pollutants, hazardous materials, or conditions. Other studies beyond the scope of this project would be required to evaluate the potential of such contamination or pollution.

Appendix A.

Soil Boring Location Diagram





LEGEND

- RIGHT OF WAY
- CITY PROPERTY LINE
- RIVERLINE
- U.S. HARBOR CHANNEL LINE
- PIERHEAD BULKHEAD LINE
- 580 CONTOUR
- BUILDING
- ROAD/SIDEWALK
- BRUSH LINE
- TREE
- B-1 BORING LOCATION (APPROXIMATE)

AECOM

PROJECT

City of Manitowoc
River Walk

CLIENT

City of Manitowoc
900 Quay Street
Manitowoc, Wisconsin 54220

CONSULTANT

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REGISTRATION

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60317415

SHEET TITLE

SOIL BORING LOCATION DIAGRAM

SHEET NUMBER

1

Appendix B.

Geotechnical Soil Boring Logs

AECOM

CLIENT: City of Manitowoc

LOG OF BORING NUMBER: B-1

PROJECT NAME: Manitowoc Riverwalk

ARCHITECT-ENGINEER: AECOM

SITE LOCATION: Manitowoc, Wisconsin

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.³
					SURFACE ELEVATION Approx. 652.0	
	1	SS			Topsoil: Fine to medium sandy silt - little clay - trace fine gravel and roots - black - moist - medium dense (Topsoil-ML)	
		PA			1.5	
	2	SS			Fine to coarse sand - trace fine gravel and silt - brown - moist - loose (SP)	
		PA				
5.0	3	SS			5.5	
		PA			Silty clay - light brown - stiff (CL)	
	4	SS				
		PA			Brown silty fine sand seams	
	5	SS				
10.0		RB				
	6	SS				
		RB				
15.0						
	7	SS			16.0	
		PA			Fine sandy silt - light brown - moist - medium dense to dense (ML)	
		RB				
20.0						
	8	SS				
		RB				
25.0						
	9	SS				
		RB			28.0	
					Fine to coarse sand - trace silt - brown - wet - dense to medium dense (SP)	
30.0						
	10	SS				
		RB				
35.0						
	11	SS				
		RB			38.0	
					Fine sandy silt - light brown - moist - dense to very dense (ML)	
40.0						
	12	SS				
		RB				
45.0						
	13	SS				
		RB				
50.0						

. . . continued

* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

AECOM JOB NO. 60317415

SHEET NO. 1 OF 3

AECOM LOG 60317415.GPJ FS_DATATEMPLATE.GDT 8/27/14

AECOM

CLIENT: City of Manitowoc
LOG OF BORING NUMBER: B-1
PROJECT NAME: Manitowoc Riverwalk
ARCHITECT-ENGINEER: AECOM
SITE LOCATION: Manitowoc, Wisconsin

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² (1 2 3 4 5)
PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)
STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.³
				SURFACE ELEVATION Approx. 652.0 (Continued)	
	14	SS		Fine sandy silt - light brown - moist - dense to very dense (ML)	
		RB			
55.0	15	SS		Brown silty clay seams from 55.0 to 56.5 feet	
		RB			
60.0				60.0	
	16	SS		Fine sand - little silt - light brown - moist to saturated - very dense to dense (SM)	
		RB			
65.0	17	SS			
		RB			
70.0	18	SS			
		RB			
75.0				75.0	
	19	SS		Fine to coarse sand - trace silt - brown - wet - dense to very dense (SP)	
		RB			
80.0	20	SS			
		RB			
85.0				85.0	
	21	SS		86.2 Silt - little fine sand - gray - wet - dense (ML)	
	21A	SS		Sandy fine to coarse gravel - little silt - gray - wet - extremely dense (GP)	
		RB		Possible hard pan	
90.0	RUN #1	DB		Boulder from 87.5 to 88.6 feet	
		RB			
95.0	22	SS		95.0	
		RB		Fine to coarse sandy silt - little fine to coarse gravel and clay - gray - extremely dense (ML)	
				Hard pan	
100.0					

#1 56 55 54 48 36 51 40 50/0.2' 50/0.2' 50/0.1'

. . . continued

* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: In situ, the transition may be gradual.

AECOM JOB NO. 60317415 | SHEET NO. 2 OF 3

AECOM LOG 60317415.GPJ FS_DATATEMPLATE.GDT 8/27/14

AECOM	CLIENT: City of Manitowoc	LOG OF BORING NUMBER: B-1
	PROJECT NAME: Manitowoc Riverwalk	ARCHITECT-ENGINEER: AECOM

SITE LOCATION: Manitowoc, Wisconsin

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.³	UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² (1 2 3 4 5) / PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % (10 20 30 40 50) / STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)	
					SURFACE ELEVATION Approx. 652.0 (Continued)			
	23	SS			Fine to coarse sandy silt - little fine to coarse gravel and clay - gray - extremely dense (ML)			50/0.1'
		RB			Hard pan			
105.0	24	SS						50/0.3'
		RB						
110.0	25	SS			110.2			50/0.2'
					Boring advanced to 9.5 feet by hollow-stem auger Boring advanced from 9.5 to 88.0 feet and from 93.0 to 110.2 feet by rotary bit and fluid 8.5 feet of casing installed Boring advanced from 88.0 feet to 93.0 feet with diamond bit Standard Penetration Tests performed with automatic hammer Boring backfilled with bentonite grout		* Calibrated Penetrometer	

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING: 10	BORING STARTED: 4/15/14	AECOM OFFICE: Oshkosh, Wisconsin	
EASTING: 10	BORING COMPLETED: 4/16/14	ENTERED BY: CAH	SHEET NO.: 3 OF 3
WL: Drilling Mud BCR/Grout ACR	RIG/FOREMAN: D-50/SES/RT	APP'D BY: JMT	AECOM JOB NO.: 60317415

AECOM LOG 60317415.GPJ FS_DATATEMPLATE.GDT 8/27/14

AECOM

CLIENT: City of Manitowoc

LOG OF BORING NUMBER: B-2

PROJECT NAME: Manitowoc Riverwalk

ARCHITECT-ENGINEER: AECOM

SITE LOCATION: Manitowoc, Wisconsin

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE / RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}	UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5) / PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % (10 20 30 40 50) / STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)
				SURFACE ELEVATION Approx. 637.0		
	1	SS		Fill: Silty clay - little fine to coarse gravel - trace fine to coarse sand and roots - black (Fill-CL)		5
		PA		2.0		
	2	SS		Fine sand - trace silt - light brown - moist - medium dense (SP)		13
		PA				
5.0	3	SS				16
		PA		6.0		
	4	SS		Fine sandy silt - light brown - moist - medium dense to dense (ML)		27
		PA				
	5	SS				33
10.0		RB		10.0		
	6	SS		Silt - trace fine sand and clay - brown - very dense (ML)		66
		RB				
15.0				15.0		
	7	SS		Fine sandy silt - light brown - moist - very dense (ML)		74
		RB				
20.0						
	8	SS				52
		RB				
25.0				25.0		
	9	SS		Fine sand - little silt - light brown - moist to saturated at 56.0 feet - medium dense to dense (SM)		44
		RB				
30.0						
	10	SS				28
		RB				
35.0						
	11	SS				30
		RB				
40.0						
	12	SS				44
		RB				
45.0						
	13	SS				41
		RB				
50.0						

. . . continued

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

AECOM JOB NO. 60317415

SHEET NO. 1 OF 2

AECOM LOG 60317415.GPJ FS_DATATEMPLATE.GDT 8/27/14

AECOM

CLIENT: City of Manitowoc

LOG OF BORING NUMBER: B-2

PROJECT NAME: Manitowoc Riverwalk

ARCHITECT-ENGINEER: AECOM

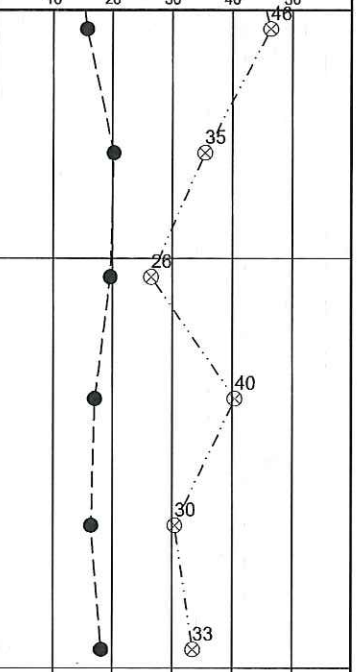
SITE LOCATION: Manitowoc, Wisconsin

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
					SURFACE ELEVATION Approx. 637.0 (Continued)	
	14	SS			Fine sand - little silt - light brown - moist to saturated at 56.0 feet - medium dense to dense (SM)	
		RB				
55.0						
	15	SS				
		RB				
60.0					60.0	
	16	SS			Fine to coarse sand - trace fine to coarse gravel and silt - gray - saturated - medium dense to dense (SP)	
		RB				
65.0						
	17	SS				
		RB				
70.0						
	18	SS				
		RB				
75.0						
76.5	19	SS			76.5	
					End of Boring Boring advanced to 9.5 feet by hollow-stem auger Boring advanced from 9.5 to 76.5 feet by rotary bit and fluid 8.5 feet of casing installed Standard Penetration Tests performed with automatic hammer Boring backfilled with bentonite grout	



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING 20	BORING STARTED 4/16/14	AECOM OFFICE Oshkosh, Wisconsin	
EASTING 20	BORING COMPLETED 4/17/14	ENTERED BY CAH	SHEET NO. 2 OF 2
WL 56.0 ft. WS/Drilling Mud BCR/Grout ACR	RIG/FOREMAN D-50/SES/RT	APP'D BY JMT	AECOM JOB NO. 60317415

AECOM LOG 60317415.GPJ FS_DATATEMPLATE.GDT 8/27/14

AECOM

CLIENT: City of Manitowoc

LOG OF BORING NUMBER: B-3

PROJECT NAME: Manitowoc Riverwalk

ARCHITECT-ENGINEER: AECOM

SITE LOCATION: Manitowoc, Wisconsin

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
					SURFACE ELEVATION Approx. 612.0	
	1	SS			Topsoil: Sandy silt - little clay - trace fine to medium gravel and roots - black - moist - loose (Topsoil-ML)	
		PA			1.5	
	2	SS			Fill: Medium to coarse sand - little fine to coarse gravel - trace silt - brown - moist - loose (Fill-SP)	
5.0		PA				
	3	SS			5.5	
		PA			Fill: Sandy silt - little medium to coarse gravel and clay - dark brown - moist - loose (Fill-ML)	
	4	SS			8.0	
		PA			Fill: Fine to medium sandy silt - little clay - dark brown - moist - very loose (Fill-ML)	
	5	SS			10.0	
10.0		RB			Medium to coarse gravel and medium to coarse sand - trace to little silt - gray - saturated - medium dense to extremely dense (SP-GP)	
	6	SS				
		RB				
15.0	7	SS				
		RB				
20.0	8	SS				
		RB				
25.0	9	SS				
		RB				
30.0	10	SS				
		RB				
35.0	11	SS				
		RB				
40.0	12	SS				
		RB				
45.0	13	SS				
		RB				
50.0					. . . continued	

STANDARD PENETRATION BLOWS/(FT): 6, 5, 4, 4, 3, 13, 24, 50, 36, 18, 40, 41, 90/0.8'

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

AECOM JOB NO. 60317415

SHEET NO. 1 OF 2

AECOM LOG 60317415.GPJ FS_DATATEMPLATE.GDT 8/27/14

AECOM	CLIENT: City of Manitowoc	LOG OF BORING NUMBER: B-3
	PROJECT NAME: Manitowoc Riverwalk	ARCHITECT-ENGINEER: AECOM

SITE LOCATION: Manitowoc, Wisconsin

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² (1, 2, 3, 4, 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10, 20, 30, 40, 50)

STANDARD PENETRATION BLOWS/(FT) (10, 20, 30, 40, 50)

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.³	STANDARD PENETRATION BLOWS/(FT)
					SURFACE ELEVATION Approx. 612.0 (Continued)		
	14	SS			Medium to coarse gravel and medium to coarse sand - trace to little silt - gray - saturated - medium dense to extremely dense (SP-GP)		90
		RB					
55.0	15	SS					50/0.2'
		RB					
60.0	16	SS					68
		RB					
65.0	17	SS					32
		RB					
70.0	18	SS					59
		RB					
75.0	19	SS			75.5		64/0.5'
					End of Boring Boring advanced to 8.0 feet by hollow-stem auger Boring advanced from 8.0 to 75.5 feet by rotary bit and fluid 8.5 feet of casing installed Standard Penetration Tests performed with automatic hammer Boring backfilled with bentonite chips and bentonite sand slurry		

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING: 30	BORING STARTED: 4/17/14	AECOM OFFICE: Oshkosh, Wisconsin	
EASTING: 30	BORING COMPLETED: 4/21/14	ENTERED BY: CAH	SHEET NO.: 2 OF 2
WL: 26.0 ft. BCR/30.2 ft. ACR	RIG/FOREMAN: D-50/SES/RT	APP'D BY: JMT	AECOM JOB NO.: 60317415

AECOM LOG 60317415.GPJ FS_DATATEMPLATE.GDT 8/27/14

AECOM

CLIENT: City Centre, LLC

LOG OF BORING NUMBER: 1

PROJECT NAME: Dockwall Replacement

ARCHITECT-ENGINEER: AECOM

SITE LOCATION: 500 16th Street, Manitowoc, Wisconsin

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/FT. (10 20 30 40 50)

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	DRY UNIT WT. LBS./FT.^{3}	STANDARD PENETRATION BLOWS/FT.
						SURFACE ELEVATION 585.0 (IGLD)		
		1	SS			Fill - Gray sand and gravel (GP) - very dense		43
			PA					
		2	SS					36
			PA			4.0		
5.0		3	SS			Fill - Dark brown silty sand (SM) - with trace of gravel and clay - moist - medium dense		13
			PA			6.0		
		4	SS			Brown silty fine sand (SM) - wet - medium dense		14
			PA			8.0		
		5	SS			Dark gray clayey sand (SC) - with trace of wood fragments - wet		4
10.0			PA					
		6	SS					4
			RB			14.0		
15.0						Black peat (Pt) - wet - very soft		
		7	SS					2
			RB			19.0		
20.0						Dark gray organic silt (OL) - wet - very soft		WT. OF HAMMER
		8	SS					
			RB					
25.0								WT. OF HAMMER
		9	SS					
			RB					
30.0								1
		10	SS					
			RB			34.0		
35.0						Gray fine to coarse sand and fine gravel (SP) - wet - medium dense		10
		11	SS					
						37.5		
			RB			Brown silty clay (CL) - with trace of sand - moist - stiff to very stiff		
40.0								9
		12	SS					
			RB					
45.0								*
		13	ST					
			RB					
50.0								

. . . continued

* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

STS JOB NO. 60160995

SHEET NO. 1 OF 2

BORING_LOG_2 60160995-LIS.GPJ STS.GDT 10/1/10

AECOM

CLIENT: City Centre, LLC

LOG OF BORING NUMBER: 1

PROJECT NAME: Dockwall Replacement

ARCHITECT-ENGINEER: AECOM

SITE LOCATION: 500 16th Street, Manitowoc, Wisconsin

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	DRY UNIT WT. LBS./FT.³	UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² (1 2 3 4 5) / PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % (10 20 30 40 50) / STANDARD PENETRATION BLOWS/FT. (10 20 30 40 50)
					SURFACE ELEVATION 585.0 (IGLD) (Continued)		
	14	ST			Brown silty clay (CL) - with trace of sand - moist - stiff to very stiff		* *
		RB					
55.0							
	15	ST					*
		RB					
60.0							
	16	ST					*
		RB					
65.0							
	17	ST					
					68.0		
		RB			Gray clayey silt (ML) - with a little to some sand and fine gravel - moist - medium dense to very dense - Hard pan		
70.0							
	18	SS					⊗ 43
		RB					
75.0	19	SS					⊗ 66
					75.0		
					End of Boring Boring terminated on apparent bedrock or boulder. Boring advanced to 10.0 feet with solid-stem auger Boring advanced from 10.0 to 75.0 feet with roller bit and drilling mud HW casing driven to 8.0 feet Boring backfilled with 3/8" chipped bentonite		* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WL 7 ft. WS	BORING STARTED 8/9/10	AECOM OFFICE Green Bay, WI	
WL	BORING COMPLETED 8/9/10	ENTERED BY CAH	SHEET NO. 2 OF 2
WL	RIG/FOREMAN Mobile B-61/RT	APP'D BY JJB	AECOM JOB NO. 60160995

BORING_LOG_2 60160995-LJS.GPJ STS.GDT 10/1/10

AECOM

CLIENT: City Centre, LLC

LOG OF BORING NUMBER: 2

PROJECT NAME: Dockwall Replacement

ARCHITECT-ENGINEER: AECOM

SITE LOCATION: 500 16th Street, Manitowoc, Wisconsin

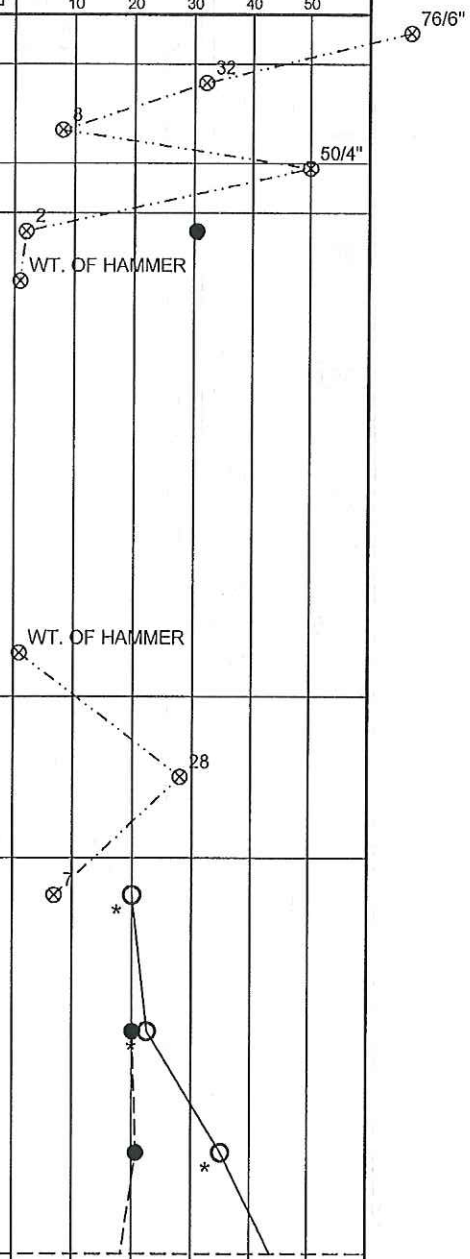
SURFACE ELEVATION 583.7 (IGLP)

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² (1 2 3 4 5)

PLASTIC LIMIT % | WATER CONTENT % | LIQUID LIMIT %

STANDARD PENETRATION BLOWS/FT. (10 20 30 40 50)

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	DRY UNIT WT. LBS./FT.³
	1	SS			Fill - Gray sand and gravel (GP) - very dense	
		PA			2.0	
	2	SS			Fill - Black silty sand and gravel (SM) - moist - medium dense	
5.0	3	SS				
		PA			6.0	
	4	SS			Fill - Wood fragments with steel	
		PA			8.0	
	5	SS			Gray organic silt (OL) - wet - very soft to stiff	
10.0		PA				
	6	SS				
		RB				
15.0						
	7	OST				
		RB				
	8	OST				
20.0		RB				
	9	OST				
		RB				
	10	OST				
25.0		RB				
	11	SS			27.5	
		RB			Gray silty sand and gravel (GM) - wet - medium dense	
30.0	12	SS				
		HW			34.0	
35.0	13	SS			Brown silty clay (CL) - with trace of sand and gravel - moist - very stiff to hard	
		RB				
40.0	14	ST				
		RB				
45.0	14A	ST				
		RB				
50.0					. . . continued	



*Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

STS JOB NO. 60160995

SHEET NO. 1 OF 2

BORING_LOG_2 60160995-LJS.GPJ STS.GDT 10/1/10

AECOM

CLIENT: City Centre, LLC

LOG OF BORING NUMBER: 2

PROJECT NAME: Dockwall Replacement

ARCHITECT-ENGINEER: AECOM

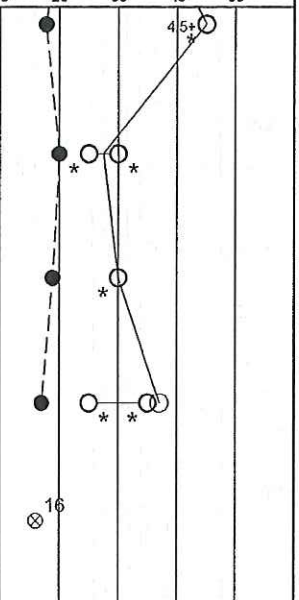
SITE LOCATION: 500 16th Street, Manitowoc, Wisconsin

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	DRY UNIT WT. LBS./FT.^{3}
					SURFACE ELEVATION 583.7 (IGLP) (Continued)	
	15	ST			Brown silty clay (CL) - with trace of sand and gravel - moist - very stiff to hard	
		RB				
55.0						
	16	ST				
		RB				
60.0						
	17	ST				
		RB				
65.0						
	18	ST				
		RB				
70.0						
	19	SS				
		RB				
					74.0	
75.0					Gray limestone - hard - non-weathered - open clean fractures	
		DB			Recovery = 86.0%	
77.7					77.7 RQD = 32%	
					Fracture Frequency = 3.8/ft.	
					End of Boring	
					Boring advanced to 10.0 feet with solid-stem auger	
					Boring advanced from 5.0 to 74.5 feet with roller bit and rilling mud	
					Boring advanced from 74.5 to 77.7 feet with NX core barrel HW casing driven to 10.0 feet	
					Boring backfilled with 3/8" chipped bentonite	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2}: 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT %: 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT.: 10 20 30 40 50



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WL 5.4 ft. WS	BORING STARTED 8/10/10	AECOM OFFICE Green Bay, WI	
WL	BORING COMPLETED 8/11/10	ENTERED BY CAH	SHEET NO. 2 OF 2
WL	RIG/FOREMAN Mobile B-61/RT	APP'D BY JJB	AECOM JOB NO. 60160995

BORING_LOG_2 60160995-LJS.GPJ STS.GDT 10/1/10

AECOM

CLIENT: City Centre, LLC

LOG OF BORING NUMBER: 3

PROJECT NAME: Dockwall Replacement

ARCHITECT-ENGINEER: AECOM

SITE LOCATION: 500 16th Street, Manitowoc, Wisconsin

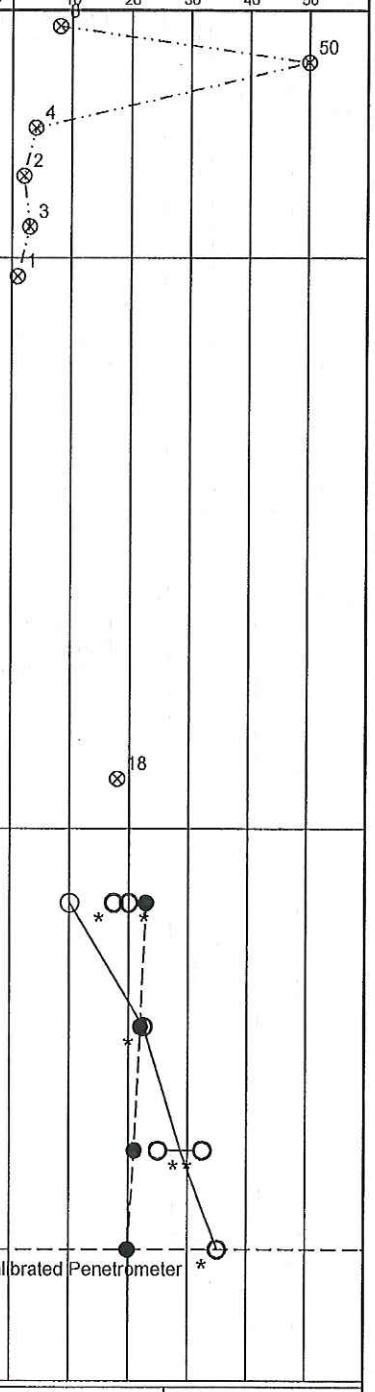
SURFACE ELEVATION 582.3 (IGLD)

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	DRY UNIT WT. LBS./FT.³
	1	SS			Fill - Brown silty sand and gravel (SM) - with trace of organics and wood below 6.0 ft. - moist to wet at 6.0 ft.	
	2	SS				
		PA				
5.0	3	SS				
		PA				
	4	SS				
		PA				
	5	SS				
10.0		RB			10.0	
	6	SS			Gray organic silt (OL) - with trace of shells - very moist - medium dense to very stiff	
		RB				
15.0						
		RB			VS1 = 1065 psf	
					VS2 = 745 psf	
20.0					VS3 = 2140 psf	
	7	SS				
		RB			VS4 = 1330 psf	
25.0					VS5 = 2025 psf	
	8	SS			VS6 = 1760 psf	
		RB				
30.0						
	9	SS				
					33.0	
		RB			Brown silty clay (CL) - with trace of sand and fine gravel - moist - stiff to very stiff	
35.0						
	10	ST				106
		RB				
40.0						
	11	ST				
		RB				
45.0						
	12	ST				
		RB				
50.0						
					. . . continued	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/FT. (10 20 30 40 50)



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

STS JOB NO. 60160995

SHEET NO. 1 OF 2

BORING_LOG_2 60160995-LJS.GPJ STS.GDT 10/1/10

AECOM

CLIENT: City Centre, LLC

LOG OF BORING NUMBER: 3

PROJECT NAME: Dockwall Replacement

ARCHITECT-ENGINEER: AECOM

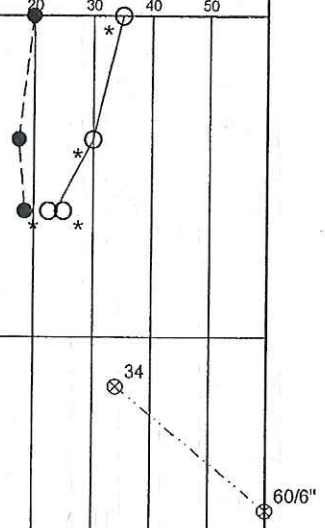
SITE LOCATION: 500 16th Street, Manitowoc, Wisconsin

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	DRY UNIT WT. LBS./FT.³
					SURFACE ELEVATION 582.3 (IGLD) (Continued)	
	13	ST			Brown silty clay (CL) - with trace of sand and fine gravel - moist - stiff to very stiff	112
		RB				
55.0						
	14	ST				
		RB				
60.0						
	15	ST				
					63.0	
		RB			Gray sandy silt (ML) - with a little gravel - wet - dense to extremely dense - hard pan	
65.0						
	16	SS				
		RB				
70.0	17	SS				
		RB				
74.5					74.5	
					End of Boring Boring terminated on apparent bedrock or boulder Boring advanced to 10.0 feet with solid-stem auger HW casing driven to 13.0 feet	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/FT. (10 20 30 40 50)



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WL 4.4 ft. WD	BORING STARTED 8/12/10	AECOM OFFICE Green Bay, WI	
WL	BORING COMPLETED 8/12/10	ENTERED BY CAH	SHEET NO. 2 OF 2
WL	RIG/FOREMAN D-120/RT	APP'D BY JJB	AECOM JOB NO. 60160995

BORING_LOG_2 60160995-LJS.GPJ STS.GDT 10/5/10

AECOM

CLIENT: City Centre, LLC

LOG OF BORING NUMBER: 4

PROJECT NAME: Dockwall Replacement

ARCHITECT-ENGINEER: AECOM

SITE LOCATION: 500 16th Street, Manitowoc, Wisconsin

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	DRY UNIT WT. LBS./FT.^{3}
						SURFACE ELEVATION 583.2 (IGLD)	
		1	SS			Fill - Dark brown silty sand and gravel (SM) - with trace of wood	
			PA				
		2	SS				
			PA			4.0	
5.0		3	SS			4.5 Black peat (Pt)	
		3A	SS			Gray to black organic clayey silt (OL - with trace of shells - wet - soft	
			PA				
		4	SS				
			PA				
		5	SS				
10.0			PA				
		6	SS				
			RB				
15.0		7	SS				
			RB				
20.0		8	SS				
			RB				
25.0		9	SS				
		9A	SS				
			RB				
						29.0	
30.0		10	SS			Brown silty sand and gravel (GM) - wet - medium dense	
			RB				
						33.0	
35.0		11	SS			Reddish brown silty clay (CL) - with trace of sand and fine gravel - moist - stiff to very stiff	
			RB				
40.0		12	ST				
			RB				
45.0		13	ST				
			RB				
50.0						. . . continued	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/FT. (10 20 30 40 50)

WT. OF HAMMER

WT. OF HAMMER

* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

STS JOB NO. 60160995

SHEET NO. 1 OF 2

BORING_LOG_2 60160995-LJS.GPJ STS.GDT 10/1/10

AECOM

CLIENT: City Centre, LLC

LOG OF BORING NUMBER: 4

PROJECT NAME: Dockwall Replacement

ARCHITECT-ENGINEER: AECOM

SITE LOCATION: 500 16th Street, Manitowoc, Wisconsin

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/FT. (10 20 30 40 50)

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	DRY UNIT WT. LBS./FT.³
					SURFACE ELEVATION 583.2 (IGLD) (Continued)	
	14	ST			Reddish brown silty clay (CL) - with trace of sand and fine gravel - moist - stiff to very stiff	
		RB				
55.0	15	ST				
		RB			58.0	
					Gray sandy silt (ML) - with trace to little gravel - moist -medium dense to extremely dense - hard pan	
60.0	16	SS				
		RB				
65.0	17	SS				
		RB				
70.0	18	SS				
		RB				
75.0	19	SS				
		RB			75.0	
	R#1	DB			Gray limestone - non weathered - hard - open fractures	
77.5					77.5	

Recovery = 93%
RQD = 60%
Fracture Frequency = 2.1/ft.

End of Boring
Boring advanced to 8.0 feet with solid-stem auger
Boring advanced from 8.0 to 74.5 feet with roller bill and drilling mud
Boring advanced from 74.5 to 77.5 feet with NX diamond core barrel
HW casing driven to 13.0 feet
Boring backfilled with 3/8" chipped bentonite

* Calibrated Penetrometer

22 — 50/.3 — 70 — 50/.1

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WL 4.4 ft. WD	BORING STARTED 8/12/10	AECOM OFFICE Green Bay, WI	
WL	BORING COMPLETED 8/12/10	ENTERED BY CAH	SHEET NO. 2 OF 2
WL	RIG/FOREMAN Mobile B-61/RT	APP'D BY JJB	AECOM JOB NO. 60160995

BORING_LOG_2 60160995-LJS.GPJ STS.GDT 10/1/10

AECOM

CLIENT: City Centre, LLC

LOG OF BORING NUMBER: 5

PROJECT NAME: Dockwall Replacement

ARCHITECT-ENGINEER: AECOM

SITE LOCATION: 500 16th Street, Manitowoc, Wisconsin

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² (1 2 3 4 5)

PLASTIC LIMIT % | WATER CONTENT % | LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/FT. (10 20 30 40 50)

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	DRY UNIT WT. LBS./FT.³	STANDARD PENETRATION BLOWS/FT.
		PA			SURFACE ELEVATION 582.9 (IGLD)		
		PA			0.2 Asphalt - 2"		
	1	SS			Fill - Brown fine sand (SP) - with trace of brick fragments to 4.0 feet - moist to wet at 4.0 ft. - medium dense to very loose		16
	2	SS					16
		PA					
5.0	3	SS					5
		PA					
	4	SS					2
		HW			8.0		
	5	SS			Gray organic silt (OL) - very moist - very loose		1
10.0		RB					
	6	SS					1
		RB					
15.0							
	7	SS					1
		RB					
20.0	8	SS			20.0		1
					End of Boring. Boring advanced from 0.0 feet to 7.5 feet with solid-stem auger. Boring advanced from 7.5 feet to 20.0 feet with roller bit and drilling mud. HW casing driven to 8.0 feet.		

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WL 3.9 ft. WD	BORING STARTED 8/13/10	AECOM OFFICE Green Bay, WI	
WL	BORING COMPLETED 8/13/10	ENTERED BY CAH	SHEET NO. 1 OF 1
WL	RIG/FOREMAN Mobile B-61/RT	APP'D BY JJB	AECOM JOB NO. 60160995

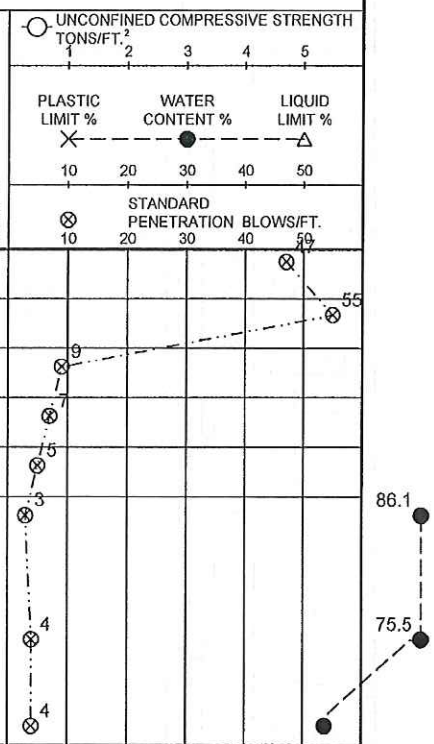
BORING_LOG_2 60160995-LJS.GPJ STS.GDT 10/1/10

AECOM

CLIENT	LOG OF BORING NUMBER
City Centre, LLC	6
PROJECT NAME	**ARCHITECT-ENGINEER**
Dockwall Replacement	AECOM

SITE LOCATION
500 16th Street, Manitowoc, Wisconsin

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	DRY UNIT WT. LBS./FT.^{3}
					SURFACE ELEVATION 583.2 (IGLD)	
	1	SS			Fill - Gray sand and gravel - extremely dense	
		PA			2.0	
	2	SS			Fill - Black silty sand and fine gravel - very dense	
		PA			4.0	
5.0	3	SS			Fill - Brown silty fine sand (SM) - wet - loose	
		PA			6.0	
	4	SS			Fill - Brown silty clay (CL) - moist - stiff	
		PA			8.0	
	5	SS			Black peat (PT) - wet - soft	
10.0		PA			10.0	
	6	SS			Dark brown organic silt (OL) - moist - medium to soft	
		RB				
15.0						
	7	SS				
		RB				
20.0	8	SS			20.0	
					End of Boring Boring advanced to 10 feet with solid-stem auger Boring advanced from 10 to 20 feet with roller bit and drilling mud HW casing driven to 8 feet Boring backfilled with 3/8" chipped bentonite	



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WL 11 ft. WD	BORING STARTED 8/10/10	AECOM OFFICE Green Bay, WI	
WL	BORING COMPLETED 8/10/10	ENTERED BY CAH	SHEET NO. 1 OF 1
WL	RIG/FOREMAN Mobile B-61/RT	APP'D BY JJB	AECOM JOB NO. 60160995

BORING_LOG_2 60160995-LJS.GPJ STS.GDT 10/1/10

AECOM

CLIENT: City Centre, LLC

LOG OF BORING NUMBER: 7

PROJECT NAME: Dockwall Replacement

ARCHITECT-ENGINEER: AECOM

SITE LOCATION: 500 16th Street, Manitowoc, Wisconsin

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/FT. (10 20 30 40 50)

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	DRY UNIT WT. LBS./FT.^{3}	STANDARD PENETRATION BLOWS/FT.
						SURFACE ELEVATION 584.7 (IGLD)		
		1	SS			0.2 Asphalt - 3 inches		
		2	SS			2.0 Fill - Brown sand and gravel (GP) - medium dense		11 19
		3	SS			Fill - gray silty sand and fine gravel (SM) - moist - medium dense		WT. OF HAMMER
5.0		4	SS			6.0		
		5	SS			Gray to black organic silt (OL) - very moist - medium		1 WT. OF HAMMER
10.0		6	SS					
			RB					
15.0		7	SS					WT. OF HAMMER
			RB					
20.0		8	SS			20.0		WT. OF HAMMER

End of Boring
Boring advanced to 10 feet with solid-stem auger
Boring advanced from 10 to 20 feet with roller bit and drilling mud
Boring backfilled with 3/8" chipped bentonite

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WL 3.5 ft. WS	BORING STARTED 8/11/10	AECOM OFFICE Green Bay, WI	
WL	BORING COMPLETED 8/11/10	ENTERED BY CAH	SHEET NO. 1 OF 1
WL	RIG/FOREMAN Mobile B-61/RT	APP'D BY JJB	AECOM JOB NO. 60160995

BORING_LOG_2 60160995-LJS.GPJ STS.GDT 10/1/10

AECOM

CLIENT	LOG OF BORING NUMBER
City Centre, LLC	8
PROJECT NAME	ARCHITECT-ENGINEER
Dockwall Replacement	AECOM

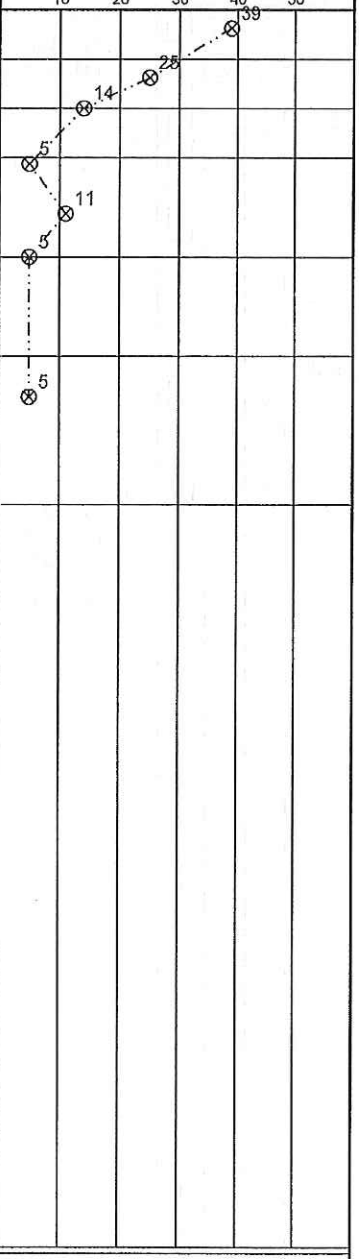
SITE LOCATION
500 16th Street, Manitowoc, Wisconsin

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/FT. (10 20 30 40 50)

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	DRY UNIT WT. LBS./FT.^{3}
					SURFACE ELEVATION 584.6 (IGLD)	
	1	SS			Fill - Gray sand and gravel - dry - extremely dense	
					2.0	
	2	SS			Fill - Dark brown silty sand (SM) - with a little fine gravel - moist - dense	
					4.0	
5.0	3	SS			Fill - Brown silty fine sand (SM) - moist - medium dense	
					6.0	
	4	SS			Brown sandy clay (CL) - moist - very stiff to stiff	
	5	SS				
10.0					10.0	
	6	SS			Brown clayey silt (ML-CL) - wet - stiff	
		RB			14.0	
15.0					Black peat (PT) - with a little wood - wet - loose	
	7	SS				
		RB				
20.0	8	SS			20.0	
					End of Boring Boring advanced to 10 feet with solid-stem auger Boring advanced from 10 to 20 feet with roller bit and drilling mud HW casing driven to 8 feet Boring backfilled with 3/8" chipped bentonite	



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WL 6.9 ft. WD	BORING STARTED 8/10/10	AECOM OFFICE Green Bay, WI	
WL	BORING COMPLETED 8/10/10	ENTERED BY CAH	SHEET NO. 1 OF 1
WL	RIG/FOREMAN Mobile B-61/RT	APP'D BY JJB	AECOM JOB NO. 60160995

BORING_LOG_2 60160995.GPJ STS.GDT 9/30/10

STS Consultants Ltd.

OWNER: **Burger Boat**

LOG OF BORING NUMBER: **4**

PROJECT NAME: **Dockwall Construction**

ARCHITECT-ENGINEER: **ARCHITECT/ENGINEER**

SITE LOCATION: **1811 Spring Street, Manitowoc, Wisconsin**

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
						SURFACE ELEVATION +583.0	
		1	SS			Fill: Gravel base course - moist - very dense	
		1A	SS				
						1.5	
		2	SS			Fill: Brown and black silty fine sand (SM) - moist - medium dense	
5.0						5.0	
		3	SS			Gray organic silt (OL) - very moist - very soft	
10.0							
		4	SS				
15.0							
		5	SS				
20.0							
		6	SS				
						24.0	
25.0						Gray fine to coarse sand (SP) - wet - loose	
		7	SS				
30.0							
		8	SS				
						34.0	
						. . . continued	

N-values: 10/6" (1A), 26/8" (1), 2 (2), WT. OF HAMMER (3), WT. OF HAMMER (4), 2 (5), 4 (6), 9 (7), 11 (8), *

* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

STS JOB NO. 200801699

SHEET NO. 1 OF 2

BORING_LOG 200801699.GPJ FS_DATATEMPLATE.GDT 5/2/14

STS Consultants Ltd.

OWNER: **Burger Boat**

LOG OF BORING NUMBER: **4**

PROJECT NAME: **Dockwall Construction**

ARCHITECT-ENGINEER: **ARCHITECT/ENGINEER**

SITE LOCATION: **1811 Spring Street, Manitowoc, Wisconsin**

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE / RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}	UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5) / PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % (10 20 30 40 50) / STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)
				SURFACE ELEVATION +583.0 (Continued)		
35.0	9	ST		Brown silty clay (CL) - moist - stiff	107	*
40.0	10	SS		43.0		46
45.0	11	SS		Gray sandy silt (ML) - with trace of gravel - moist - very dense to extremely dense (hardpan)		56/6"
50.0	12	SS				58/6"
55.0	13	SS				58/6"
60.0						
62.5				62.5		

End of Boring
Boring advanced to 5.0 feet with solid-stem auger
Boring advanced from 5.0 to 62.5 feet with roller bit and drilling fluid
HW casing driven to 10.0 feet
Boring backfilled with 3/8" chipped bentonite
Boring terminated on apparent bedrock or boulder

* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WL 7.5 ft. WS	BORING STARTED 5/21/08	STS OFFICE	
WL	BORING COMPLETED 5/21/08	ENTERED BY BJV	SHEET NO. 2 OF 2
WL	RIG/FOREMAN Mobile B-61/JC	APP'D BY JJB	STS JOB NO. 200801699

BORING_LOG 200801699.GPJ FS_DATATEMPLATE.GDT 5/2/14

Appendix C.

Slope Stability Outputs

PROJECT: Manitowoc Riverwalk
PROJECT NO.: 60317415
SUBJECT: Cross Section 1

SOIL BORING: B-1

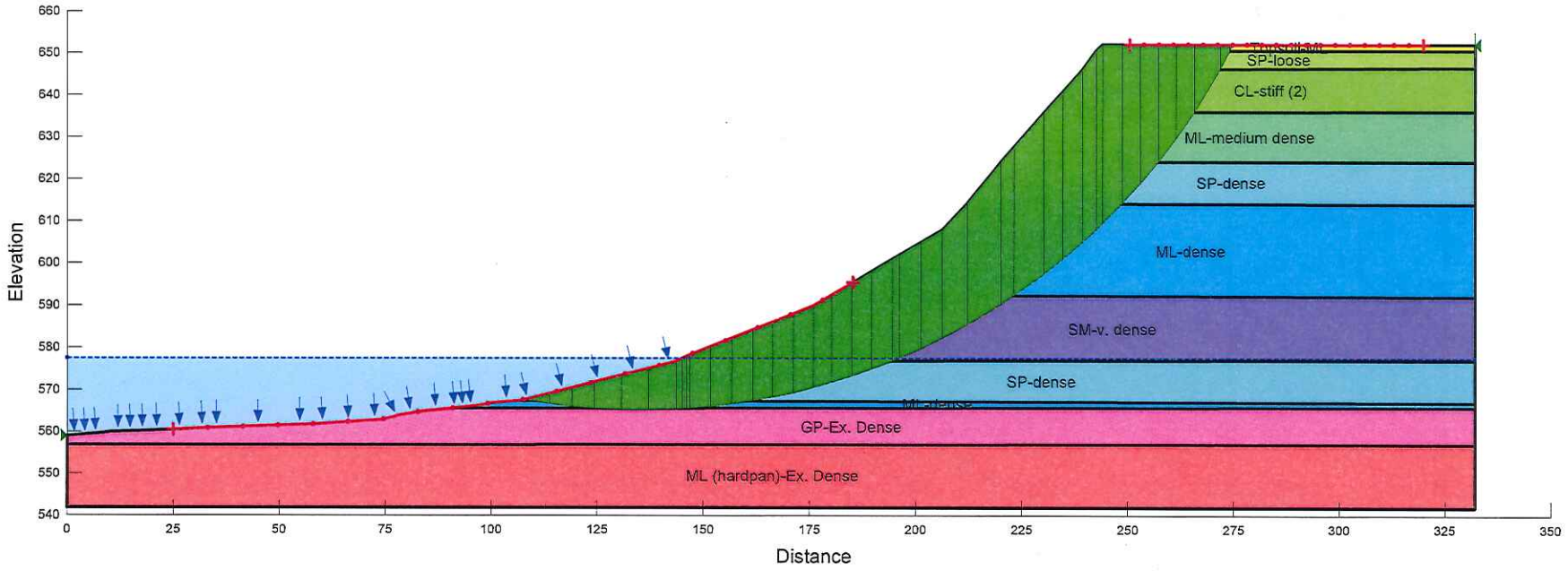
ANALYSIS TYPE: Morgenstern-Price
ANALYSIS CONDITION: Existing Conditions-Undrained

ORIGINATED BY: Allen, Shannon
DATE: 5/28/2014
CHECKED BY: Thomas, Jeremy
DATE: 5/28/2014
APPROVED BY: Thomas, Jeremy
DATE: 5/28/2014

Name: Topsoil-ML Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion': 0 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: SP-loose Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: ML-medium dense Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: SP-dense Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1
Name: ML-dense Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: SM-v. dense Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1
Name: GP-Ex. Dense Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 34 ° Phi-B: 0 ° Piezometric Line: 1
Name: ML (hardpan)-Ex. Dense Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 34 ° Phi-B: 0 ° Piezometric Line: 1
Name: CL-stiff (2) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 3,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1

NOTES:
1) Factor of Safety: 1.3
2) Failure Surface Type: Entry and Exit
3) Direction of Movement: Right to Left

1.3



PROJECT: Manitowoc Riverwalk
PROJECT NO.: 60317415
SUBJECT: Cross Section 1

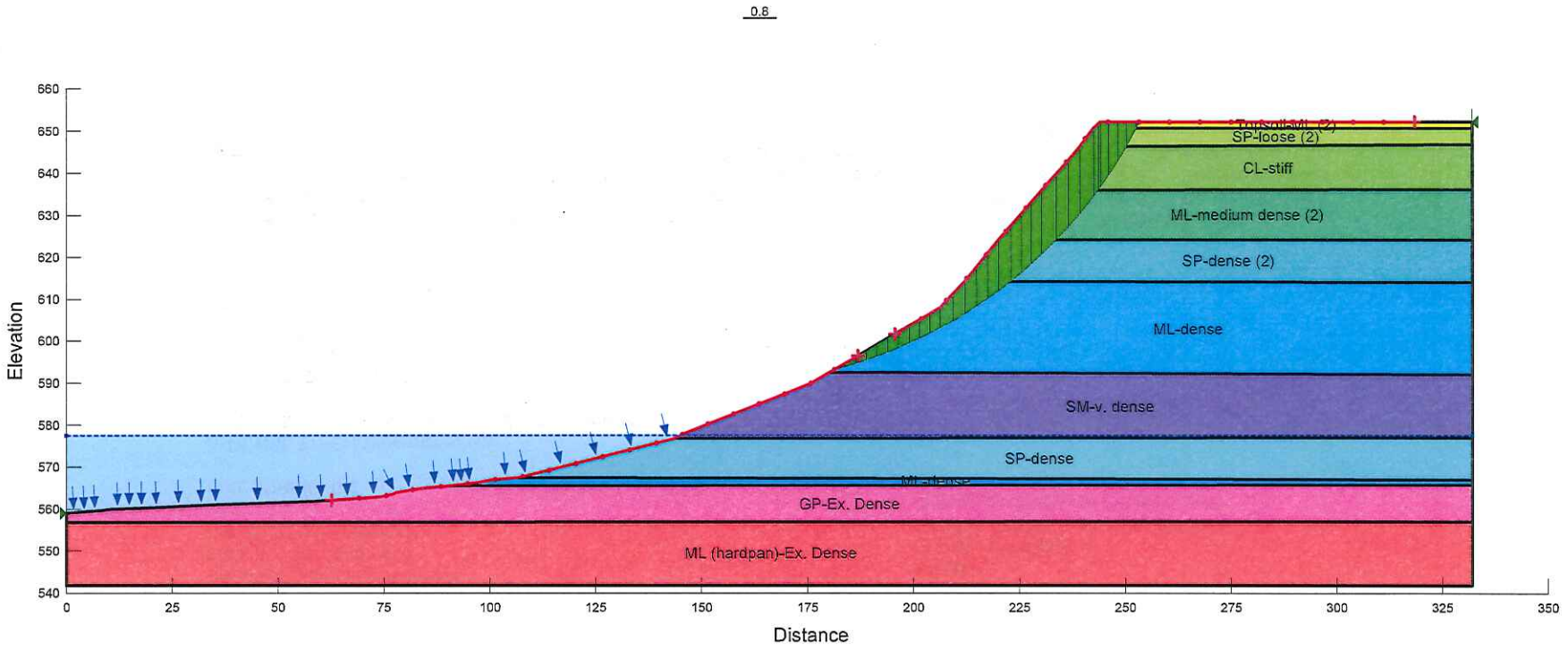
SOIL BORING: B-1

ANALYSIS TYPE: Morgenstern-Price
ANALYSIS CONDITION: Existing Conditions-Drained

ORIGINATED BY: Allen, Shannon
DATE: 5/28/2014
CHECKED BY: Thomas, Jeremy
DATE: 5/28/2014
APPROVED BY: Thomas, Jeremy
DATE: 5/28/2014

Name: CL-stiff Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 100 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: SP-dense Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1
Name: ML-dense Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: SM-v. dense Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1
Name: GP-Ex. Dense Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 34 ° Phi-B: 0 ° Piezometric Line: 1
Name: ML (hardpan)-Ex. Dense Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 34 ° Phi-B: 0 ° Piezometric Line: 1
Name: Topsoil-ML (2) Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion': 100 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: SP-loose (2) Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 100 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: ML-medium dense (2) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: SP-dense (2) Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1

NOTES:
1) Factor of Safety: 0.8
2) Failure Surface Type: Entry and Exit
3) Direction of Movement: Right to Left



PROJECT: Manitowoc Riverwalk
PROJECT NO.: 60317415
SUBJECT: Cross Section 2

SOIL BORING: B-2

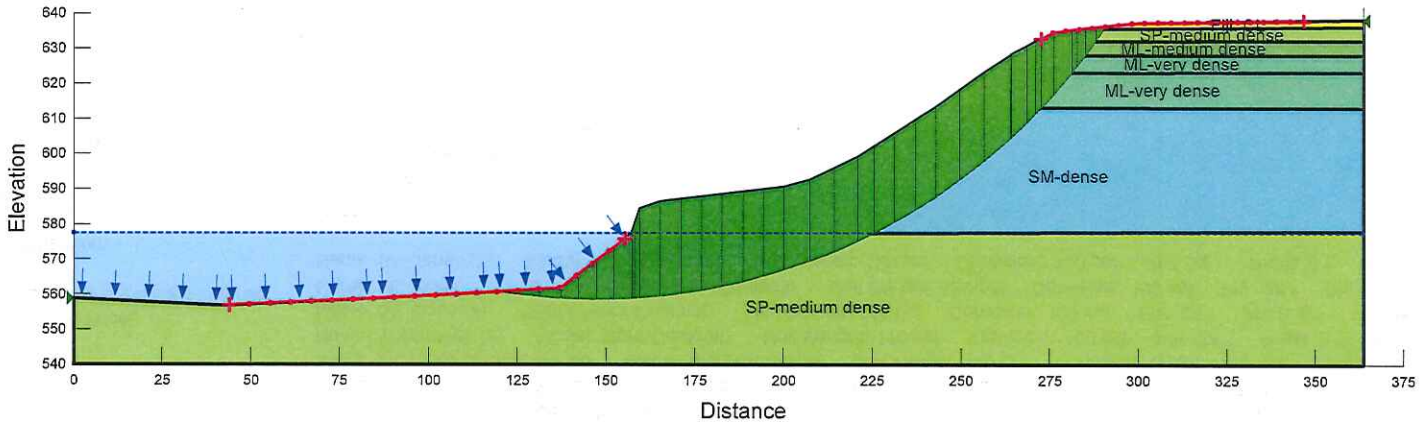
ANALYSIS TYPE: Morgenstern-Price
ANALYSIS CONDITION: Existing Conditions-Undrained

ORIGINATED BY: Allen, Shannon
DATE: 5/28/2014
CHECKED BY: Thomas, Jeremy
DATE: 5/28/2014
APPROVED BY: Thomas, Jeremy
DATE: 5/28/2014

NOTES:
1) Factor of Safety: 1.4
2) Failure Surface Type: Entry and Exit
3) Direction of Movement: Right to Left

Name: Fill: CL Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 1,000 psf Phi': 0 ° Phi-B: 0 ° Piezometric Line: 1
Name: SP-medium dense Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: ML-medium dense Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: ML-very dense Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: SM-dense Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1

1.4



PROJECT: Manitowoc Riverwalk
PROJECT NO.: 60317415
SUBJECT: Cross Section 2

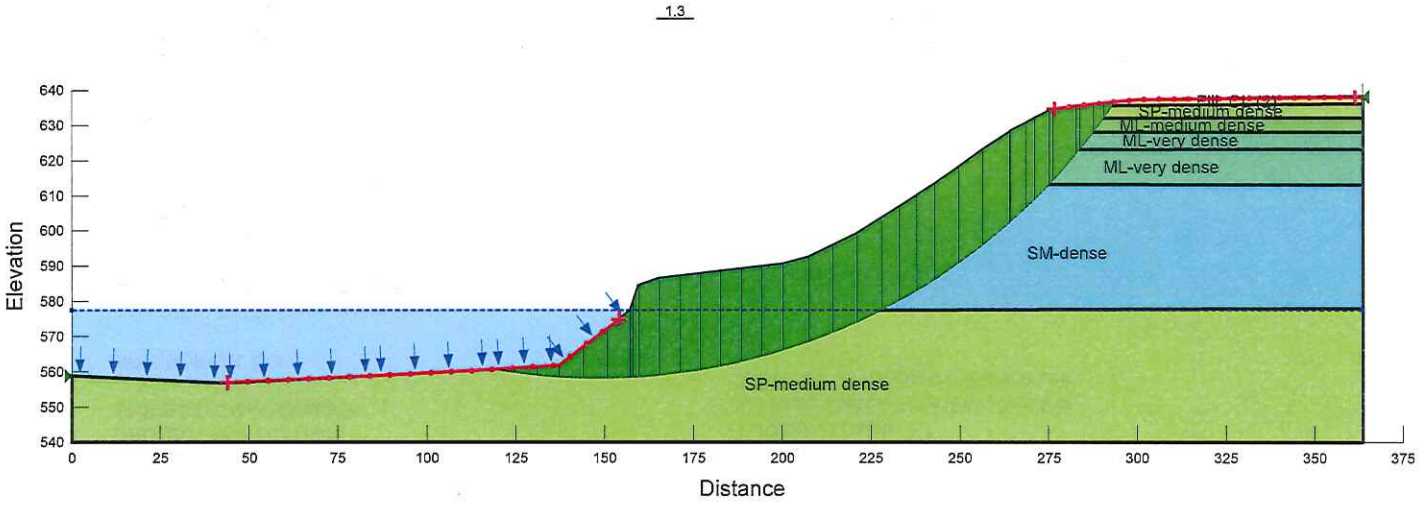
SOIL BORING: B-2

ANALYSIS TYPE: Morgenstern-Price
ANALYSIS CONDITION: Existing Conditions-Drained

ORIGINATED BY: Allen, Shannon
DATE: 5/28/2014
CHECKED BY: Thomas, Jeremy
DATE: 5/28/2014
APPROVED BY: Thomas, Jeremy
DATE: 5/28/2014

NOTES:
1) Factor of Safety: 1.3
2) Failure Surface Type: Entry and Exit
3) Direction of Movement: Right to Left

Name: SP-medium dense Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: ML-medium dense Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: ML-very dense Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: SM-dense Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 100 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Fill: CL (2) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 100 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1



PROJECT: Manitowoc Riverwalk
PROJECT NO.: 60317415
SUBJECT: Cross Section 3

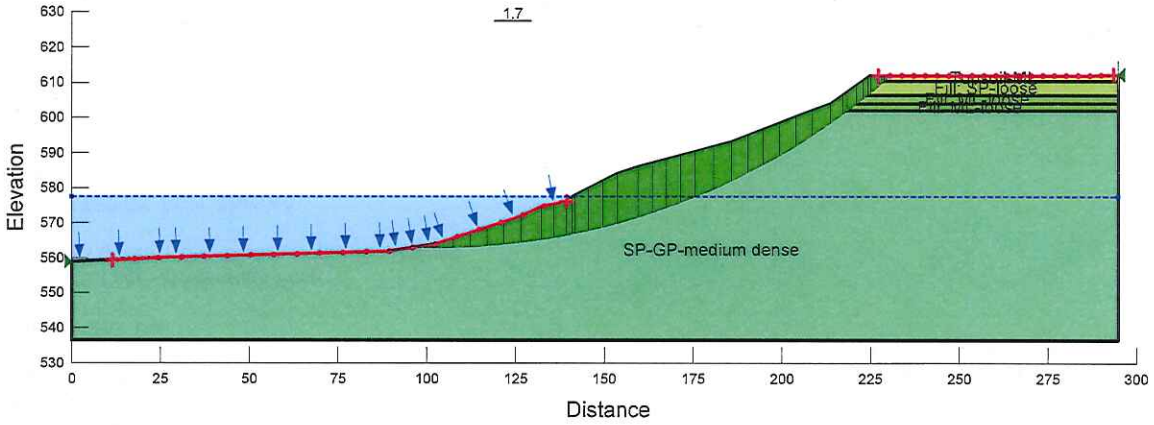
SOIL BORING: B-3

ANALYSIS TYPE: Morgenstern-Price
ANALYSIS CONDITION: Existing Conditions

ORIGINATED BY: Allen, Shannon
DATE: 5/28/2014
CHECKED BY: Thomas, Jeremy
DATE: 5/28/2014
APPROVED BY: Thomas, Jeremy
DATE: 5/28/2014

NOTES:
1) Factor of Safety: 1.7
2) Failure Surface Type: Entry and Exit
3) Direction of Movement: Right to Left

Name: Topsoil-ML Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion': 0 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: Fill: SP-loose Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: Fill: ML-loose Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: SP-GP-medium dense Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 34 ° Phi-B: 0 ° Piezometric Line



Appendix D.

AECOM General Notes and Procedures

AECOM

AECOM General Notes

Drilling and Sampling Symbols:

SS : Split Spoon - 1-3/8" I.D. 2" O.D. (Unless otherwise noted)	HS : Hollow Stem Auger
ST : Shelby Tube-2" O.D. (Unless otherwise noted)	WS : Wash Sample
PA : Power Auger	FT : Fish Tail
DB : Diamond Bit-NX, BX, AX	RB : Rock Bit
AS : Auger Sample	BS : Bulk Sample
JS : Jar Sample	PM : Pressuremeter Test
VS : Vane Shear	GS : Giddings Sampler
OS : Osterberg Sampler	

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split spoon sampler, except where otherwise noted.

Water Level Measurement Symbols:

WL : Water Level	WCI : Wet Cave In
WS : While Sampling	DCI : Dry Cave In
WD : While Drilling	BCR : Before Casing Removal
AB : After Boring	ACR : After Casing Removal

Water levels indicated on the boring logs are the levels measured in the boring at the time indicated. In pervious soils, the indicated elevations are considered reliable groundwater levels. In impervious soils, the accurate determination of groundwater elevations may not be possible, even after several days of observations; additional evidence of groundwater elevations must be sought.

Gradation Description and Terminology:

Coarse grained or granular soils have more than 50% of their dry weight retained on a #200 sieve; they are described as boulders, cobbles, gravel or sand. Fine grained soils have less than 50% of their dry weight retained on a #200 sieve; they are described as clay or clayey silt if they are cohesive and silt if they are non-cohesive. In addition to gradation, granular soils are defined on the basis of their relative in-place density and fine grained soils on the basis of their strength or consistency and their plasticity.

Major Component of Sample	Size Range	Description of Other Components Present in Sample	Percent Dry Weight
Boulders	Over 8 in. (200 mm)	Trace	1-9
Cobbles	8 inches to 3 inches (200 mm to 75 mm)	Little	10-19
Gravel	3 inches to #4 sieve (75 mm to 4.76 mm)	Some	20-34
Sand	#4 to #200 sieve (4.76 mm to 0.074 mm)	And	35-50
Silt	Passing #200 sieve (0.074 mm to 0.005 mm)		
Clay	Smaller than 0.005 mm		

Consistency of Cohesive Soils:

Unconfined Compressive Strength, Qu, tsf	Consistency
<0.25	Very Soft
0.25 - 0.49	Soft
0.50 - 0.99	Medium (firm)
1.00 - 1.99	Stiff
2.00 - 3.99	Very Stiff
4.00 - 8.00	Hard
>8.00	Very Hard

Relative Density of Granular Soils:

N-Blows per foot	Relative Density
0 - 3	Very Loose
4 - 9	Loose
10 - 29	Medium Dense
30 - 49	Dense
50 - 80	Very Dense
>80	Extremely Dense

AECOM

AECOM Field and Laboratory Procedures

Field Sampling Procedures

Auger Sampling (AS)

In this procedure, soil samples are collected from cuttings off of the auger flights as they are removed from the ground. Such samples provide a general indication of subsurface conditions; however, they do not provide undisturbed samples, nor do they provide samples from discrete depths.

Split-Barrel Sampling (SS) - (ASTM Standard D-1586-99)

In the split-barrel sampling procedure, a 2-inch O.D. split barrel sampler is driven into the soil a distance of 18 inches by means of a 140-pound hammer falling 30 inches. The value of the Standard Penetration Resistance is obtained by counting the number of blows of the hammer over the final 12 inches of driving. This value provides a qualitative indication of the in-place relative density of cohesionless soils. The indication is qualitative only, however, since many factors can significantly affect the Standard Penetration Resistance Value, and direct correlation of results obtained by drill crews using different rigs, drilling procedures, and hammer-rod-spoon assemblies should not be made. A portion of the recovered sample is placed in a sample jar and returned to the laboratory for further analysis and testing.

Shelby Tube Sampling Procedure (ST) - ASTM Standard D-1587-94

In the Shelby tube sampling procedure, a thin-walled steel seamless tube with a sharp cutting edge is pushed hydraulically into the soil and a relatively undisturbed sample is obtained. This procedure is generally employed in cohesive soils. The tubes are identified, sealed and carefully handled in the field to avoid excessive disturbance and are returned to the laboratory for extrusion and further analysis and testing.

Giddings Sampler (GS)

This type of sampling device consists of 5-foot sections of thin-wall tubing which are capable of retrieving continuous columns of soil in 5-foot maximum increments. Because of a continuous slot in the sampling tubes, the sampler allows field determination of stratification boundaries and containerization of soil samples from any sampling depth within the 5-foot interval.

AECOM Field and Laboratory Procedures

Subsurface Exploration Procedures

Hand-Auger Drilling (HA)

In this procedure, a sampling device is driven into the soil by repeated blows of a sledge hammer or a drop hammer. When the sampler is driven to the desired sample depth, the soil sample is retrieved. The hole is then advanced by manually turning the hand auger until the next sampling depth increment is reached. The hand auger drilling between sampling intervals also helps to clean and enlarge the borehole in preparation for obtaining the next sample.

Power Auger Drilling (PA)

In this type of drilling procedure, continuous flight augers are used to advance the boreholes. They are turned and hydraulically advanced by a truck, trailer or track-mounted unit as site accessibility dictates. In auger drilling, casing and drilling mud are not required to maintain open boreholes.

Hollow Stem Auger Drilling (HS)

In this drilling procedure, continuous flight augers having open stems are used to advance the boreholes. The open stem allows the sampling tool to be used without removing the augers from the borehole. Hollow stem augers thus provide support to the sides of the borehole during the sampling operations.

Rotary Drilling (RB)

In employing rotary drilling methods, various cutting bits are used to advance the boreholes. In this process, surface casing and/or drilling fluids are used to maintain open boreholes.

Diamond Core Drilling (DB)

Diamond core drilling is used to sample cemented formations. In this procedure, a double tube (or triple tube) core barrel with a diamond bit cuts an annular space around a cylindrical prism of the material sampled. The sample is retrieved by a catcher just above the bit. Samples recovered by this procedure are placed in sturdy containers in sequential order.

AECOM

AECOM Laboratory Procedures

Water Content (Wc)

The water content of a soil is the ratio of the weight of water in a given soil mass to the weight of the dry soil. Water content is generally expressed as a percentage.

Hand Penetrometer (Qp)

In the hand penetrometer test, the unconfined compressive strength of a soil is determined, to a maximum value of 4.5 tons per square foot (tsf) or 7.0 tsf depending on the testing device utilized, by measuring the resistance of the soil sample to penetration by a small, spring-calibrated cylinder. The hand penetrometer test has been carefully correlated with unconfined compressive strength tests, and thereby provides a useful and a relatively simple testing procedure in which soil strength can be quickly and easily estimated.

Unconfined Compression Tests (Qu)

In the unconfined compression strength test, an undisturbed prism of soil is loaded axially until failure or until 20% strain has been reached, whichever occurs first.

Dry Density (γd)

The dry density is a measure of the amount of solids in a unit volume of soil. Use of this value is often made when measuring the degree of compaction of a soil.

Classification of Samples

In conjunction with the sample testing program, all soil samples are examined in our laboratory and visually classified on the basis of their texture and plasticity in accordance with the AECOM Soil Classification System which is described on a separate sheet. The soil descriptions on the boring logs are derived from this system as well as the component gradation terminology, consistency of cohesive soils and relative density of granular soils as described on a separate sheet entitled "AECOM General Notes". The estimated group symbols included in parentheses following the soil descriptions on the boring logs are in general conformance with the Unified Soil Classification System (USCS) which serves as the basis of the AECOM Soil Classification System.

AECOM

AECOM Standard Boring Log Procedures

In the process of obtaining and testing samples and preparing this report, standard procedures are followed regarding field logs, laboratory data sheets and samples.

Field logs are prepared during performance of the drilling and sampling operations and are intended to essentially portray field occurrences, sampling locations and procedures.

Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory by experienced geotechnical engineers, and as such, differences between the field logs and the final logs may exist. The engineer preparing the report reviews the field logs, laboratory test data and classifications, and using judgment and experience in interpreting this data, may make further changes. It is common practice in the geotechnical engineering profession not to include field logs and laboratory data sheets in engineering reports, because they do not represent the engineer's final opinions as to appropriate descriptions for conditions encountered in the exploration and testing work. Results of laboratory tests are generally shown on the boring logs or are described in the text of the report, as appropriate.

Samples taken in the field, some of which are later subjected to laboratory tests, are retained in our laboratory for sixty days and are then discarded unless special disposition is requested by our client. Samples retained over a long period of time, even in sealed jars, are subject to moisture loss which changes the apparent strength of cohesive soil, generally increasing the strength from what was originally encountered in the field. Since they are then no longer representative of the moisture conditions initially encountered, observers of these samples should recognize this factor.

AECOM Soil Classification System [1]

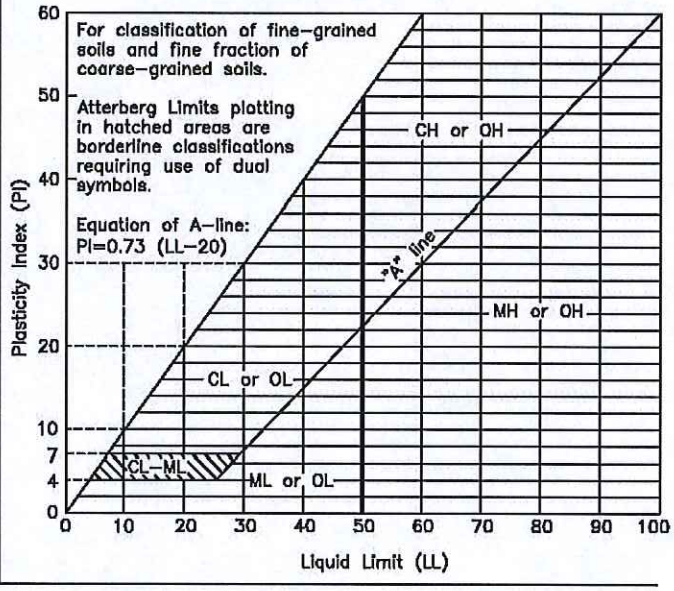
Major Divisions		Group Symbols	Typical Names	Laboratory Classification Criteria
Coarse-grained soils (More than half of material is *larger* than No. 200 sieve size)				
Gravel (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravel (Little or no fines)	GW	Well-graded, gravel, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 & 3
		GP	Poorly graded gravel, gravel-sand mixtures, little or no fines	Not meeting all gradation requirements for GW
	Gravel with fines (Appreciable amount of fines)	GM	Silty gravel, gravel-sand-silt mixtures	Atterberg limits below "A" line or PI less than 4
		GC	Clayey gravel, gravel-sand-clay mixtures	Atterberg limits above "A" line or PI greater than 7
Sand (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sand (Little or no fines)	SW	Well-graded sand, gravelly sand, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 & 3
		SP	Poorly graded sand, gravelly sand, little or no fines	Not meeting all gradation requirements for SW
	Sand with fines (Appreciable amount of fines)	SM	Silty sand, sand-silt mixtures	Atterberg limits below "A" line or PI less than 4
		SC	Clayey sand, sand-clay mixtures	Atterberg limits above "A" line or PI greater than 7
Fine-grained soils (More than half of material is *smaller* than No. 200 sieve size)				
Silt and clay (Liquid limit less than 50)		ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or clayey silt with slight plasticity	
		CL	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay, silty clay, lean clay	
		OL	Organic silt and organic silty clay of low plasticity	
Silt and clay (Liquid limit greater than 50)		MH	Inorganic silt, micaceous or diatomaceous fine sandy or silty soils, elastic silt	
		CH	Inorganic clay of high plasticity, fat clay	
		OH	Organic clay of medium to high plasticity, organic silt	
Highly organic soils		PT	Peat and other highly organic soil	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:
Less than 5 percent . . . . . GW, GP, SW, SP
More than 12 percent . . . . . GM, GC, SM, SC
5 to 12 percent . . . . . Borderline cases *requiring* dual symbols [3]

Above "A" line with PI between 4 and 7 are *borderline* cases requiring use of dual symbols

Limits plotting in hatched zone with PI between 4 and 7 are *borderline* cases requiring use of dual symbols

Plasticity Chart [2]



1. See AECOM General Notes for component gradation terminology, consistency of cohesive soils and relative density of granular soils.
2. Reference: Unified Soil Classification Systems
3. Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder.

About AECOM

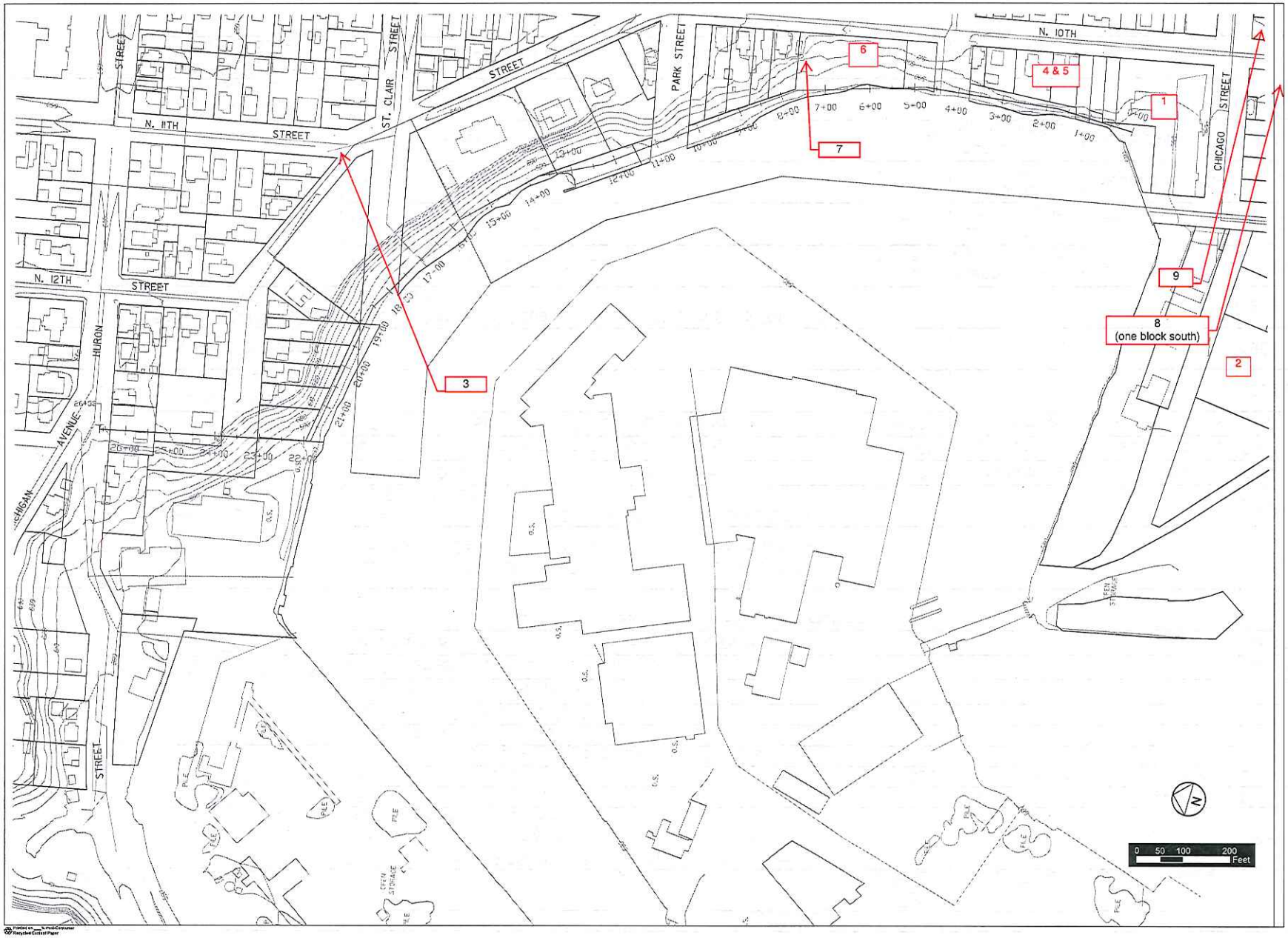
AECOM (NYSE: ACM) is a global provider of professional technical and management support services to a broad range of markets, including transportation, facilities, environmental, energy, water and government. With approximately 45,000 employees around the world, AECOM is a leader in all of the key markets that it serves. AECOM provides a blend of global reach, local knowledge, innovation, and collaborative technical excellence in delivering solutions that enhance and sustain the world's built, natural, and social environments. A *Fortune 500* company, AECOM serves clients in more than 130 countries and has annual revenue in excess of $8.0 billion.

More information on AECOM and its services can be found at www.aecom.com.

Address
Phone number
Other Contact Information

Summary Table of Potential Environmental Impacts to the Proposed Manitowoc Riverwalk Project

Environmental Identification Number	Address	Concern				Source
		Type	Size Gallons	Tank Status	Tank Contents	
1	402 N 10th Street/ N 11th Street & Chicago Street	Open ERP Site, BRRTS (#02-36-000219): WI Fuel & Light Co (WPCS), VOCs - groundwater contamination, soil contamination, vapor intrusion pathway (potential) on and off-site				BRRTS and RR Maps
		UST- Wisconsin Fuel & Light Co	1,000	closed/removed	leaded gasoline	DATCP
		UST- Wisconsin Fuel & Light Co	1,000	closed/removed	unleaded gasoline	DATCP
		Manitowoc Gas Co (Coal Gas) and gas holder, coke yard				1906 Sanborn Map
2	W of N 11th Street at Buffalo Street	WI Central RR and Coal Dock				1900 Sanborn Map
		and Northern Elevator Co. No. 1				1919 Sanborn Map
		and Standard Oil Co. with multiple Tanks				1919 Sanborn Map
		and Stphani-Strupp Oil Co. with multiple Tanks				1927 Sanborn Map
		and Wingfield Oil Co with Oil House and multiple Tanks				1956 Sanborn Map
		and Sinclair Refining Co. Bulk Oil Station with Oil House and multiple Tanks				1956 Sanborn Map
3	620 N Water Street/ 610 N 10th Street	Closed (August 20, 2004) ERP Site, BRRTS (#02-36-182657): Mobil One-Stop, VOCs - soil contamination, groundwater contamination				BRRTS and RR Maps
		Closed (March 23, 1998) LUST Site, BRRTS (#03-36-002046): Mobil One-Stop, Gasoline and VOCs - soil contamination				BRRTS and RR Maps
		UST- Mobil One Stop, Schroeder Oil & Excavating	8,000	closed/removed	unleaded gasoline	DATCP
		UST- Mobil One Stop, Schroeder Oil & Excavating	6,000	closed/removed	unleaded gasoline	DATCP
		UST- Mobil One Stop, Schroeder Oil & Excavating	6,000	closed/removed	unleaded gasoline	DATCP
4	414 & 430 N Main (10th) Street	Machine Shops				1906 Sanborn Map
5	420 N 10th Street	Paints				1956 Sanborn Map
6	500 Block N Main (10th) Street	Goodrich Transit Co. Repair Shops with Electric Shop, Paint Shop, and Store Room				1919 Sanborn Map
7	533 N 10th Street	UST- Park Ten Service, Donald Laurie	300	abandoned without product	fuel oil	DATCP
		UST- Park Ten Service, Donald Laurie	550	abandoned without product	diesel	DATCP
		UST- Park Ten Service, Donald Laurie	8,000	abandoned without product	unleaded gasoline	DATCP
		UST- Park Ten Service, Donald Laurie	10,000	abandoned without product	leaded gasoline	DATCP
8	N 10th Street and Buffalo Street	Filling Station, Autos, Oil Warehouse				1927 Sanborn Map
9	N 10th Street and Chicago Street	Filling Station and Battery Service				1956 Sanborn Map



AECOM

PROJECT

CITY OF MANITOWOC WI
2013 COASTAL
MANAGMENT GRANT

SHEETWALL AND RIVER WALK ALONG THE MANITOWOC RIVER

CLIENT

CITY OF MANITOWOC
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REGISTRATION

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

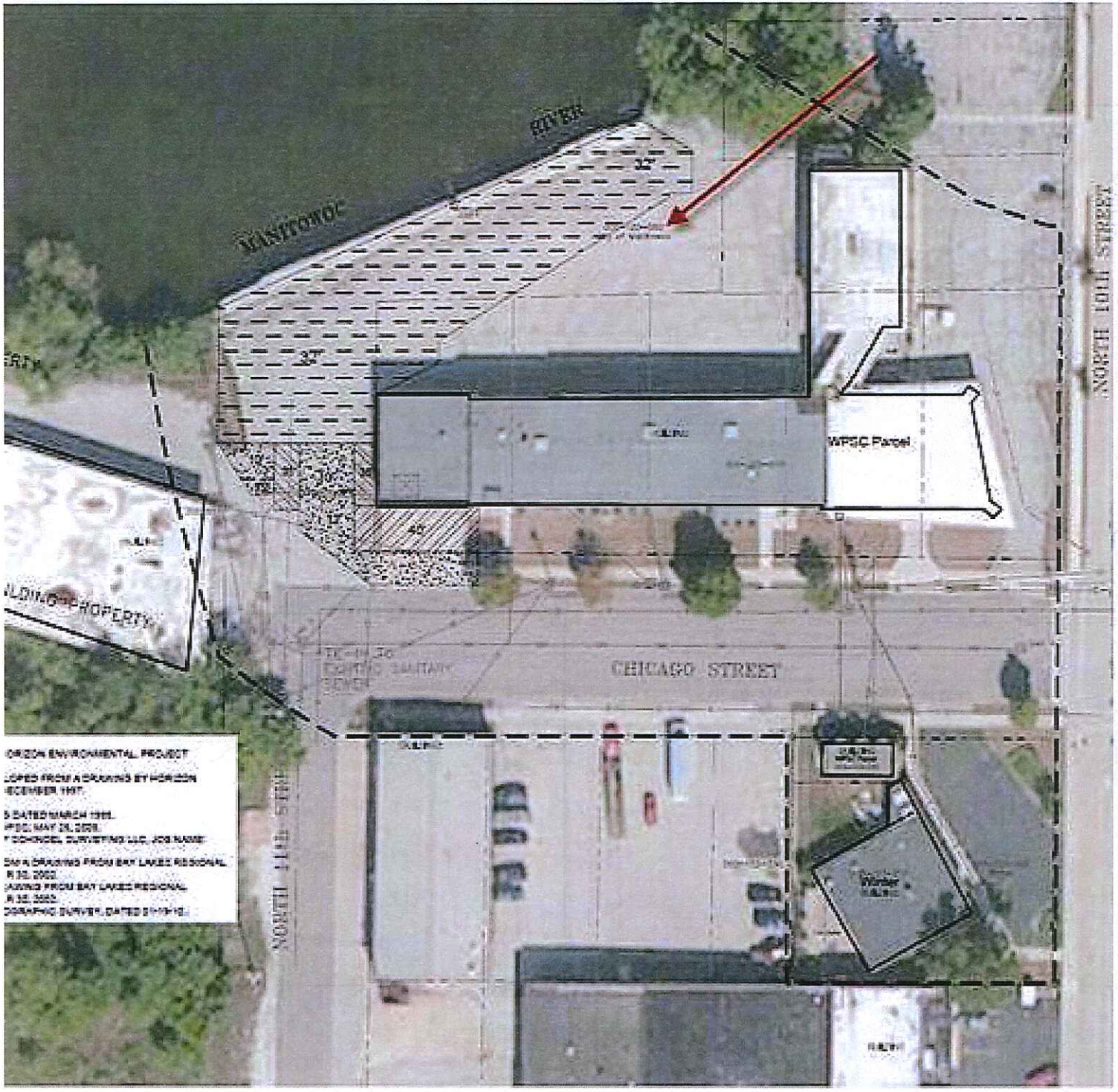
60317415

SHEET TITLE

PROJECT OVERVIEW

SHEET NUMBER

Env Review Figure



HORIZON ENVIRONMENTAL PROJECT

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ECEMBER 1997.

S DATED MARCH 1998.
PSC, MAY 28, 2008.
T SCHINDEL SURVEYING LLC, JOB NAME:

DATA DRAWING FROM BAY LAKES REGIONAL
R 30, 2002.
AWING FROM BAY LAKES REGIONAL
R 30, 2002.
OGRAPHIC SURVEY, DATED 3/19/10.

SITE LAYOUT AND EXISTING STRUCTURES

REMEDIAL INVESTIGATION DATA PACKAGE
FORMER MANITOWOC MGP SITE
WISCONSIN PUBLIC SERVICE CORPORATION
MANITOWOC, WISCONSIN

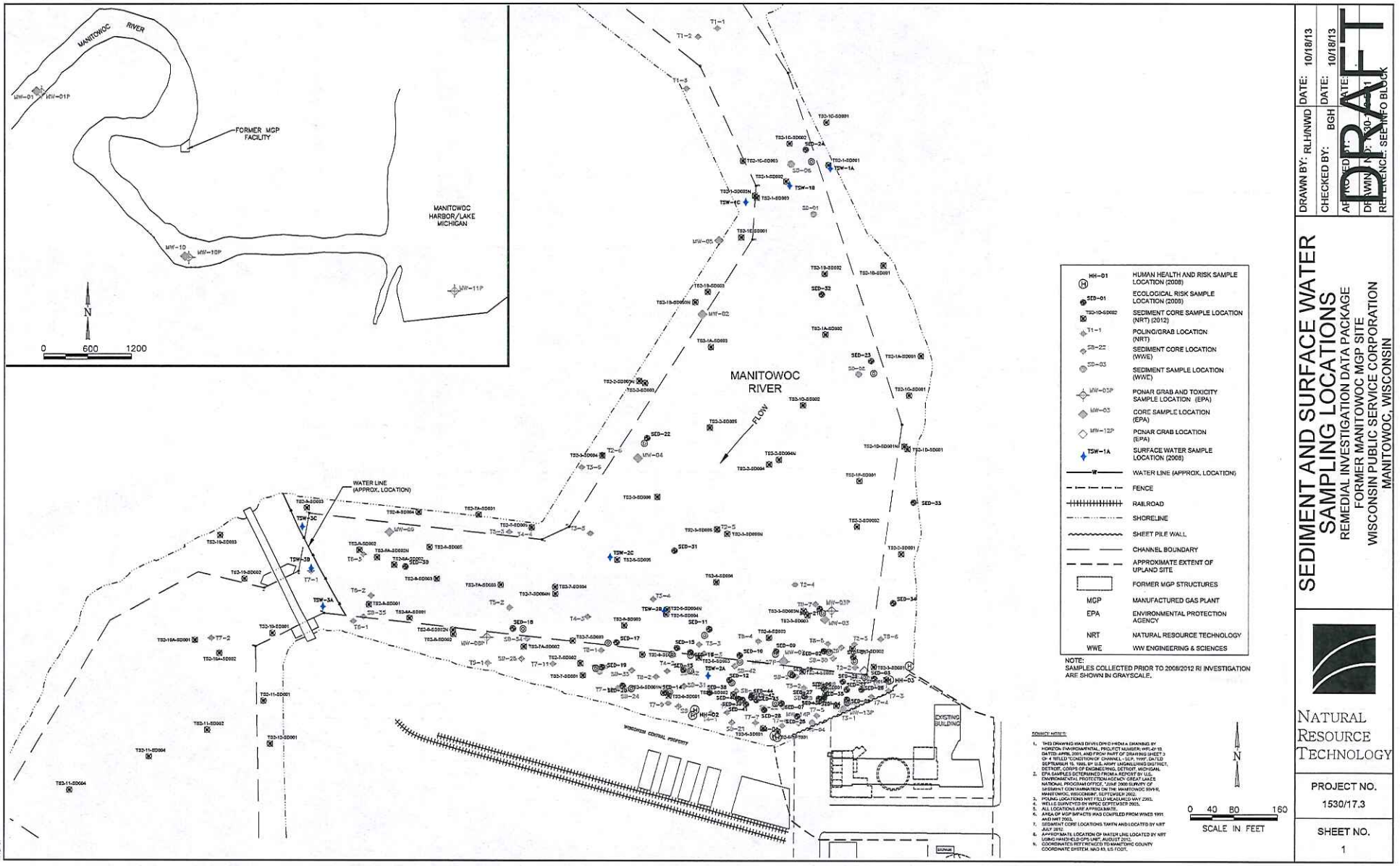
DRAWN BY: RJH DATE 10/7/13
CHECKED BY: MPH DATE 10/7/13

DRAFT

NATURAL RESOURCE TECHNOLOGY

PROJECT NO. 1830/17.3

FIGURE NO. 2



Oct 18, 2013 2:46pm PLOTTED BY: rhopkins SAVED BY: rhopkins
N:\ACAD\Projects\1530 Manitowoc\07-31\1530-173-001.dwg LAYOUT1
MAGIC
XREFS

DRAWN BY: RLH/NWD DATE: 10/18/13
CHECKED BY: BGH DATE: 10/18/13
APPROVED BY: DATE:
DRAWING NO: 1530-173-001
REFERENCE: SEE INFO BLOCK

DRAFT

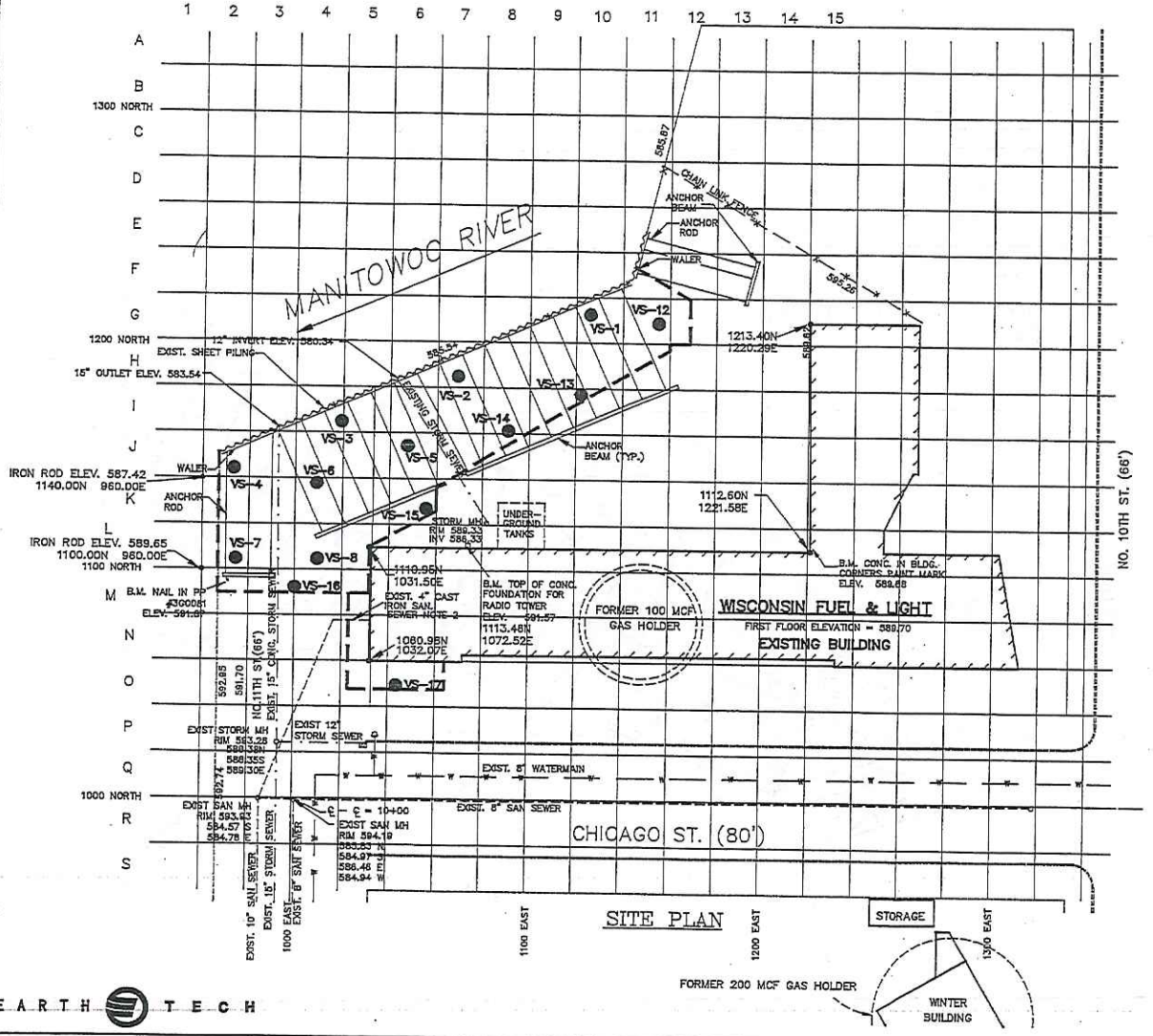
SEDIMENT AND SURFACE WATER SAMPLING LOCATIONS

REMEDIAL INVESTIGATION DATA PACKAGE
FORMER MANITOWOC MGP SITE
WISCONSIN PUBLIC SERVICE CORPORATION
MANITOWOC, WISCONSIN

NATURAL RESOURCE TECHNOLOGY

PROJECT NO.
1530/17.3

SHEET NO.
1



SITE PLAN

LEGEND

000.00 – EXIST ELEV. USGS DATUM

– WISCONSIN FUEL & LIGHT PROPERTY LINE

– WISCONSIN CENTRAL PROPERTY LINE

– LIMITS OF REMEDIATION

W W W – WATER MAIN LOCATION

– SANITARY SEWER LOCATION

– STORM SEWER LOCATION

– CURB LINE

– VERIFICATION SAMPLING LOCATION

NORTH

0 25 50 100

SCALE IN FEET

EARTH TECH

22574VS2
VR022395

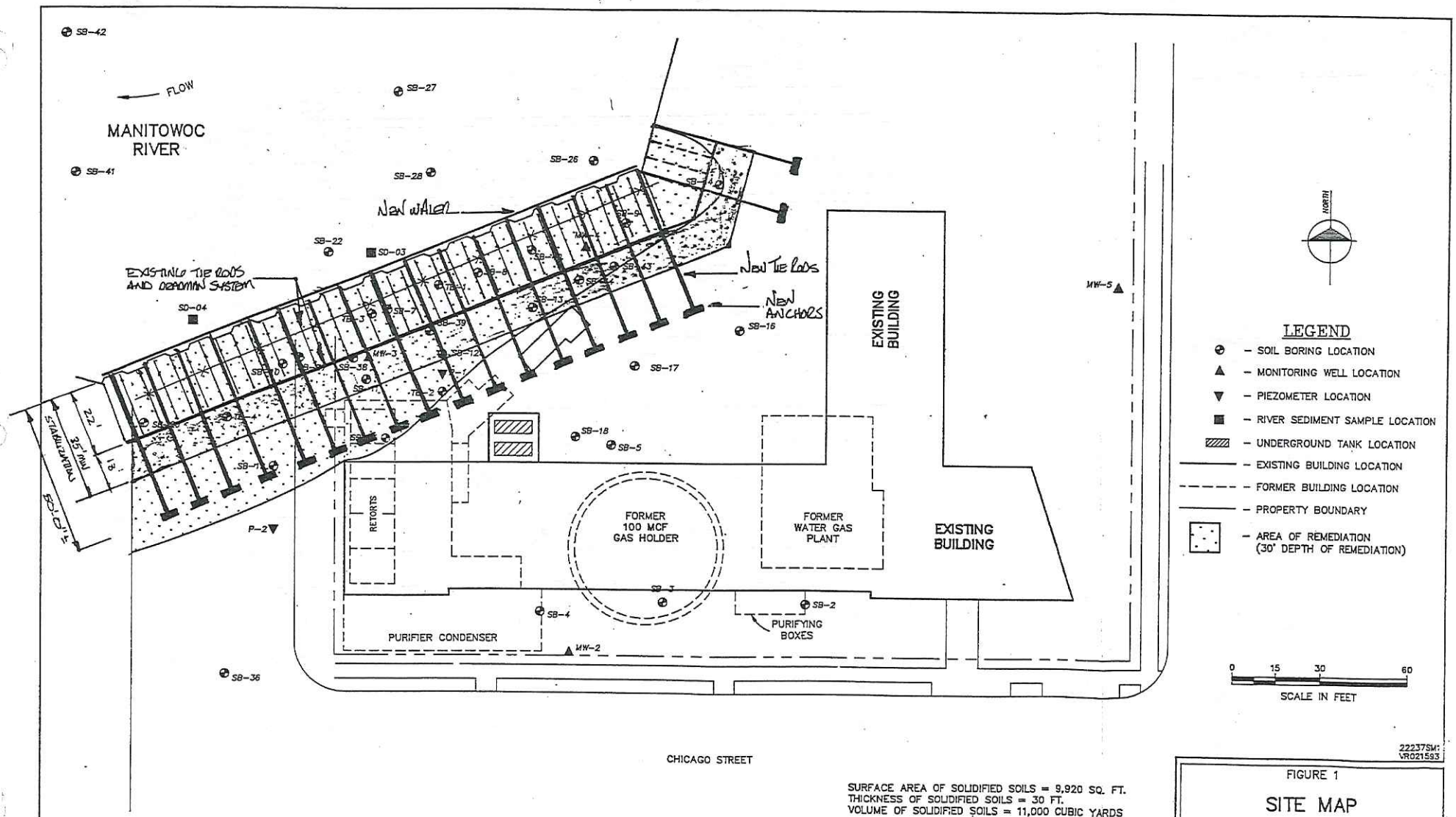
FIGURE 3

VERIFICATION SAMPLE LOCATION MAP

WISCONSIN FUEL & LIGHT COMPANY
MANITOWAC, WISCONSIN

FEBRUARY, 1995

22574



SURFACE AREA OF SOLIDIFIED SOILS = 9,920 SQ. FT.
THICKNESS OF SOLIDIFIED SOILS = 30 FT.
VOLUME OF SOLIDIFIED SOILS = 11,000 CUBIC YARDS

22237SM:
VR021593

FIGURE 1

SITE MAP

WISCONSIN FUEL AND LIGHT COMPANY
MANITOWOC, WISCONSIN

FEBRUARY, 1993 22237

WW Engineering & Science

Modified Anchor System MARCH 1993 MMB.

Wetland Indicators Map

Legend

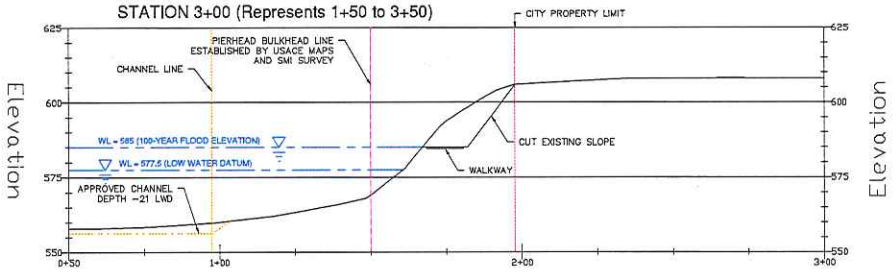
- Wetland Class Points
  - Dammed pond
  - Excavated pond
  - Filled excavated pond
  - Filled/drained wetland
  - Wetland too small to delineate
- Filled Points
- Wetland Class Areas
  - Wetland
  - Upland
- Filled Areas
- NRCS Wetspots
- Wetland Indicators
- 2010 Air Photos (WROC)

Notes

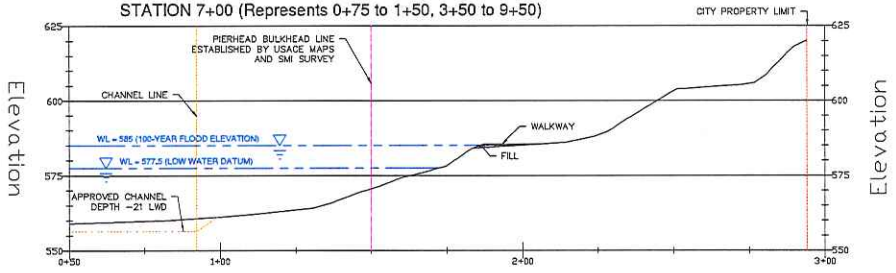
0.3 0 0.14 0.3 Miles

NAD_1983_HARN_Wisconsin_TM

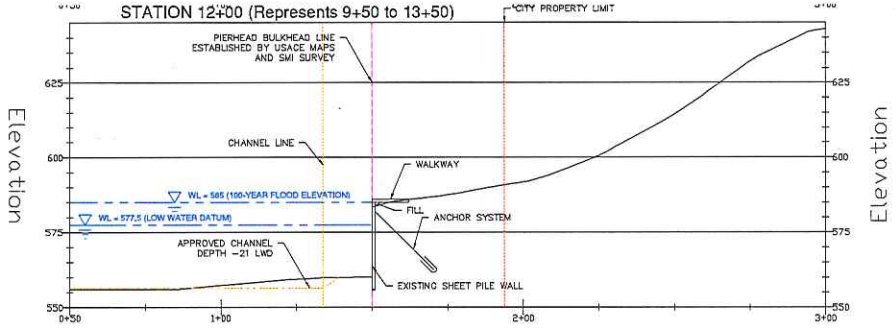
STATION 3+00 (Represents 1+50 to 3+50)



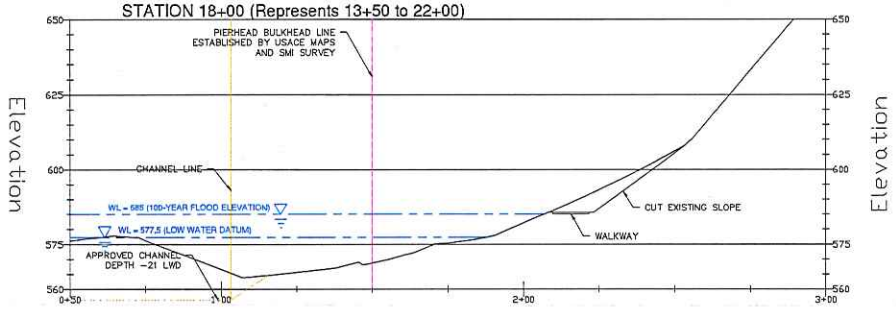
STATION 7+00 (Represents 0+75 to 1+50, 3+50 to 9+50)



STATION 12+00 (Represents 9+50 to 13+50)



STATION 18+00 (Represents 13+50 to 22+00)



NOTES

- GROUND SURFACE ELEVATIONS REFERENCED TO NAVD88
- 100-YEAR FLOOD ELEVATION REFERENCED TO NAVD88
- LOW WATER DATUM (LWD) REFERENCED TO IGLD85

DATUM ADJUSTMENTS
0.00LWD = +577.5 IGLD85 = +577.05 NAVD88

NOTE

RETROFIT EXISTING SHEET PILE WALL ALONG STA 9+00 TO 13+50

20 0 20 40
1" = 20'
HORIZONTAL AND VERTICAL SCALE FOR CROSS SECTIONS

AECOM

PROJECT

City of Manitowoc
River Walk

CLIENT

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REGISTRATION

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

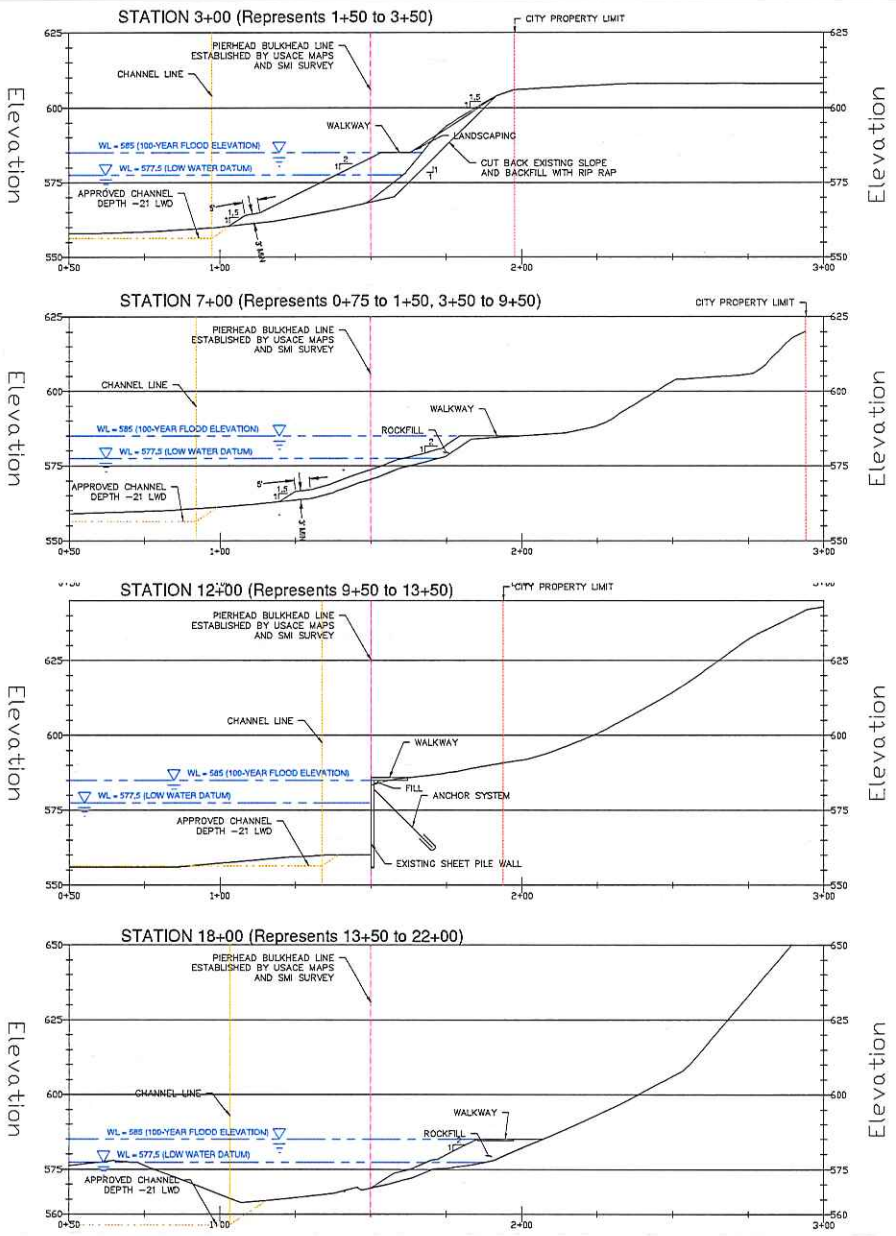
60317415

SHEET TITLE

PROPOSED AT-GRADE, CUT/FILL CROSS SECTIONS

SHEET NUMBER

1



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NOTE

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20 0 20 40
1" = 20'
HORIZONTAL AND VERTICAL SCALE FOR CROSS SECTIONS

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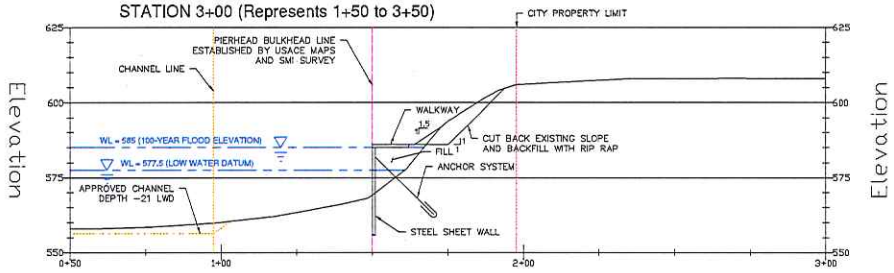
I/R	DATE	DESCRIPTION

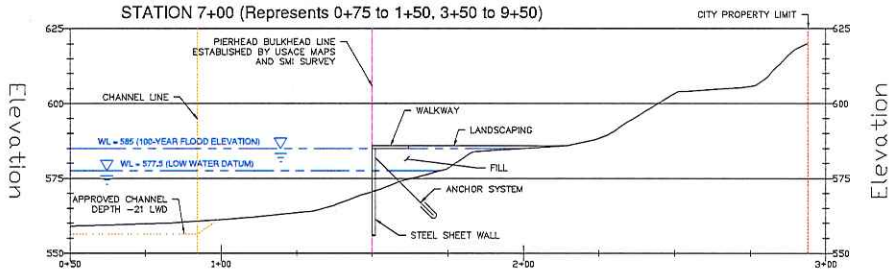
KEY PLAN

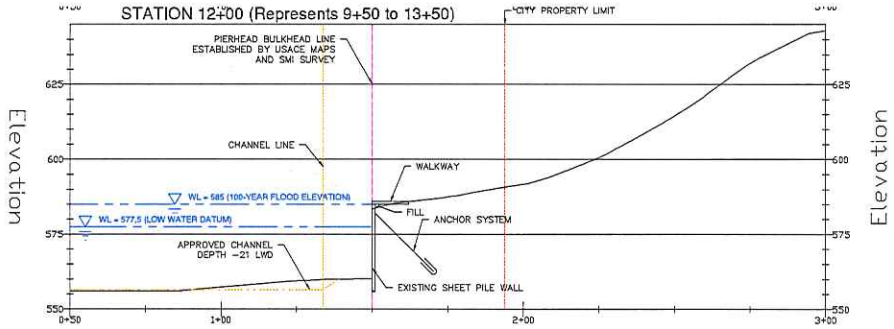
PROJECT NUMBER
60317415

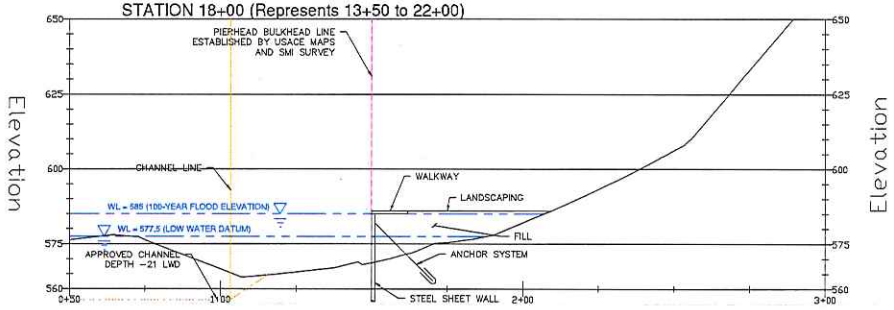
SHEET TITLE
PROPOSED ROCKFILL EMBANKMENT CROSS SECTIONS

SHEET NUMBER
2









NOTES

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- LOW WATER DATUM (LWD) REFERENCED TO IGLD85

DATUM ADJUSTMENTS
0.00LWD = -577.5 IGLD85 = -577.66 NAVD88

NOTE

RETROFIT EXISTING SHEET PILE WALL ALONG STA 6+00 TO 13+50

20 0 20 40
1" = 20'
HORIZONTAL AND VERTICAL SCALE FOR CROSS SECTIONS

AECOM

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REGISTRATION

ISSUE/REVISION

NR	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER
60317415

SHEET TITLE
PROPOSED SEA WALL
CROSS SECTIONS

SHEET NUMBER
3

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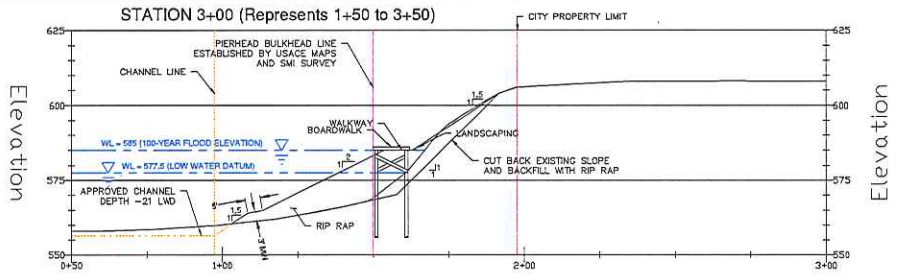

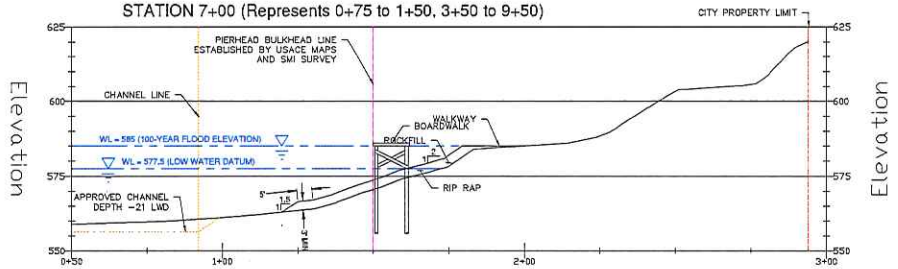

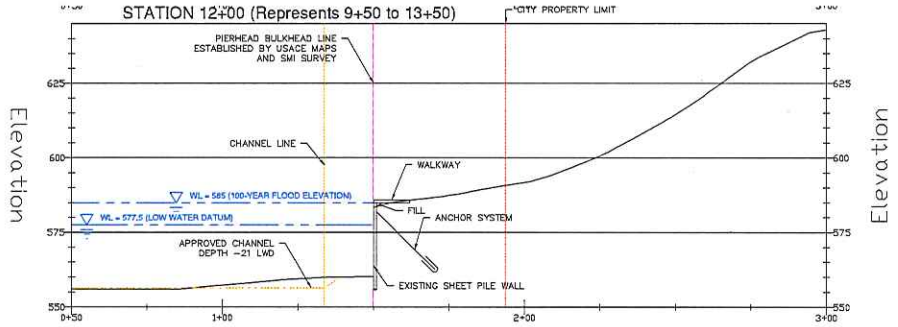

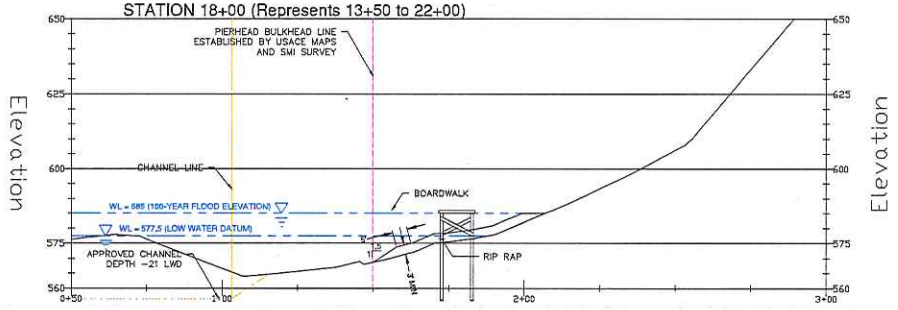

NOTES:

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- LOW WATER DATUM (LWD) REFERENCED TO IGLD85

DATUM ADJUSTMENTS
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NOTE

RETROFIT EXISTING SHEET PILE WALL ALONG STA 9+00 TO 13+50

20 0 20 40
1" = 20'
HORIZONTAL AND VERTICAL SCALE FOR CROSS SECTIONS

AECOM

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REGISTRATION

ISSUE/REVISION

NO.	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

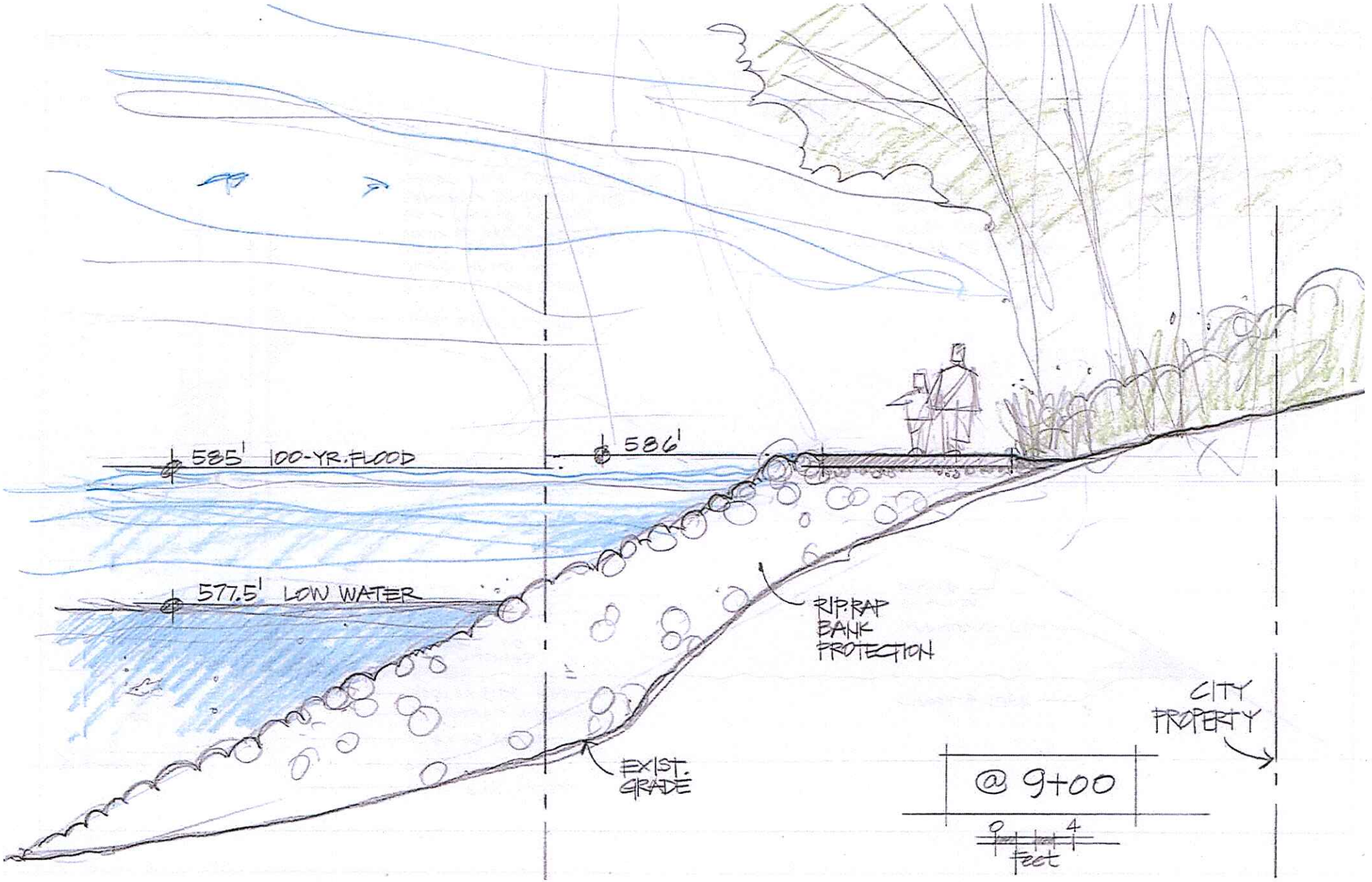
60317415

SHEET TITLE

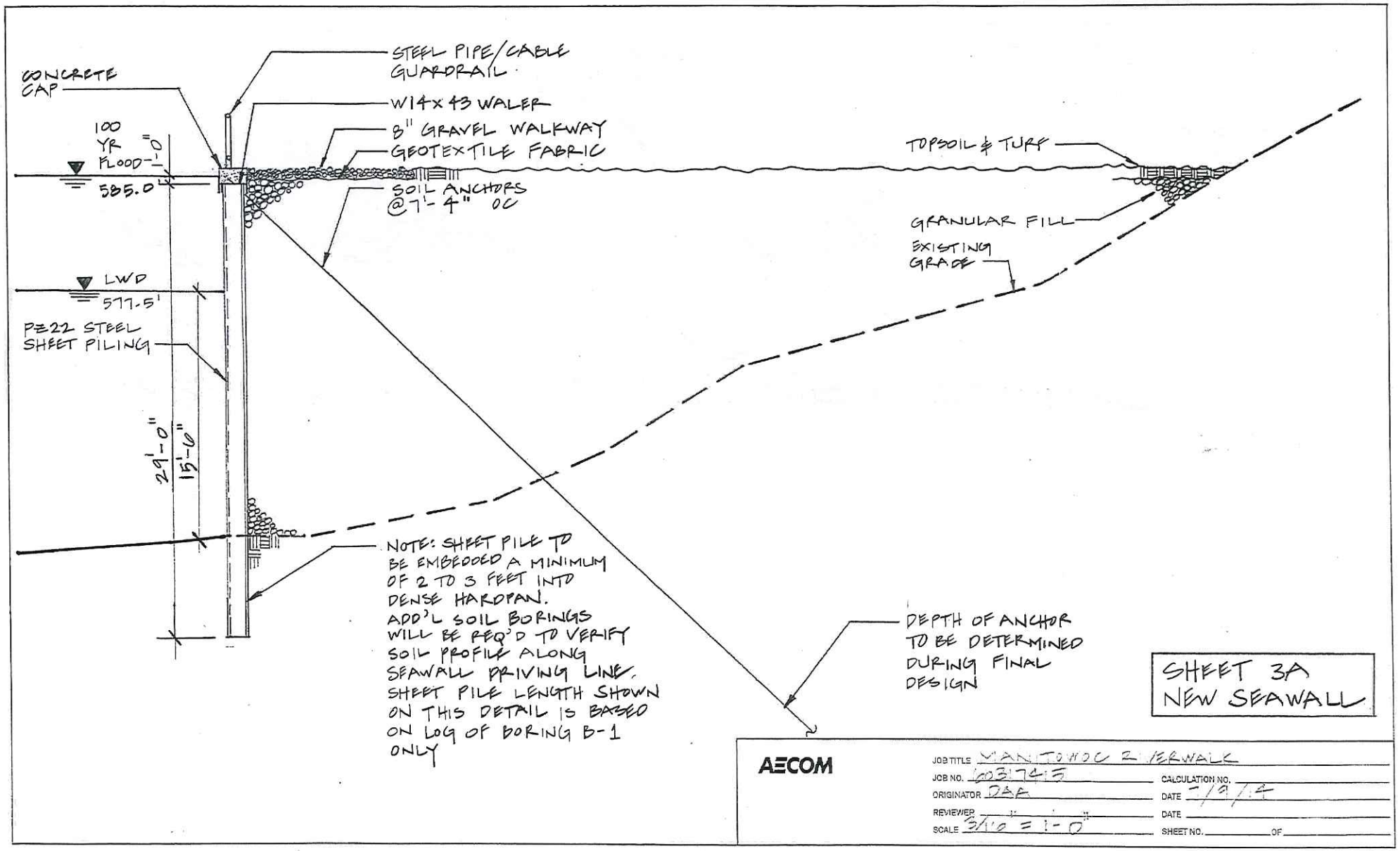
PROPOSED BOARDWALK AND RIP RAP CROSS SECTIONS

SHEET NUMBER

4



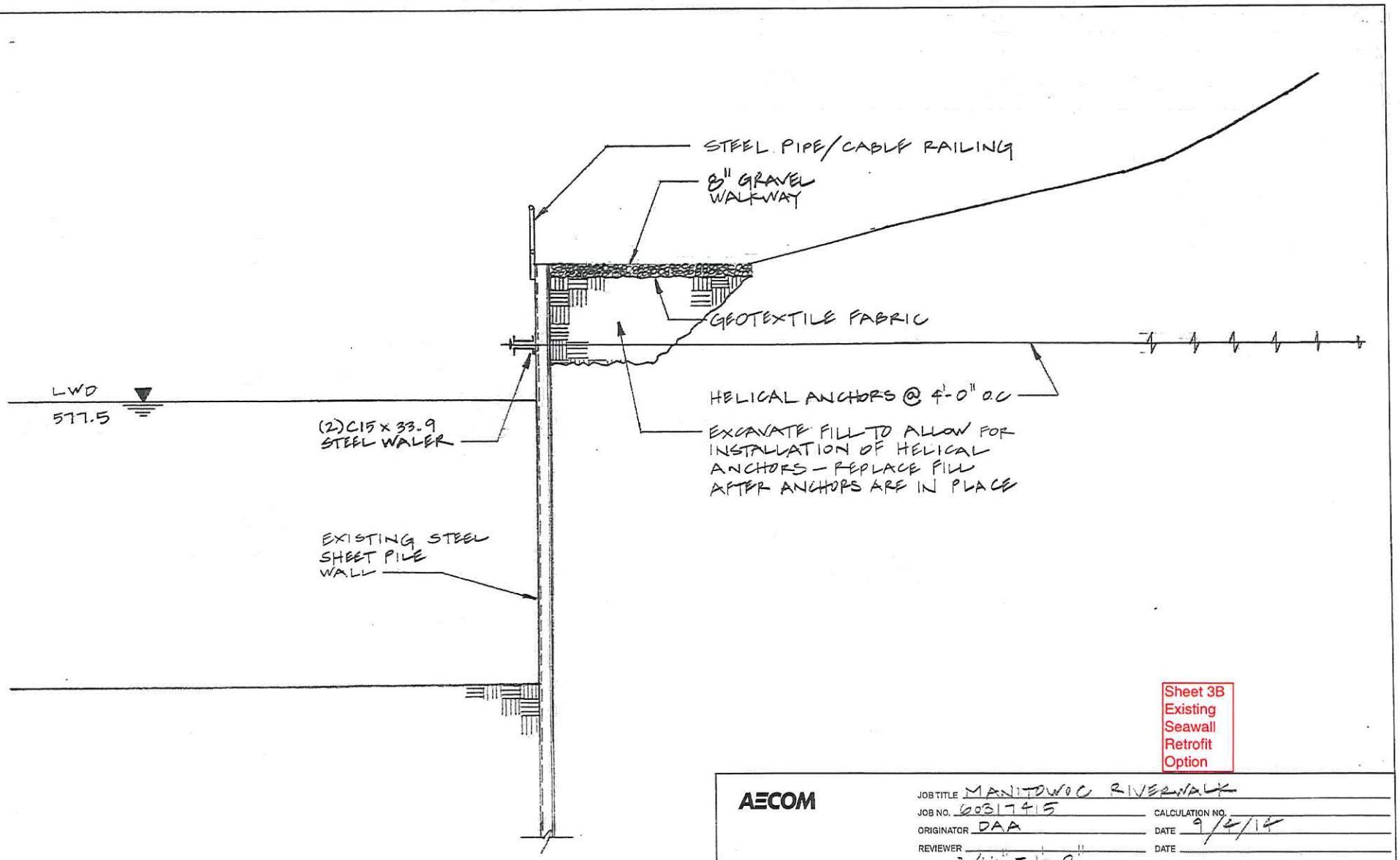
Sheet 2A - Rock Fill Embankment Typical Section



AECOM

JOB TITLE MANITOWOC RIVERWALK
JOB NO. 60374115 CALCULATION NO.
ORIGINATOR DAA DATE 7/2/14
REVIEWER DATE
SCALE 3/16" = 1'-0" SHEET NO. OF

Grid: 10x10 = 1"

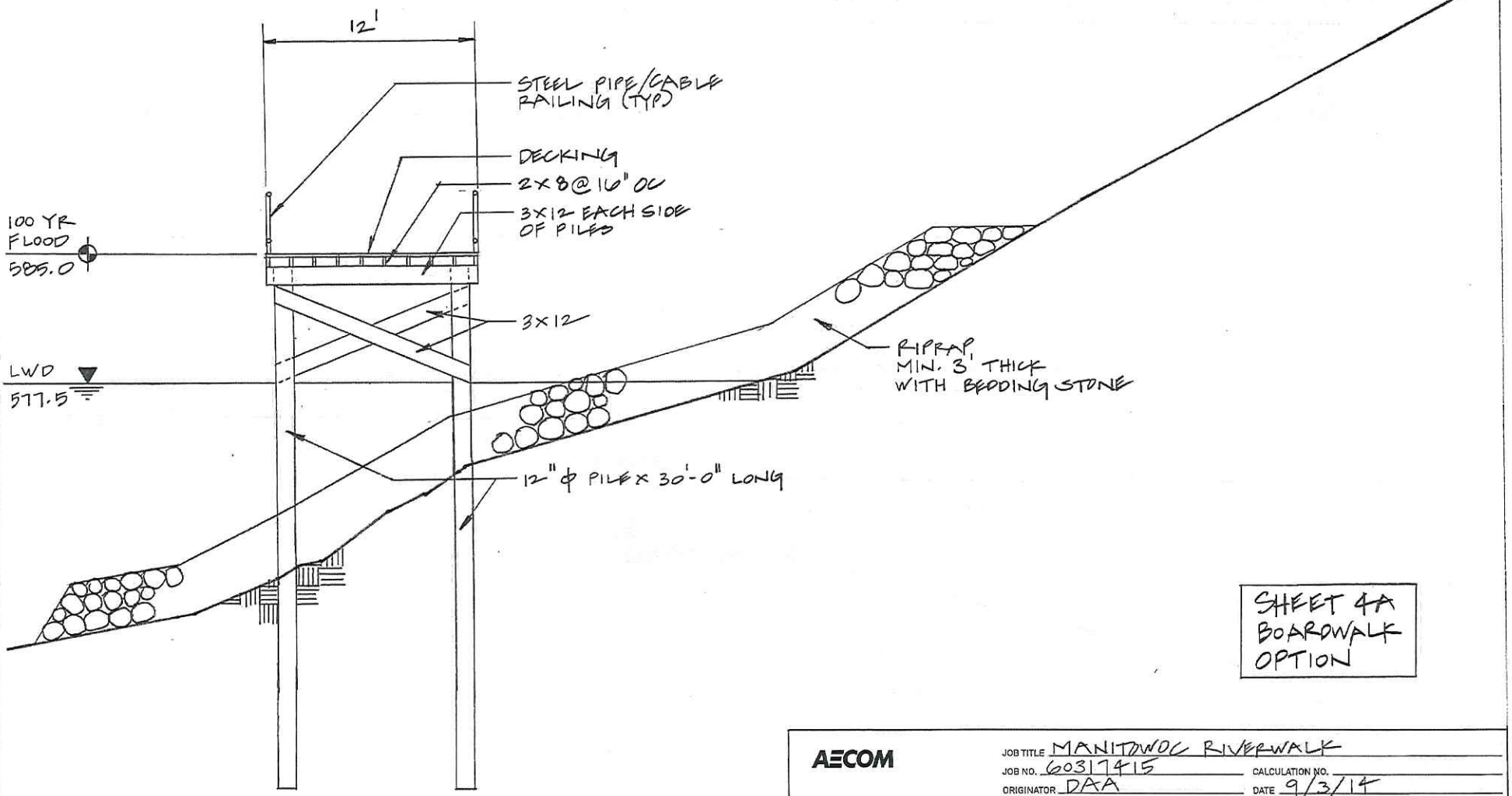


Sheet 3B
Existing
Seawall
Retrofit
Option

AECOM

JOB TITLE MANITOWOC RIVERWALK
JOB NO. 60317415 CALCULATION NO.
ORIGINATOR DAA DATE 9/4/14
REVIEWER DATE
SCALE 3/16" = 1'-0" SHEET NO. OF

Grid: 10x10 = 1"



SHEET 4A
BOARDWALK
OPTION

AECOM

JOB TITLE MANITOWOC RIVERWALK
JOB NO. 60317415 CALCULATION NO.
ORIGINATOR DAA DATE 9/3/14
REVIEWER DATE
SCALE 3/16" = 1'-0" SHEET NO. OF

Grid: 10x10 = 1"

Project: Manitowoc Riverwalk - Rockfill Embankment Option
Owner: City of Manitowoc, WI

AECOM

Construction Cost Estimate

By: TAP 9/4/2014
Checked: SRA 9/11/2014

	ITEM	# OF UNITS	UNITS	UNIT PRICE	TOTAL COST OF ITEM
1 General Conditions	Superintendent	16	Week	$3,550.00	$56,800.00
	Concrete Testing	10	Each	$30.00	$300.00
	Job Trailer	4	Month	$768.00	$3,072.00
	Temporary Fencing at ends of site	1500	LF	$7.00	$10,500.00
	Mob/Demob (Barges,Backhoe, Trucks, Compactor)	1	LS	$75,000.00	$75,000.00
2 Existing Conditions	Clearing of Shoreline (from barge, 3 X WisDOT Ave Unit Price)	2	Acre	$9,000.00	$18,000.00
3 Concrete	Ovhd Light Pole Bases (6 ft. deep, at trailheads)	4	Each	$1,500.00	$6,000.00
	Bollard Light Bases (6 ft. deep, 100 ft. intervals)	17	Each	$750.00	$12,750.00
4 Masonry					$0.00
5 Metals					$0.00
6 Wood & Plastics					$0.00
7 Thermal & Moisture Protection					$0.00
8 Doors & Windows					$0.00
9 Finishes					$0.00
10 Specialties					$0.00
11 Equipment					$0.00
12 Furnishings					$0.00
13 Special Construction					$0.00
14 Conveying Systems					$0.00
26 Electrical	City Purchase Ovhd Light Poles & Fixtures	4	Each	$4,000.00	$16,000.00
	Install Ovhd Light Poles and Fixtures	4	Each	$1,200.00	$4,800.00
	City Purchase Bollard Lights	17	Each	$2,500.00	$42,500.00
	Install Bollard Lights	17	Each	$750.00	$12,750.00
	1 inch Power Conduit	1750	LF	$9.50	$16,625.00
	Connections/Wiring/Hookup	1	Each	$10,000.00	$10,000.00
31 Earthwork	Excavation for lower slope remediation rip rap (1+50 to 3+50)	1296	CY	$6.00	$7,776.00
	Truck Excavated Material Offsite (40 mi Roundtrip)	1296	CY	$8.75	$11,340.00
	Disposal Fee (est)	1296	CY	$2.50	$3,240.00
	SAS Geotextile	2683	SY	$2.50	$6,707.50
	Compacted Gravel Pavement Surface (8' Thick)	932	Ton	$15.00	$13,980.00
	Heavy Riprap	26853	Ton	$60.00	$1,611,180.00
	Rip Rap Bedding Stone	2473	Ton	$10.00	$24,730.00
	Grading/Topsoil for Walkway Shoulders	479	CY	$25.00	$11,975.00
32 Exterior Improvements	Mechanical Seeding	25875	SF	$0.52	$13,455.00
	Erosion Control (Silt Fence)	1725	LF	$2.50	$4,312.50
	Turbidity Barrier	1725	LF	$70.00	$120,750.00
	Tracking Pad	2	Each	$3,000.00	$6,000.00
	General Cleanup/Restoration	1	Each	$10,000.00	$10,000.00
SubTotal:					$2,130,543.00
Contingency @ 20%			0.20		$426,108.60
Performance Bond @ 1.5%			0.015		$31,958.15

TOTAL CONSTRUCTION COST = $2,588,609.75

AVERAGE COST PER LINEAL FT = $1,501

1725 Lineal Ft (Station 0+75 to 9+50, Station 13+50 to 22+00)

	Project	Manitowoc Riverwalk - New Seawall Option				
	Owner	City of Manitowoc, WI				
AECOM						
	Construction Cost Estimate					
			By:	TAP	9/9/2014	
			Checked:	SRA	9/11/2014	
		ITEM	# OF UNITS	UNITS	UNIT PRICE	TOTAL COST OF ITEM
1	General Conditions	Superintendent	16	Week	$3,550.00	$56,800.00
		Job Trailer	4	Month	$768.00	$3,072.00
		Temporary Fencing at ends of site	1500	LF	$7.00	$10,500.00
		Mob/Demob (Barges,Backhoe, Trucks, Compactor)	1	LS	$100,000.00	$100,000.00
2	Existing Conditions	Clearing of Shoreline (from barge, 3 X WisDOT Ave Unit Price)	1.5	Acre	$9,000.00	$13,500.00
						$0.00
3	Concrete	Ovhd Light Pole Bases (6 ft. deep, at trailheads)	4	Each	$1,500.00	$6,000.00
		Reinforced Concrete Cap at top of new bulkhead	96	CY	$375.00	$36,000.00
4	Masonry					$0.00
5	Metals	W 14 X 43 waler	1725	LF	$130.00	$224,250.00
		PZ 22 Steel Sheet Piling	975	TON	$2,075.00	$2,023,125.00
6	Wood & Plastics					
7	Thermal & Moisture Protection					$0.00
8	Doors & Windows					$0.00
9	Finishes					$0.00
10	Specialties	Steel Railings with Stainless Cables along water-side of seawall	1725	LF	$300.00	$517,500.00
		Bollard Light Bases (on railings, 100 ft. intervals)	17	Each	$250.00	$4,250.00
11	Equipment					$0.00
12	Furnishings					$0.00
13	Special Construction	De-Watering (To Sanitary Sewer)	0	Day	$500.00	$0.00
14	Conveying Systems					$0.00
26	Electrical	City Purchase Ovhd Light Poles & Fixtures	4	Each	$4,000.00	$16,000.00
		Install Ovhd Light Poles and Fixtures	4	Each	$1,200.00	$4,800.00
		City Purchase Bollard Lights	17	Each	$2,500.00	$42,500.00
		Install Bollard Lights	17	Each	$750.00	$12,750.00
		3 inch Communications Conduit (2)	0	LF	$25.00	$0.00
		1 inch Power Conduit	1725	LF	$9.50	$16,387.50
		Connections/Wiring/Hookup	1	Each	$10,000.00	$10,000.00
31	Earthwork	Excavate for lower slope remediation riprap (1+50 to 3+50)	1111	CY	$6.00	$6,666.00
		Truck Excavated Material Offsite (40 mi Roundtrip)	1111	CY	$8.75	$9,721.25
		Disposal Fee (est)	1111	CY	$2.50	$2,777.50
		Soil Anchors @ 7'-6 3/8" oc	230	Each	$6,500.00	$1,495,000.00
		Backfill behind new bulkhead - crushed stone	45390	Ton	$15.00	$680,850.00
		SAS Geotextile	2683	SY	$2.50	$6,707.50
		Compacted Gravel Pavement Surface (8' Thick)	932	Ton	$15.00	$13,980.00
		Grading/Topsoil for Walkway Shoulders	1157	CY	$25.00	$28,925.00
32	Exterior Improvements	Mechanical Seeding	67500	SF	$0.52	$35,100.00
		Erosion Control (Silt Fence)	1725	LF	$2.50	$4,312.50
		Turbidity Barrier	1725	LF	$70.00	$120,750.00
		Tracking Pad	2	Each	$3,000.00	$6,000.00
		General Cleanup/Restoration	1	Each	$10,000.00	$10,000.00
	SubTotal:					$5,518,224.25
	Contingency @ 20%			0.20		$1,103,644.85
	Performance Bond @ 1.5%			0.015		$82,773.36

TOTAL CONSTRUCTION COST = **$6,704,642.46**

AVERAGE COST PER LINEAL FT = $3,887

1725 Lineal Ft (Station 0+75 to 9+50, 13+50 to 22+00)

Project: Manitowoc Riverwalk - Existing Seawall Retrofit Option
Owner: City of Manitowoc, WI

AECOM

Construction Cost Estimate

By: TAP 9/4/2014
Checked: SRA 9/11/2014

	ITEM	# OF UNITS	UNITS	UNIT PRICE	TOTAL COST OF ITEM
1 General Conditions	Superintendent	4	Week	$3,550.00	$14,200.00
	Job Trailer	1	Month	$768.00	$768.00
	Temporary Fencing at ends of site	500	LF	$7.00	$3,500.00
	Mob/Demob (Barges,Backhoe, Trucks, Compactor)	1	LS	$75,000.00	$75,000.00
2 Existing Conditions	Clearing of Shoreline (from barge, 3 X WisDOT Ave Unit Price)	0.5	Acre	$9,000.00	$4,500.00
	Remove Existing waler from seawall and dispose	450	LF	$3.13	$1,408.50
3 Concrete	Ovhd Light Pole Bases (6 ft. deep, at trailheads)	1	Each	$1,500.00	$1,500.00
4 Masonry					$0.00
5 Metals	Place new waler	16	Ton	$525.00	$8,400.00
	Place new Helical anchors at 4' center	113	Each	$750.00	$84,750.00
6 Wood & Plastics					$0.00
7 Thermal & Moisture Protection					$0.00
8 Doors & Windows					$0.00
9 Finishes					$0.00
10 Specialties	Steel Railings with Stainless Cables along water-side of seawall	400	LF	$300.00	$120,000.00
	Bollard Light Bases (on railing, 100 ft. intervals)	4	Each	$250.00	$1,000.00
11 Equipment					$0.00
12 Furnishings					$0.00
13 Special Construction					$0.00
14 Conveying Systems					$0.00
26 Electrical	City Purchase Ovhd Light Poles & Fixtures	1	Each	$4,000.00	$4,000.00
	Install Ovhd Light Poles and Fixtures	1	Each	$1,200.00	$1,200.00
	City Purchase Bollard Lights	4	Each	$2,500.00	$10,000.00
	Install Bollard Lights	4	Each	$750.00	$3,000.00
	1 inch Power Conduit	400	LF	$9.50	$3,800.00
	Connections/Wiring/Hookup	1	Each	$2,000.00	$2,000.00
31 Earthwork	Excavate behind wall for helical anchor installation	1422	CY	$40.00	$56,880.00
	Backfill and compact excavated soil after helical anchor installation	1304	CY	$6.00	$7,824.00
	Crushed stone fill sta 9+50 to 10+50	150	Ton	$30.00	$4,500.00
	SAS Geotextile	622	SY	$2.50	$1,555.00
	Compacted Gravel Pavement Surface (8" Thick)	216	Ton	$15.00	$3,240.00
	Grading/Topsoil for Walkway Shoulders	111	CY	$25.00	$2,775.00
32 Exterior Improvements	Mechanical Seeding	6000	SF	$0.52	$3,120.00
	Erosion Control (Silt Fence)	400	LF	$2.50	$1,000.00
	Turbidity Barrier	400	LF	$70.00	$28,000.00
	Tracking Pad	1	Each	$3,000.00	$3,000.00
	General Cleanup/Restoration	1	Each	$5,000.00	$5,000.00
SubTotal:					$455,920.50
Contingency @ 20%			0.20		$91,184.10
Performance Bond @ 1.5%			0.015		$6,838.81

TOTAL CONSTRUCTION COST = $553,943.41

AVERAGE COST PER LINEAL FT = $1,385

400 Lineal Ft (Station 9+50 to 13+50)

Project: Manitowoc Riverwalk - Boardwalk (12 ft wide) w Riprap Option
Owner: City of Manitowoc, WI

AECOM

Construction Cost Estimate

By: TAP 9/4/2014
Checked: SRA 9/11/2014

	ITEM	# OF UNITS	UNITS	UNIT PRICE	TOTAL COST OF ITEM
1 General Conditions	Superintendent	16	Week	$3,550.00	$56,800.00
	Concrete Testing	0	Each	$30.00	$0.00
	Job Trailer	4	Month	$768.00	$3,072.00
	Temporary Fencing at ends of site	1500	LF	$7.00	$10,500.00
	Mob/Demob (Barges,Backhoe, Trucks, Compactor)	1	LS	$75,000.00	$75,000.00
2 Existing Conditions	Clearing of Shoreline (from barge, 3 X WisDOT Ave Unit Price)	2	Acre	$9,000.00	$18,000.00
3 Concrete	Ovhd Light Pole Bases (6 ft. deep, at trailheads)	4	Each	$1,500.00	$6,000.00
4 Masonry					$0.00
5 Metals					$0.00
6 Wood & Plastics	(2) 30' long 12" dia treated timber piles @ 10' centers	10,350	VLF	$55.00	$569,250.00
	(2) 12 ' long treated 3X12 Beams on pile pairs	12.4	MBF	$1,075.00	$13,330.00
	(2) 12 ' long treated 3X12 Cross-braces on pile pairs	12.4	MBF	$1,075.00	$13,330.00
	(10) 10' long treated 2X8 joists @ 16" centers, between pile pairs	22.9	MBF	$1,075.00	$24,617.50
	(21) 12' long 2X6 Composite decking between pile pairs	43.5	MBF	$1,650.00	$71,775.00
7 Thermal & Moisture Protection					$0.00
8 Doors & Windows					$0.00
9 Finishes					$0.00
10 Specialties	Steel Railings with Stainless Cables, both sides of Boardwalk	3450	LF	$300.00	$1,035,000.00
	Bollard Light Bases (on railings, 100 ft. intervals)	17	Each	$250.00	$4,250.00
11 Equipment					$0.00
12 Furnishings					$0.00
13 Special Construction					$0.00
14 Conveying Systems					$0.00
26 Electrical	City Purchase Ovhd Light Poles & Fixtures	4	Each	$4,000.00	$16,000.00
	Install Ovhd Light Poles and Fixtures	4	Each	$1,200.00	$4,800.00
	City Purchase Bollard Lights	17	Each	$2,500.00	$42,500.00
	Install Bollard Lights	17	Each	$750.00	$12,750.00
	1 inch Power Conduit	1750	LF	$9.50	$16,625.00
	Connections/Wiring/Hookup	1	Each	$10,000.00	$10,000.00
31 Earthwork	Excavatioe for lower slope remediation riprap)1+50 to 3+50)	1296	CY	$6.00	$7,776.00
	Truck Excavated Material Offsite (40 mi Roundtrip)	1296	CY	$8.75	$11,340.00
	Disposal Feel (est)	1296	CY	$2.50	$3,240.00
	Heavy Riprap	23194	Ton	$60.00	$1,391,640.00
	Rip Rap Bedding Stone	2473	Ton	$10.00	$24,730.00
	Grading/Topsoil for Walkway Shoulders	479	CY	$25.00	$11,975.00
32 Exterior Improvements	Mechanical Seeding	25875	SF	$0.52	$13,455.00
	Erosion Control (Silt Fence)	1725	LF	$2.50	$4,312.50
	Turbidity Barrier	1725	LF	$70.00	$120,750.00
	Tracking Pad	2	Each	$3,000.00	$6,000.00
	General Cleanup/Restoration	1	Each	$10,000.00	$10,000.00
SubTotal:					$3,608,818.00
Contingency @ 20%			0.20		$721,763.60
Performance Bond @ 1.5%			0.015		$54,132.27

TOTAL CONSTRUCTION COST = $4,384,713.87

AVERAGE COST PER LINEAL FT = $2,542

1725 Lineal Ft (Station 0+75 to 9+50, Station 13+50 to 22+00)

Project: Manitowoc Riverwalk - Cut Back Bank Slope Remediation Option
Owner: City of Manitowoc, WI

AECOM

Construction Cost Estimate

By: TAP 9/8/2014
Checked: SRA 9/11/2014

	ITEM	# OF UNITS	UNITS	UNIT PRICE	TOTAL COST OF ITEM
1 General Conditions	Superintendent	8	Week	$3,550.00	$28,400.00
	Job Trailer	2	Month	$768.00	$1,536.00
	Temporary Fencing at ends of site	1500	LF	$7.00	$10,500.00
	Mob/Demob (Backhoe, Trucks, Compactor)	1	LS	$74,000.00	$74,000.00
2 Existing Conditions	Clearing of Upper Slope (6.7 X WisDOT Ave Unit Price)	2.3	Acre	$20,000.00	$46,000.00
3 Concrete					$0.00
4 Masonry					$0.00
5 Metals					$0.00
6 Wood & Plastics					$0.00
7 Thermal & Moisture Protection					$0.00
8 Doors & Windows					$0.00
9 Finishes					$0.00
10 Specialties					$0.00
11 Equipment					$0.00
12 Furnishings					$0.00
13 Special Construction					$0.00
14 Conveying Systems					$0.00
26 Electrical					$0.00
31 Earthwork	Excavate to 2H/1V Slope	60900	CY	$6.00	$365,400.00
	Truck Offsite (40 mi Roundtrip)	60900	CY	$8.75	$532,875.00
	Disposal Fee (est)	60900	CY	$2.50	$152,250.00
32 Exterior Improvements	Mechanical Seeding	57750	SF	$0.52	$30,030.00
	Erosion Slope Matting	6416	SYD	$3.50	$22,456.00
	Erosion Control (Silt Fence)	1050	LF	$2.50	$2,625.00
	Tracking Pad	1	Each	$3,000.00	$3,000.00
	General Cleanup/Restoration	1	Each	$10,000.00	$10,000.00
SubTotal:					$1,279,072.00
Contingency @ 20%			0.20		$255,814.40
Performance Bond @ 1.5%			0.015		$19,186.08

TOTAL CONSTRUCTION COST = $1,554,072.48

AVERAGE COST PER LINEAL FT = $1,480

	Project	Manitowoc Riverwalk - Soil Nailing Slope Remediation Option				
	Owner	City of Manitowoc, WI				
AECOM						
	Construction Cost Estimate					
			By:	TAP	9/8/2014	
			Checked:	SRA	9/11/2014	
		ITEM	# OF UNITS	UNITS	UNIT PRICE	TOTAL COST OF ITEM
1	General Conditions	Superintendent	8	Week	$3,550.00	$28,400.00
		Job Trailer	2	Month	$768.00	$1,536.00
		Temporary Fencing at ends of site	1500	LF	$7.00	$10,500.00
		Mob/Demob (Backhoe, Trucks, Compactor)	1	LS	$74,000.00	$74,000.00
2	Existing Conditions	Clearing of Upper Slope (6.7 X WisDOT Ave Unit Price)	2.3	Acre	$20,000.00	$46,000.00
3	Concrete					$0.00
4	Masonry					$0.00
5	Metals					$0.00
6	Wood & Plastics					$0.00
7	Thermal & Moisture Protection					$0.00
8	Doors & Windows					$0.00
9	Finishes					$0.00
10	Specialties					$0.00
11	Equipment					$0.00
12	Furnishings					$0.00
13	Special Construction					$0.00
14	Conveying Systems					$0.00
26	Electrical					$0.00
31	Earthwork	Place Soil Nails, drainage and shotcrete face (Vendor Unit Price)	57750	SFT	$36.00	$2,079,000.00
32	Exterior Improvements	Mechanical Seeding	10000	SFT	$0.52	$5,200.00
		Erosion Matting	6416	SYD	$3.50	$22,456.00
		Erosion Control (Silt Fence)	1050	LF	$2.50	$2,625.00
		Tracking Pad	1	Each	$3,000.00	$3,000.00
		General Cleanup/Restoration	1	Each	$10,000.00	$10,000.00
	SubTotal:					$2,282,717.00
	Contingency @ 20%			0.20		$456,543.40
	Performance Bond @ 1.5%			0.015		$34,240.76

TOTAL CONSTRUCTION COST = **$2,773,501.16**

AVERAGE COST PER LINEAL FT = $2,641

1050 Lineal Ft (Station 7+50 to 8+50, 12+50 to 22+00)

Project: Manitowoc Riverwalk - SRT Slope Remediation Option
Owner: City of Manitowoc, WI

AECOM

Construction Cost Estimate

By: TAP 9/8/2014
Checked: SRA 9/11/2014

	ITEM	# OF UNITS	UNITS	UNIT PRICE	TOTAL COST OF ITEM
1 General Conditions	Superintendent	8	Week	$3,550.00	$28,400.00
	Job Trailer	2	Month	$768.00	$1,536.00
	Temporary Fencing at ends of site	1500	LF	$7.00	$10,500.00
	Mob/Demob (Backhoe, Trucks, Compactor)	1	LS	$74,000.00	$74,000.00
2 Existing Conditions	Clearing of Upper Slope (6.7 X WisDOT Ave Unit Price)	2.3	Acre	$20,000.00	$46,000.00
3 Concrete					$0.00
4 Masonry					$0.00
5 Metals					$0.00
6 Wood & Plastics					$0.00
7 Thermal & Moisture Protection					$0.00
8 Doors & Windows					$0.00
9 Finishes					$0.00
10 Specialties					$0.00
11 Equipment					$0.00
12 Furnishings					$0.00
13 Special Construction					$0.00
14 Conveying Systems					$0.00
26 Electrical					$0.00
31 Earthwork	Place SRT System (Vendor Unit Price)	57750	SFT	$13.00	$750,750.00
32 Exterior Improvements	Mechanical Seeding	57750	SFT	$0.52	$30,030.00
	Erosion Matting	6416	SYD	$3.50	$22,456.00
	Erosion Control (Silt Fence)	1050	LF	$2.50	$2,625.00
	Tracking Pad	1	Each	$3,000.00	$3,000.00
	General Cleanup/Restoration	1	Each	$10,000.00	$10,000.00
SubTotal:					$979,297.00
Contingency @ 20%			0.20		$195,859.40
Performance Bond @ 1.5%			0.015		$14,689.46

TOTAL CONSTRUCTION COST = $1,189,845.86

AVERAGE COST PER LINEAL FT = $1,133

1050 Lineal Ft (Station 7+50 to 8+50, 12+50 to 22+00)

Project: Manitowoc Riverwalk - "Living Wall" Slope Remediation Option
Owner: City of Manitowoc, WI

AECOM

Construction Cost Estimate

By: TAP 9/16/2014
Checked: SRA 9/XX/2014

	ITEM	# OF UNITS	UNITS	UNIT PRICE	TOTAL COST OF ITEM
1 General Conditions	Superintendent	8	Week	$3,550.00	$28,400.00
	Job Trailer	2	Month	$768.00	$1,536.00
	Temporary Fencing at ends of site	1500	LF	$7.00	$10,500.00
	Mob/Demob (Backhoe, Trucks, Compactor)	1	LS	$74,000.00	$74,000.00
2 Existing Conditions	Clearing of Upper Slope (6.7 X WisDOT Ave Unit Price)	2.3	Acre	$20,000.00	$46,000.00
3 Concrete					$0.00
4 Masonry					$0.00
5 Metals					$0.00
6 Wood & Plastics					$0.00
7 Thermal & Moisture Protection					$0.00
8 Doors & Windows					$0.00
9 Finishes					$0.00
10 Specialties					$0.00
11 Equipment					$0.00
12 Furnishings					$0.00
13 Special Construction					$0.00
14 Conveying Systems					$0.00
26 Electrical					$0.00
31 Earthwork	Excavate into slope to replace soils with backfill and reinforcement	60000	CY	$6.00	$360,000.00
	Truck Offsite (40 mi Roundtrip)	60000	CY	$8.75	$525,000.00
	Disposal Fee (est)	60000	CY	$2.50	$150,000.00
	Temporary Earth Retention during excavaton and backfilling	55000	SFT	$10.00	$550,000.00
	Living Wall System (Vendor Unit Price): Polypropelene Socks, Geogrid Reinforcement, Granular Backfill, Vegatation	57750	SFT	$40.00	$2,310,000.00
32 Exterior Improvements	Erosion Control (Silt Fence)	1050	LF	$2.50	$2,625.00
	Tracking Pad	1	Each	$3,000.00	$3,000.00
	General Cleanup/Restoration	1	Each	$10,000.00	$10,000.00
SubTotal:					$4,071,061.00
Contingency @ 20%			0.20		$814,212.20
Performance Bond @ 1.5%			0.015		$61,065.92

TOTAL CONSTRUCTION COST = $4,946,339.12

AVERAGE COST PER LINEAL FT = $4,711

1050 Lineal Ft (Station 7+50 to 8+50, 12+50 to 22+00)

PROJECT: Manitowoc Riverwalk
PROJECT NO.: 60317415
SUBJECT: Cross Section 1

SOIL BORING: B-1

ANALYSIS TYPE: Morgenstern-Price
ANALYSIS CONDITION: Existing Conditions-Drained

ORIGINATED BY: Allen, Shannon
DATE: 5/27/2014
CHECKED BY: Thomas, Jeremy
DATE: 5/27/2014
APPROVED BY: Thomas, Jeremy
DATE: 5/27/2014

Name: Topsoil-ML Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion': 0 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: SP-loose Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 0 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: CL-stiff Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: ML-medium dense Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 28 ° Phi-B: 0 ° Piezometric Line: 1
Name: SP-dense Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1
Name: ML-dense Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: SM-v. dense Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1
Name: GP-Ex. Dense Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 34 ° Phi-B: 0 ° Piezometric Line: 1
Name: ML (hardpan)-Ex. Dense Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 34 ° Phi-B: 0 ° Piezometric Line: 1

NOTES:
1) Factor of Safety: 0.854
2) Failure Surface Type: Entry and Exit
3) Direction of Movement: Right to Left

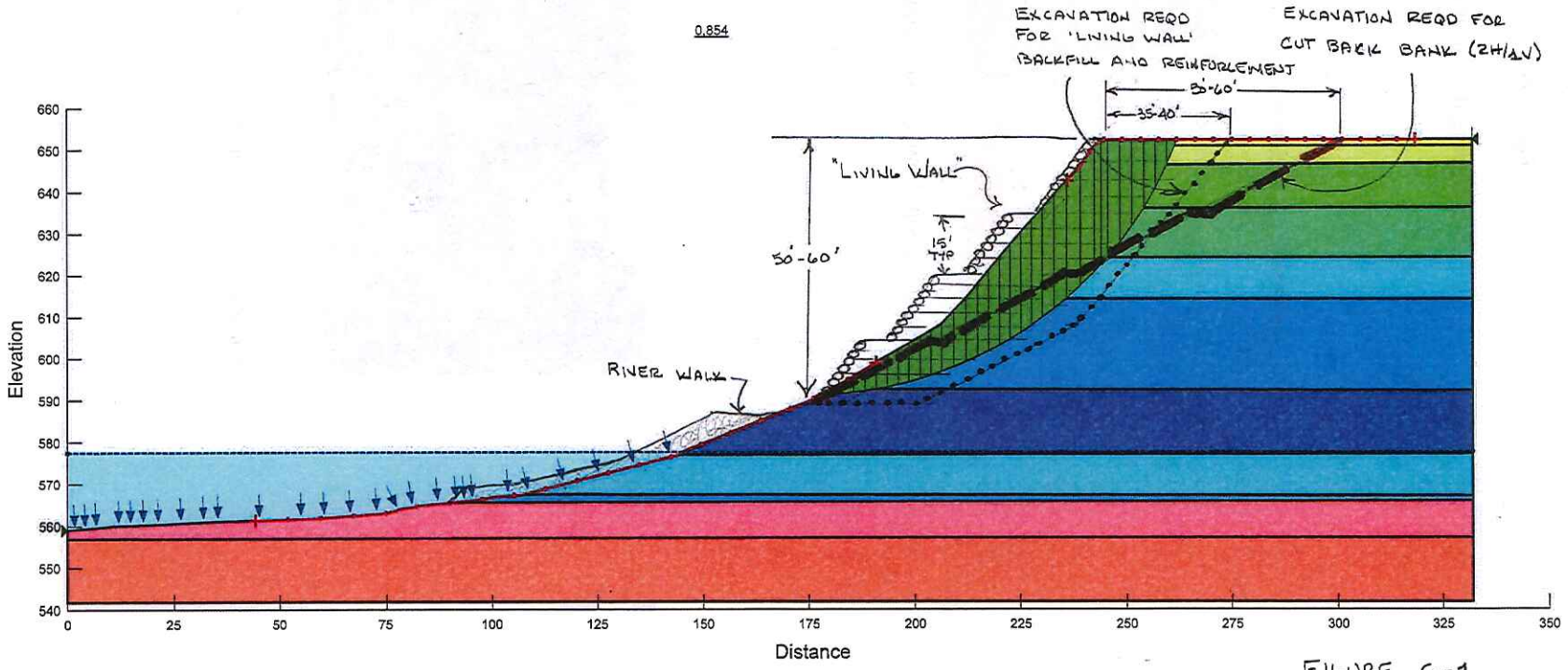
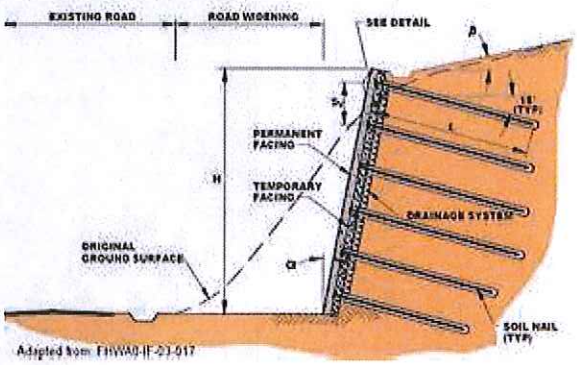


FIGURE G-1
CUT-BACK BANK & "LIVING WALL"

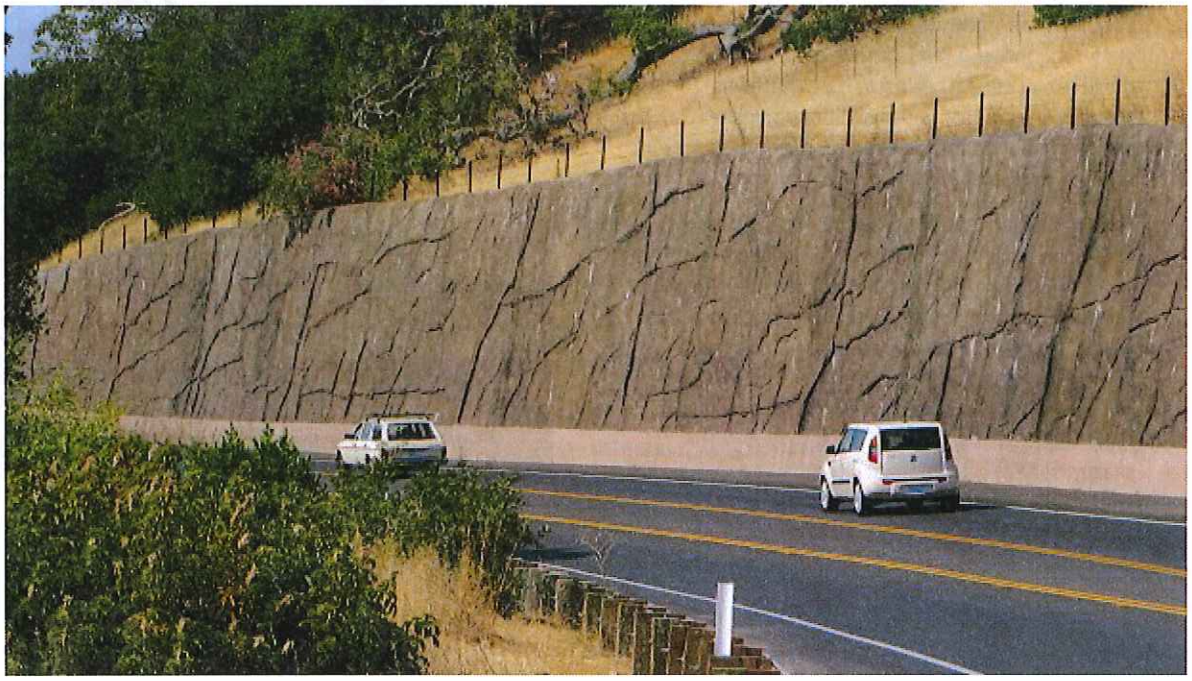
Figure G-2

Soil Nailing Information



Typical Section showing soil nailing components

Typical installation technique – track-mounted drill



Examples of wall finishes

THE GEOPIER SRT™ SYSTEM

SLOPE REINFORCEMENT TECHNOLOGY

Figure G-3
SRT Information

SRT™

The Geopier SRT™ system is an efficient and cost-effective solution for the stabilization of new slopes and active shallow slides. The patented system is comprised of Plate Pile™ elements– vertical steel reinforcements– that are rapidly driven through unstable soil into a competent layer. The Plate Pile elements are engineered into a staggered spacing based on slope grades and soil properties. The Plate Pile elements transmit slide forces to the underlying stiffer soil to resist lateral movements and increase the factor of safety against failure. Plate Pile installations are fast and allow for immediate stabilization without the need for massive earthwork and site disruption.

The Geopier SRT sytem is designed to stabilize slopes where the soil conditions consist of an upper relatively shallow zone of weathered, loose, soft or disturbed soil over a stronger zone of soil or soft rock located several feet below the slope surface. The closely spaced Plate Pile elements form a barrier where the soil arches between the plates and limits downslope movement. The Geopier SRT system is ideal for shallow slides or constrained sites.

ADVANTAGES OF THE SRT™ SYSTEM

- **PROVEN** Tens of thousands of Plate Pile elements have been installed on sites with historic landsliding and have been successful during heavy rainfalls.
- **ECONOMICAL** Geopier SRT provides measurable cost savings when compared traditional remove and replace.
- **FAST** Typical installation ranges from 100 - 400 Plate Pile elements per day.
- **AGILE** Plate Pile elements can be installed in tight sites and steep slope constraints that typically prohibit large equipment access.
- **CONVENIENT** Typical installation eliminates the need for lane closure do to equipment access.
- **ENGINEERED** Projects are engineered by Geopier Professional Engineers based on project specific grading, soil properties and site conditions.

THE INSTALLATION PROCESS

The Geopier SRT™ system is most commonly installed using machine or hand-operated impact hammers.

1. Plate Pile™ elements are arranged and installation sites are marked as predetermined based on slope steepness and soil conditions.
2. Plate Pile elements are driven one by one at an inclination of 3 to 5 degrees from vertical in the upslope direction to a depth of 12 to 18 inches below existing grade. Successive rows are staggered so that individual Plate Pile elements are centered between adjacent elements located in uphill and downhill rows.
3. Upon completion of the installation of Plate Pile elements, the slope surface is track rolled to remove any surface disturbance remaining from the installation operations. Erosion protection can be applied to the slope surface within 48 hours after the completion of the installation operations.

New Madrid, Ohio

Oakland, California

Salina, Utah

Danville, California

GEOPIER APPLICATIONS

The Geopier SRT system is one of many ground improvement solutions offered by Geopier. Geopier systems have become preferred replacements for traditional methods. Local Geopier engineers and representatives work with you and your specific soil conditions and loads to engineer a project-specific practical solution to improve your ground. With multiple systems we are able to engineer support for virtually any soil type and groundwater condition across many applications, including:

- Slope Stabilization
- Foundations
- Floor Slabs
- Industrial Facilities
- Storage Tanks
- Liquefaction Mitigation
- MSE Walls/Embankment Support
- Transportation
- Wind Turbines
- Uplift & Lateral Load Resistance

Geopier Foundation Company developed the Rammed Aggregate Pier (RAP) system to provide an efficient and cost effective Intermediate Foundation® solution for the support of settlement sensitive structures. Through continual research and development we've expanded our system capabilities to offer you more. Our design-build engineering support and site specific modulus testing combined with the experience of providing settlement control for thousands of projects provides an unmatched level of support and reliability to meet virtually all of your ground improvement challenges.

Work with regional engineers worldwide to solve your ground improvement challenges.

Tensar. | GEOPIER® FOUNDATIONS

130 Harbour Place Drive
Suite 280
Davidson, NC 28036
800.371.7470

geopier.com

Figure G-4

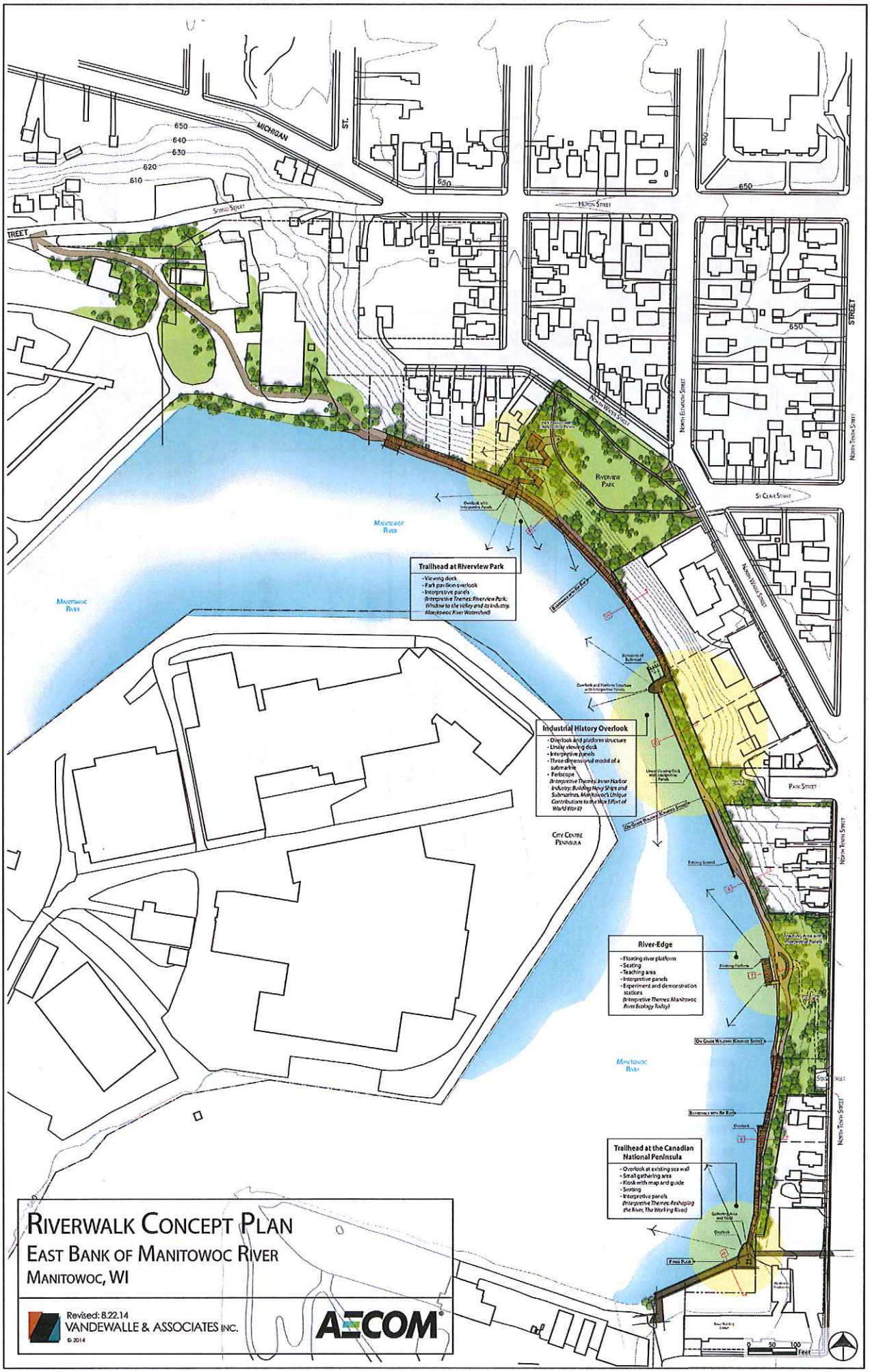
Living Wall Illustrations

Polypropylene socks filled and stacked

Geotextile/geogrid reinforcement

Finished slope Example

Finished Slope Example



Riverwalk Concept Plan

East Bank of Manitowoc River

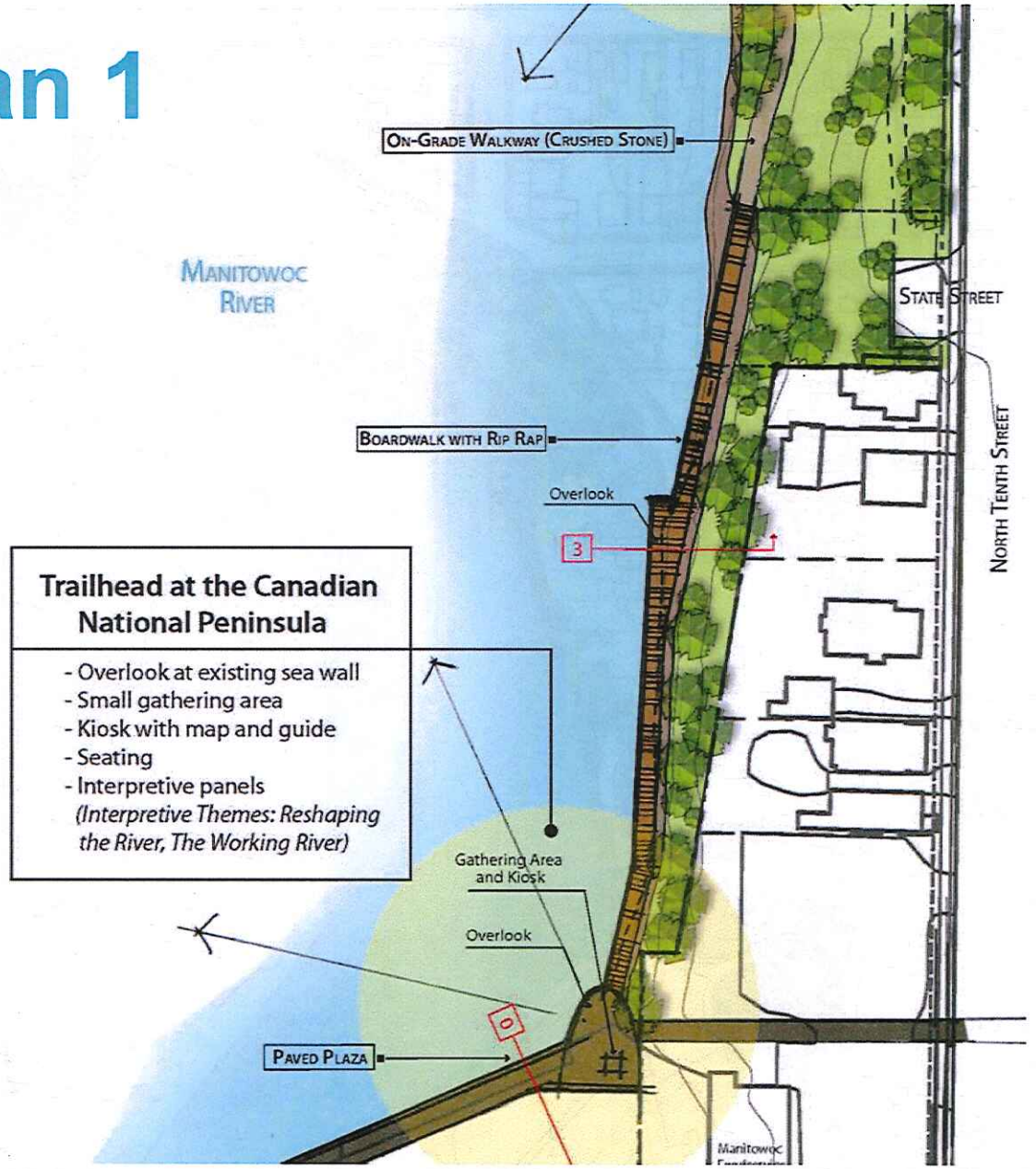
Manitowoc, WI

Revised: 8.22.14

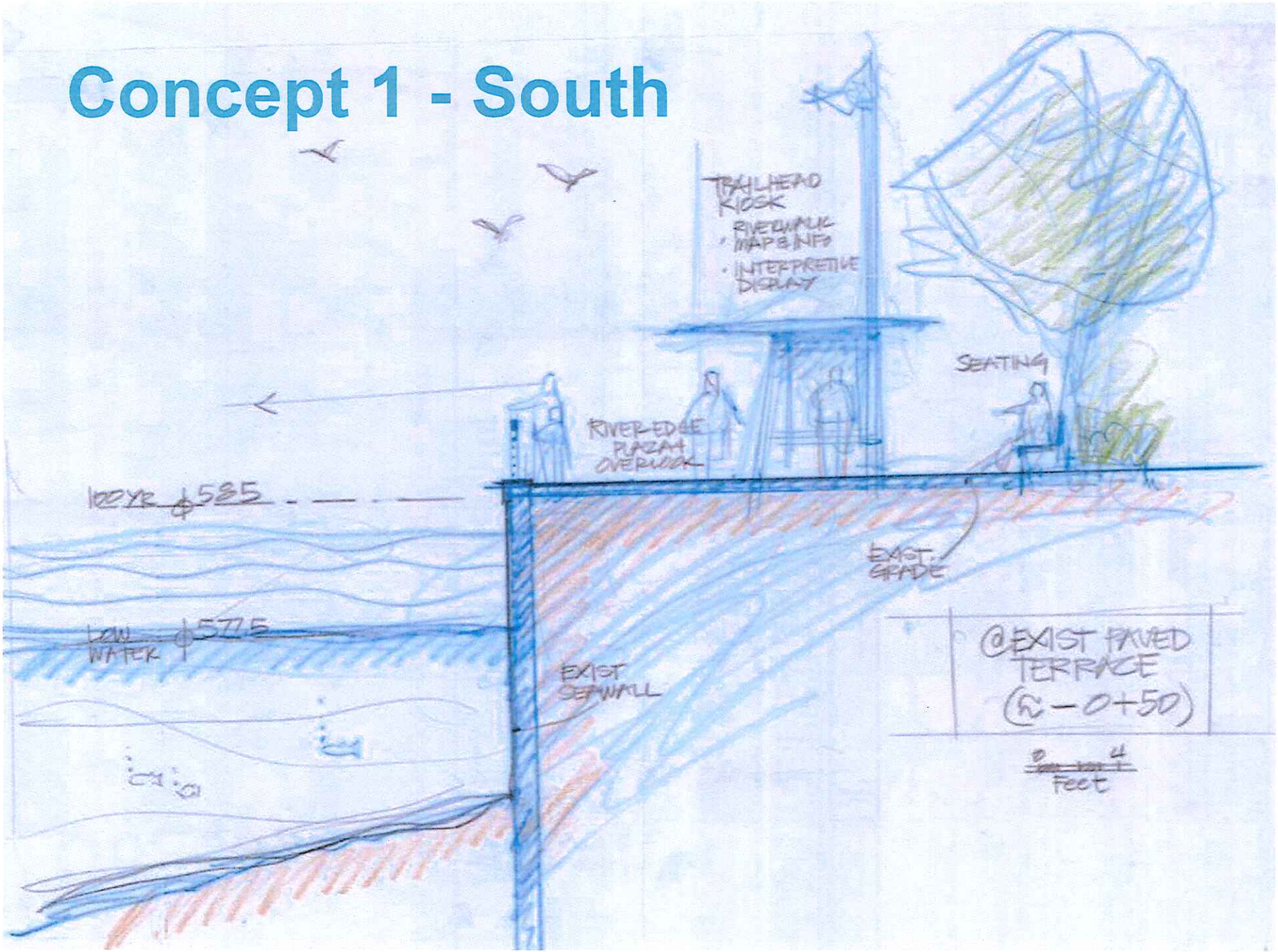
VANDEWALLE & ASSOCIATES INC.

AECOM

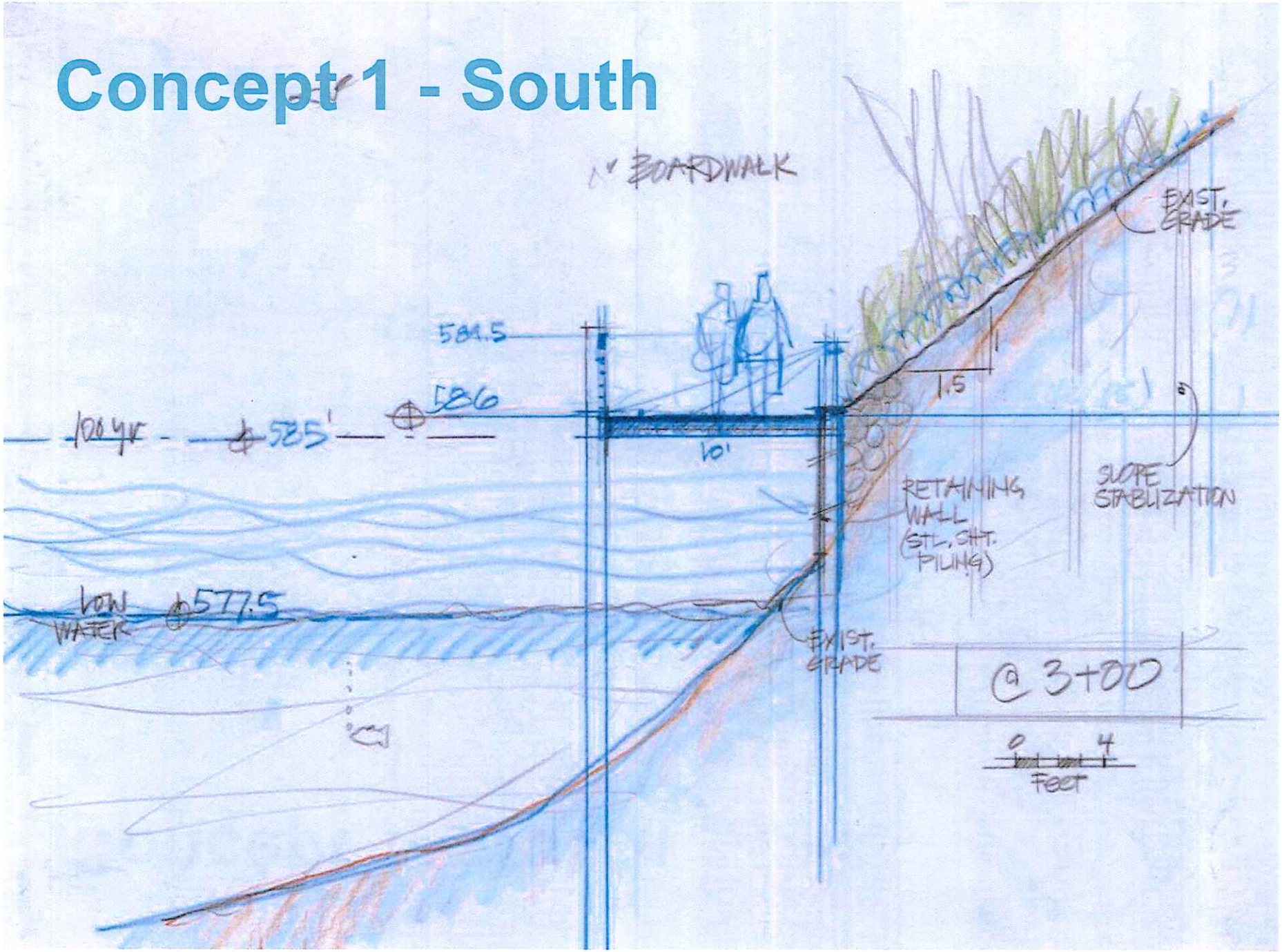
Concept Plan 1 South

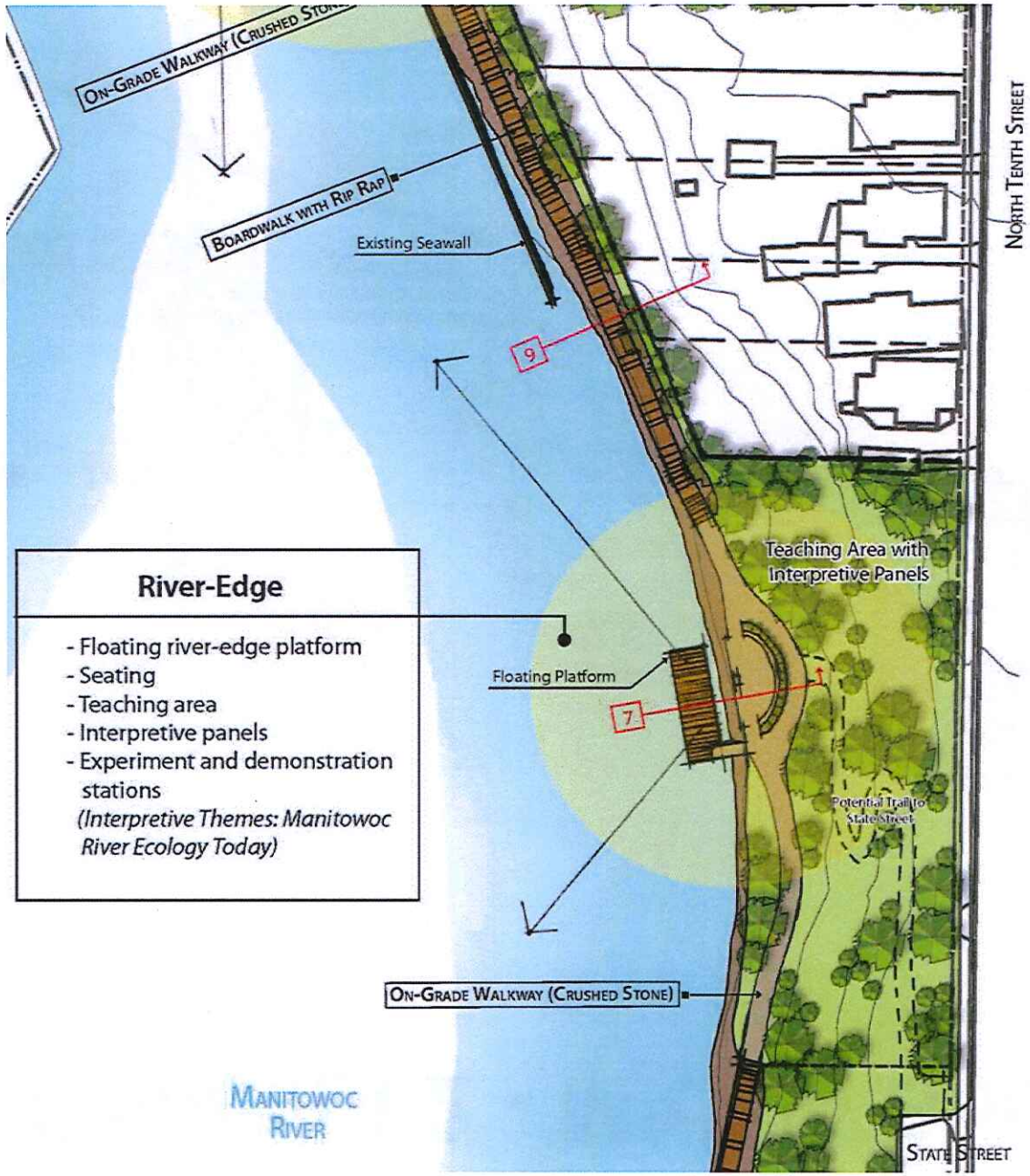


Concept 1 - South



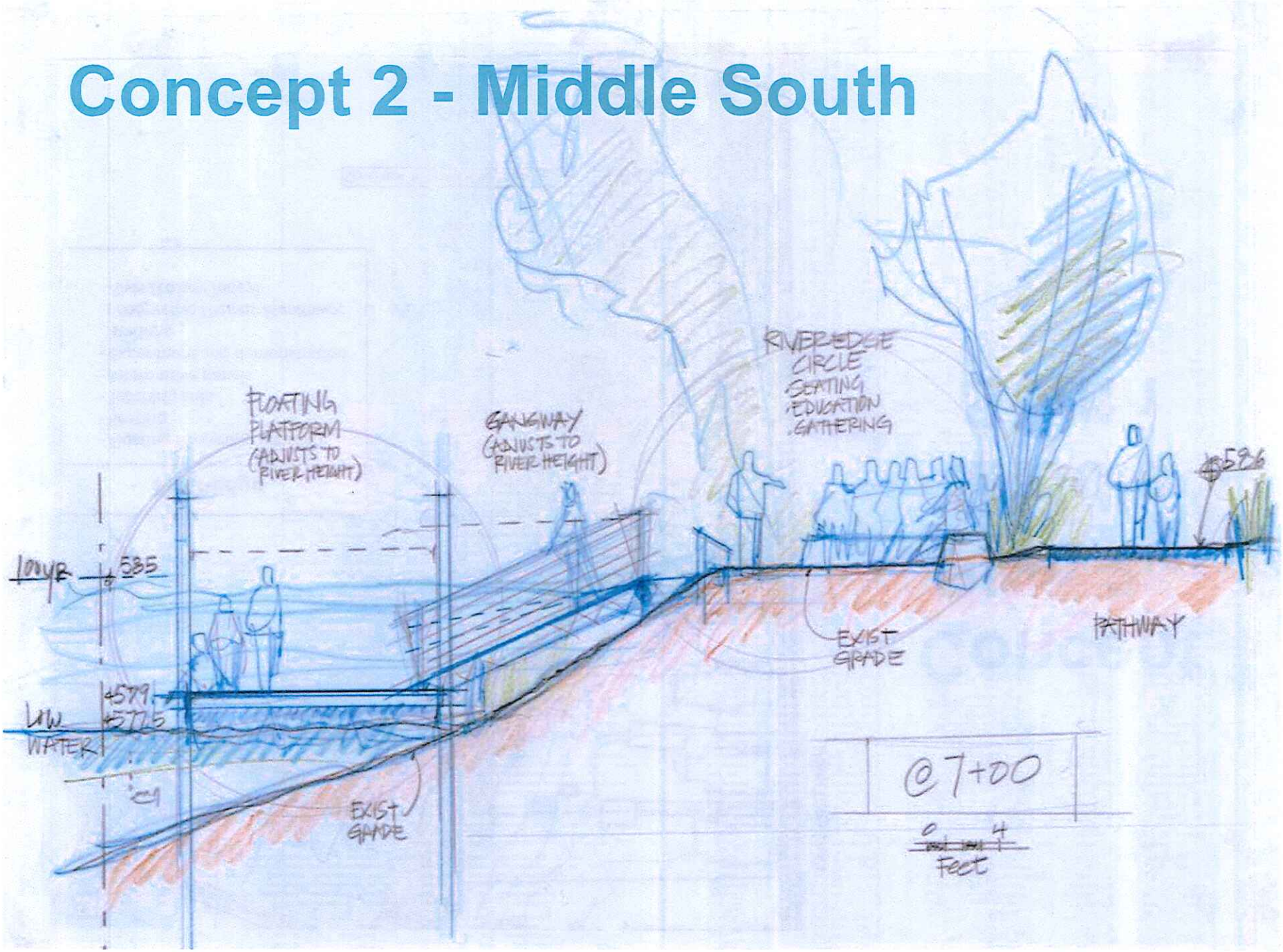
Concept 1 - South



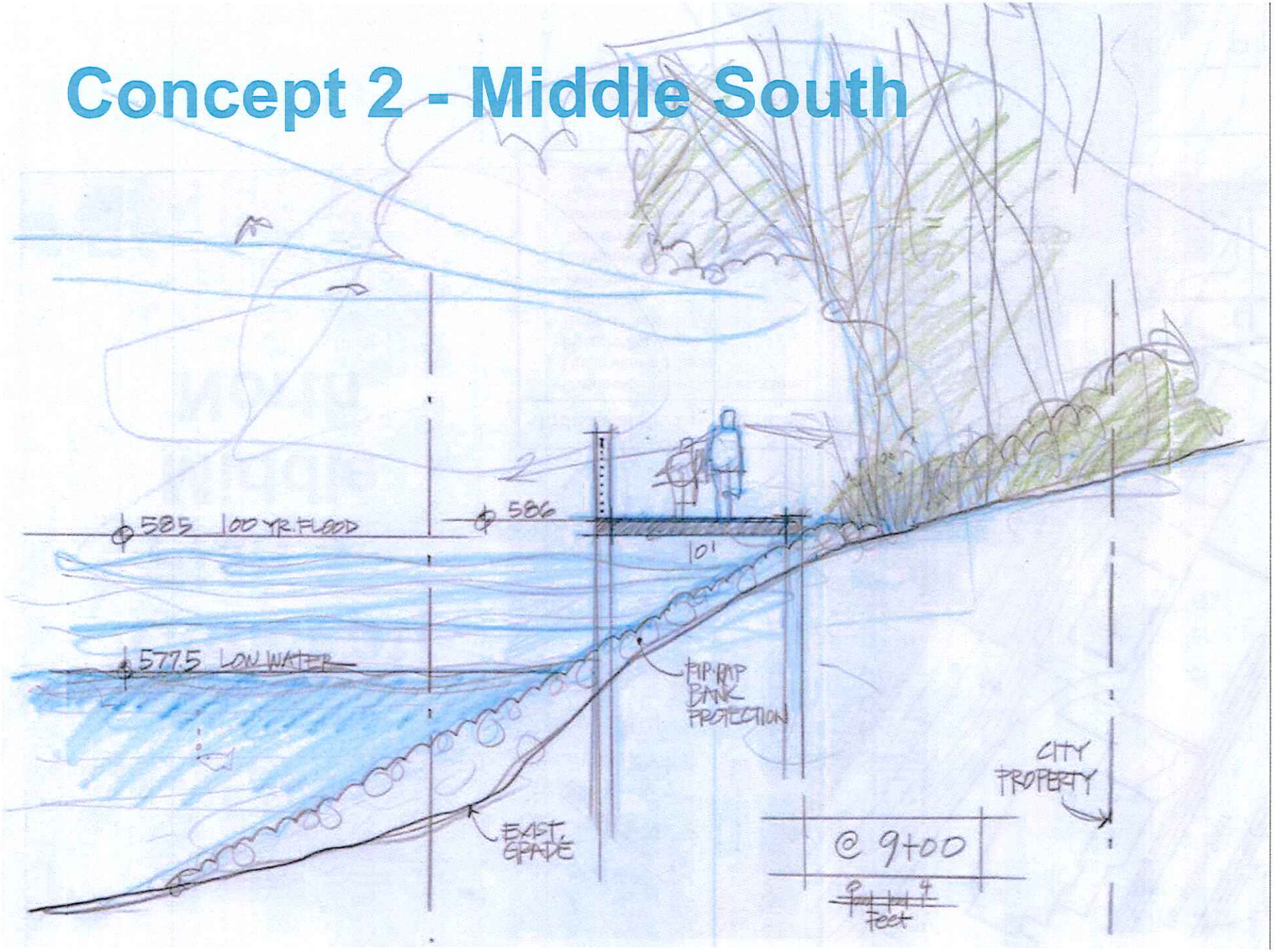


Concept Plan 2 - Middle South

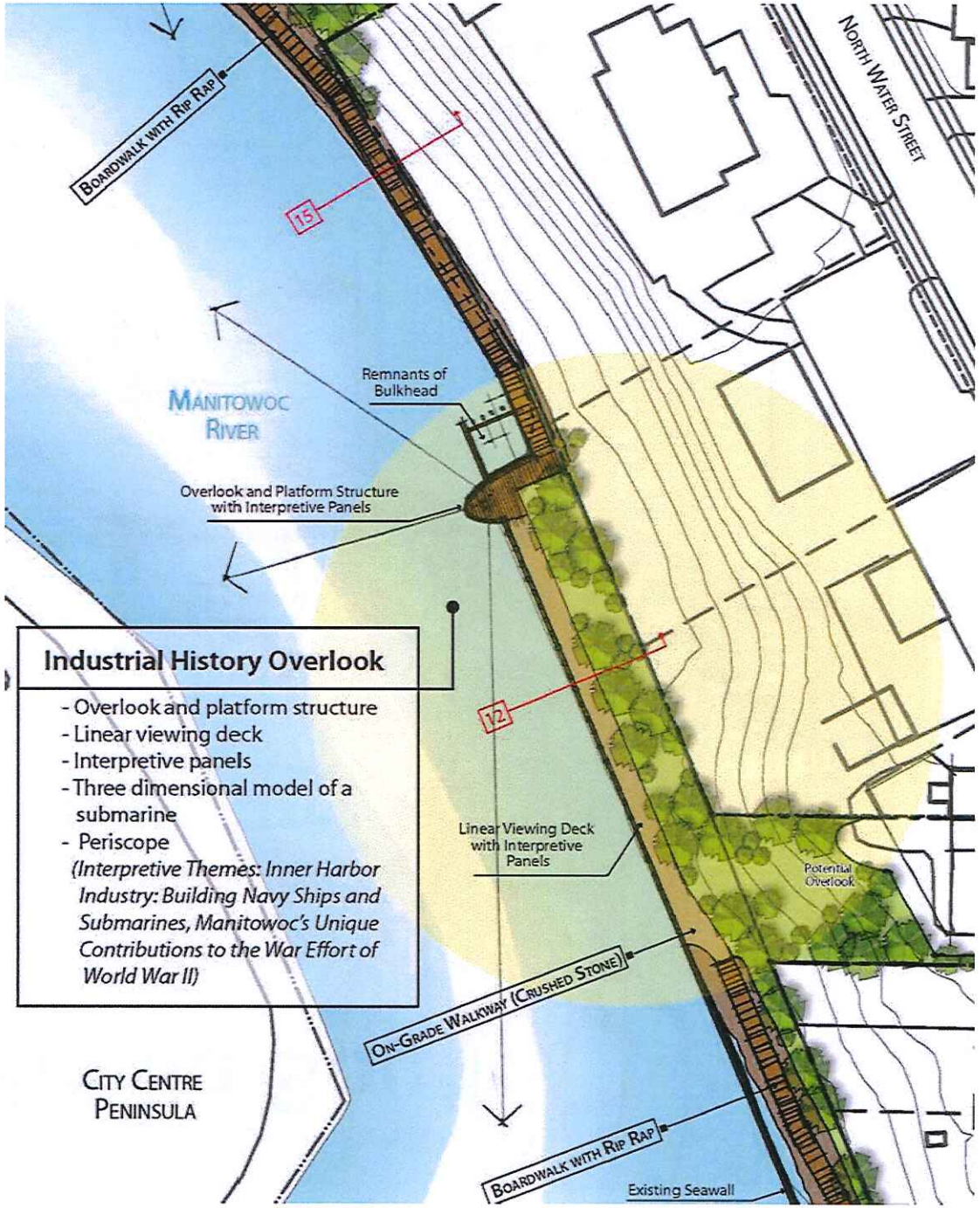
Concept 2 - Middle South



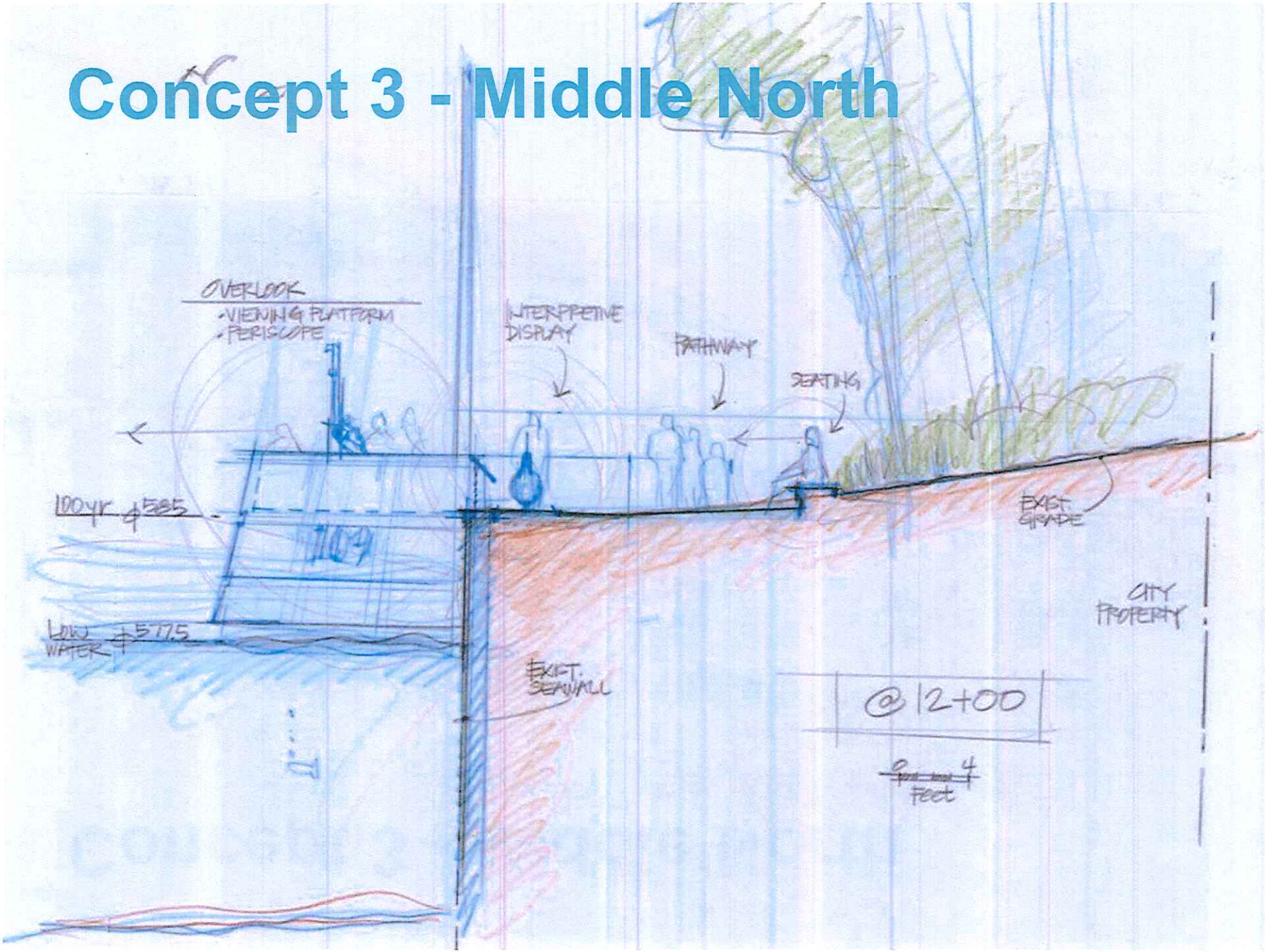
Concept 2 - Middle South



Concept Plan 3 - Middle North



Concept 3 - Middle North



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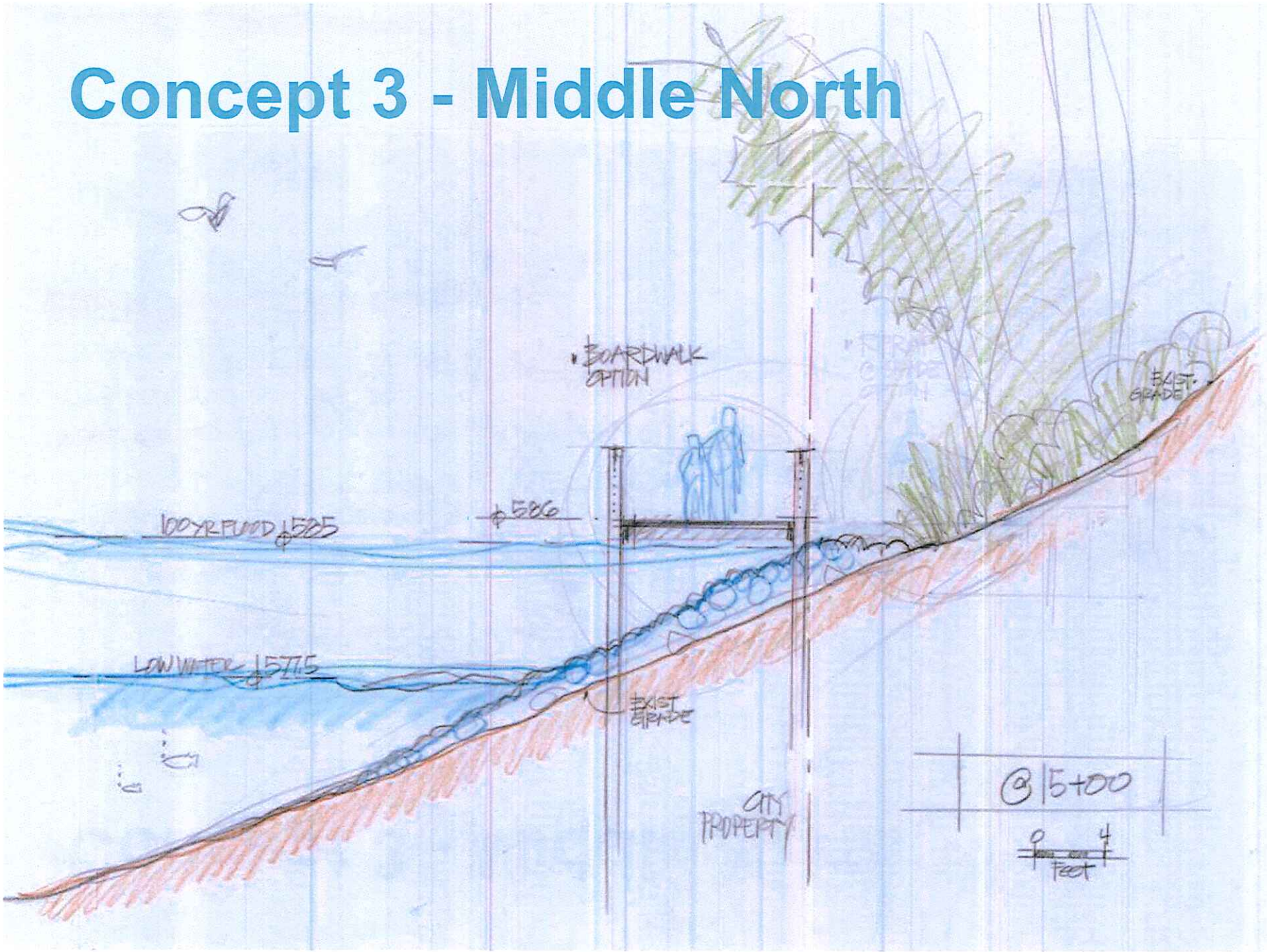
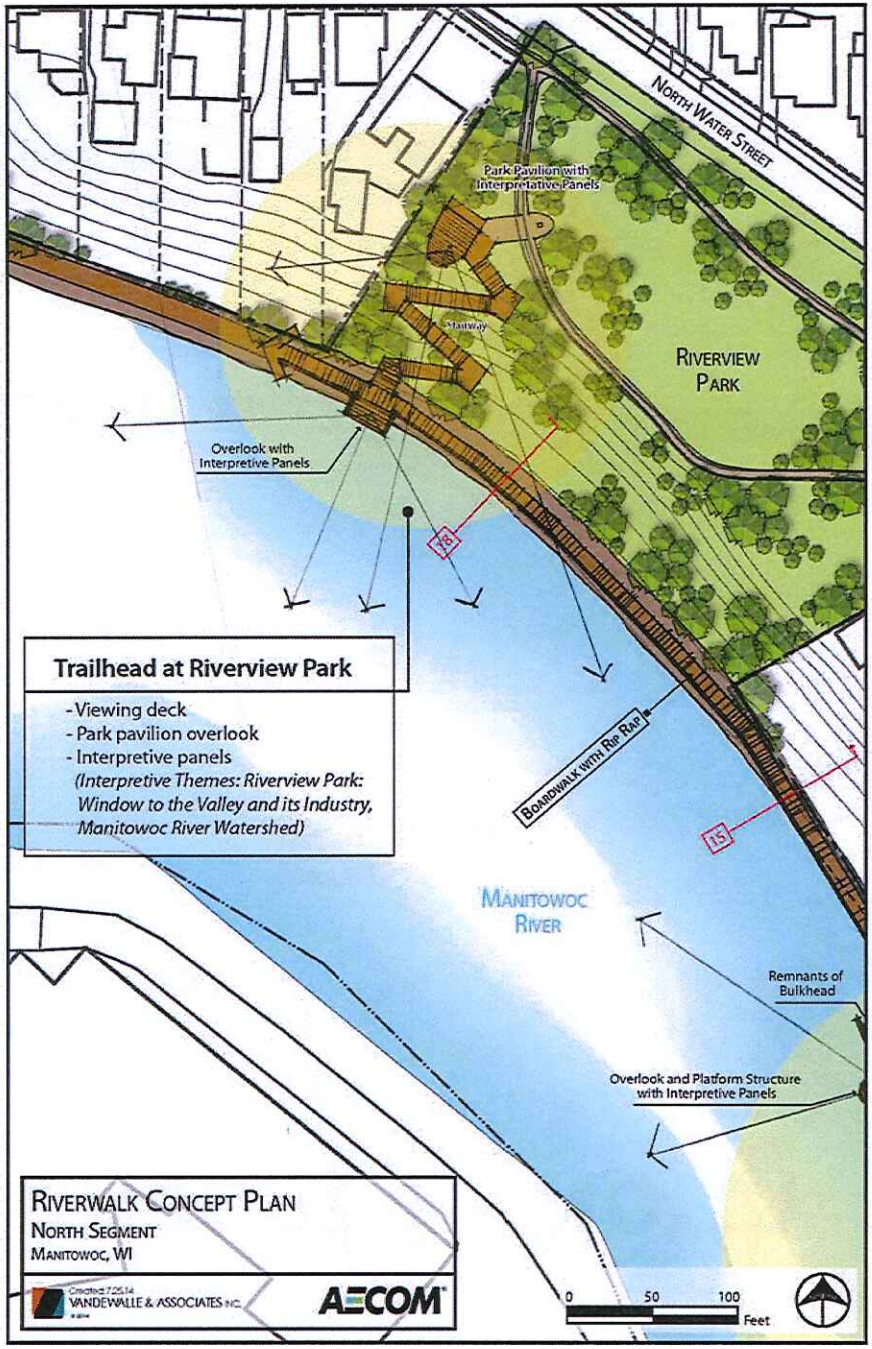
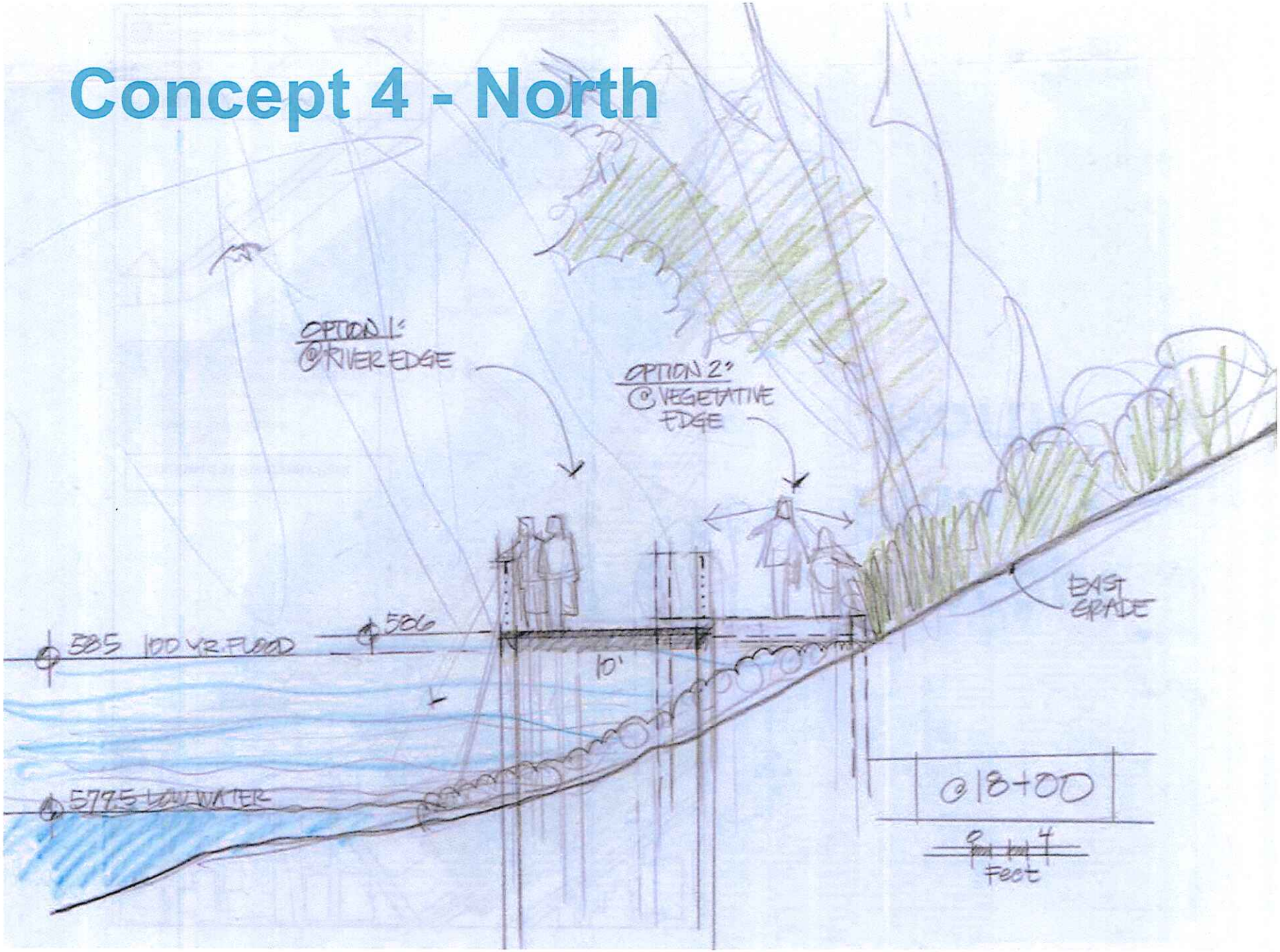
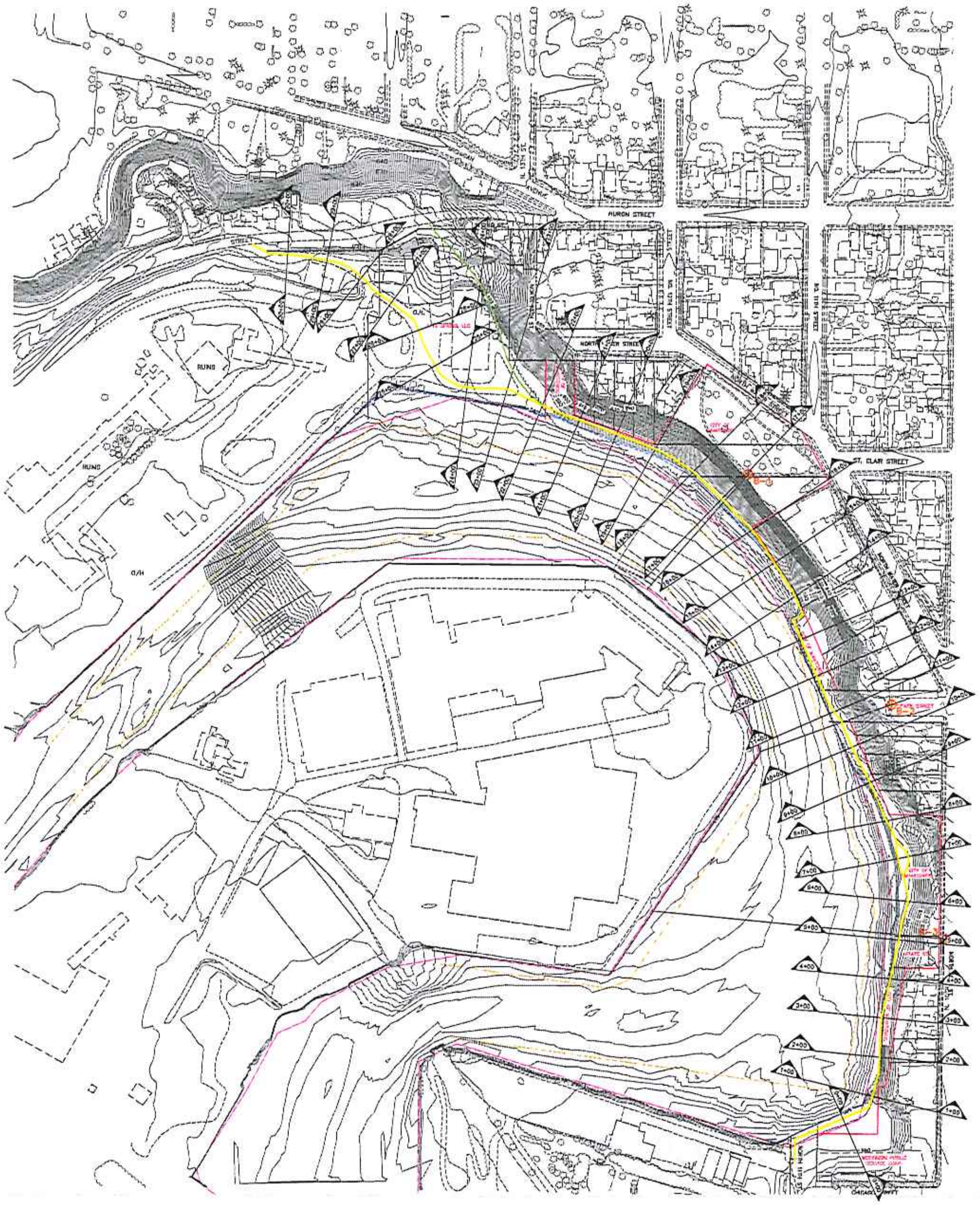




Concept Plan 4 - North

Concept 4 - North





1" = 100'

LEGEND

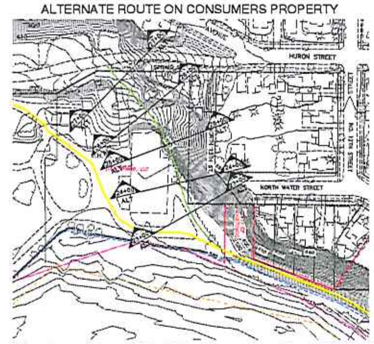
- RIGHT OF WAY
- CITY PROPERTY LINE
- PROPOSED RIVERWALK ALIGNMENT
- ALTERNATE RIVERWALK ALIGNMENT
- SHORELINE
- U.S. HARBOR CHANNEL LINE
- PIERHEAD BULKHEAD LINE
- 580 CONTOUR
- BUILDING
- ROAD/SIDEWALK
- BRUSH LINE
- TREE
- B-1 BORING LOCATION (APPROXIMATE)

NOTES

- REFERENCE TOPOGRAPHY AND PARCEL MAPPING PROVIDED BY THE CITY OF MANITOWOC
- RIVER BOTTOM CONTOURS PROVIDED FROM 2013 USACE SOUNDINGS AND 2014 AECOM BATHYMETRIC SURVEY
- PIERHEAD BULKHEAD LINE ESTABLISHED FROM USACE AND SMI SURVEY MAPS
- CHANNEL LINE ESTABLISHED BY COORDINATES SHOWN ON USACE MAPS
- EDGE OF WATER FROM CITY OF MANITOWOC AERIAL TOPOGRAPHY
- GROUND SURFACE ELEVATIONS REFERENCED TO NAVD88
- 100-YEAR FLOOD ELEVATION REFERENCED TO NAVD88
- LOW WATER DATUM (LWD) REFERENCED TO IGLD85

DATUM ADJUSTMENTS
0.00LWD = +577.5 IGLD85 = +577.96 NAVD88

ALTERNATE ROUTE ON CONSUMERS PROPERTY



AECOM

PROJECT
City of Manitowoc
River Walk

CLIENT
City of Manitowoc
900 Quay Street
Manitowoc, Wisconsin 54220

CONSULTANT
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www.vandewalle.com

REGISTRATION

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I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER
60317415

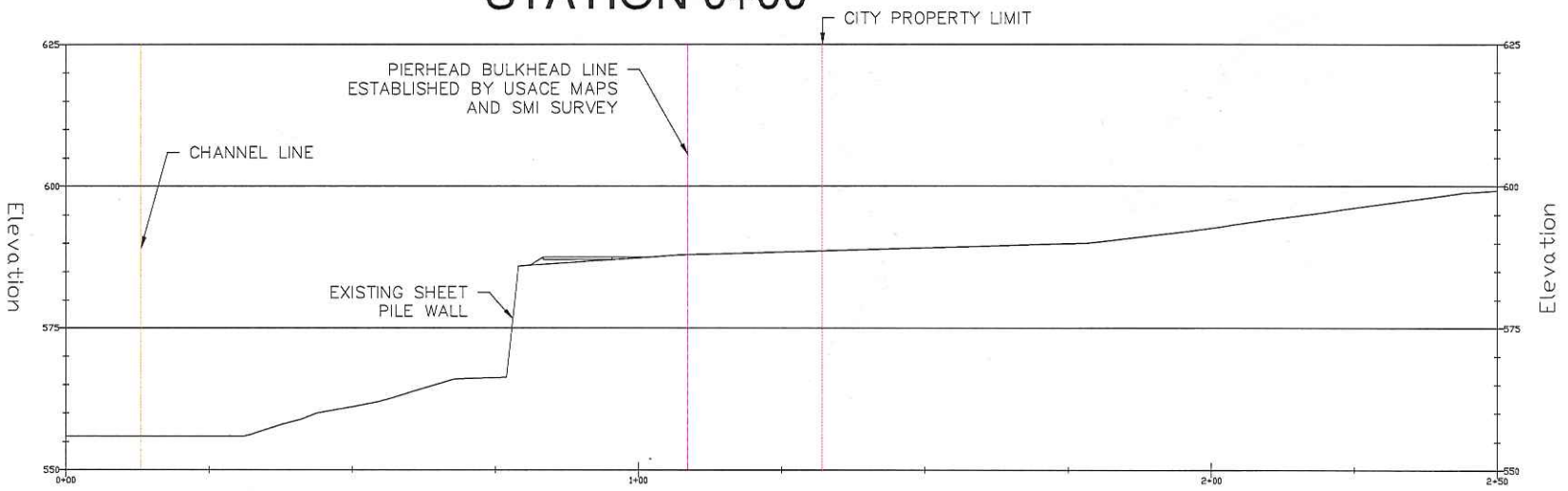
SHEET TITLE
SITE FEATURES DIAGRAM

SHEET NUMBER
FIGURE 3

Filename: \\USOSH1FP001\12PROJECTS\PROJECTS\60317415_MANITOWOC RIVERWALK PRELIM DESIGN\900-WORKING DOCS-CAD\COST ESTIMATE QUANTITIES\QUANTITIES.DWG Last saved by: KYLES1
Last Plotted: 2014.09.05

Project Management Initials: Designer: ____ Checked: ____ Approved: ____ ANSI D 22" x 34"

STATION 0+00



NOTES

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- 100-YEAR FLOOD ELEVATION REFERENCED TO NAVD88
- LOW WATER DATUM (LWD) REFERENCED TO IGLD85

DATUM ADJUSTMENTS
0.00LWD = +577.5 IGLD85 = +577.06 NAVD88

10 0 10 20
1" = 10'
HORIZONTAL AND VERTICAL
SCALE FOR CROSS SECTIONS

AECOM

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City of Manitowoc
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PROPOSED CROSS SECTIONS

SHEET NUMBER
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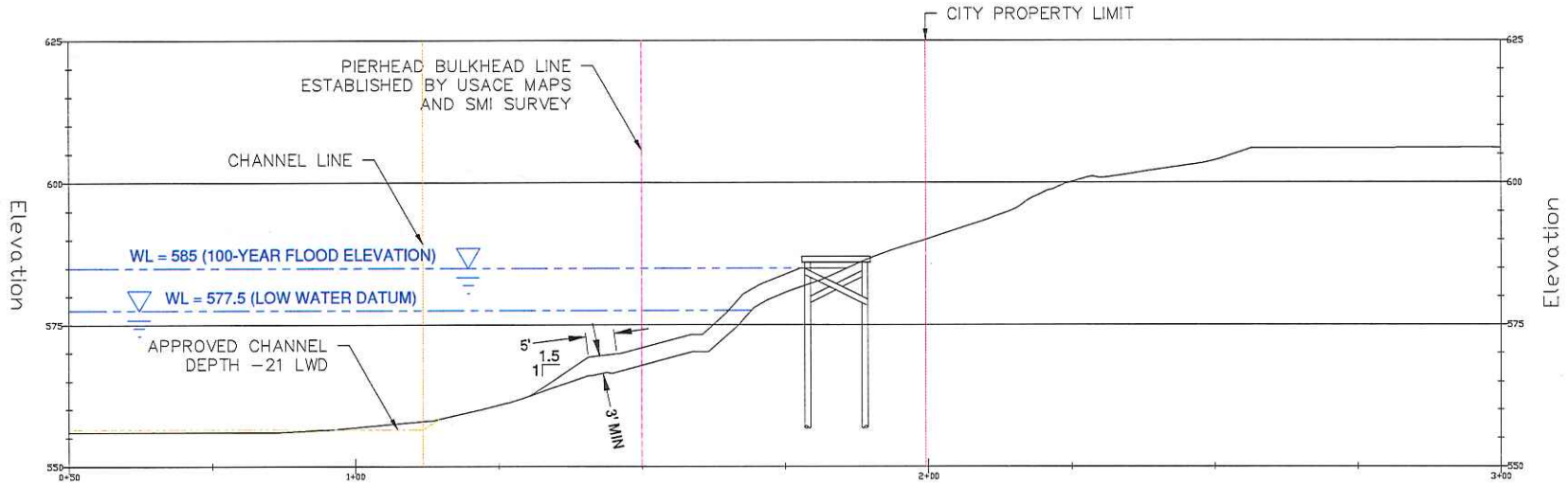

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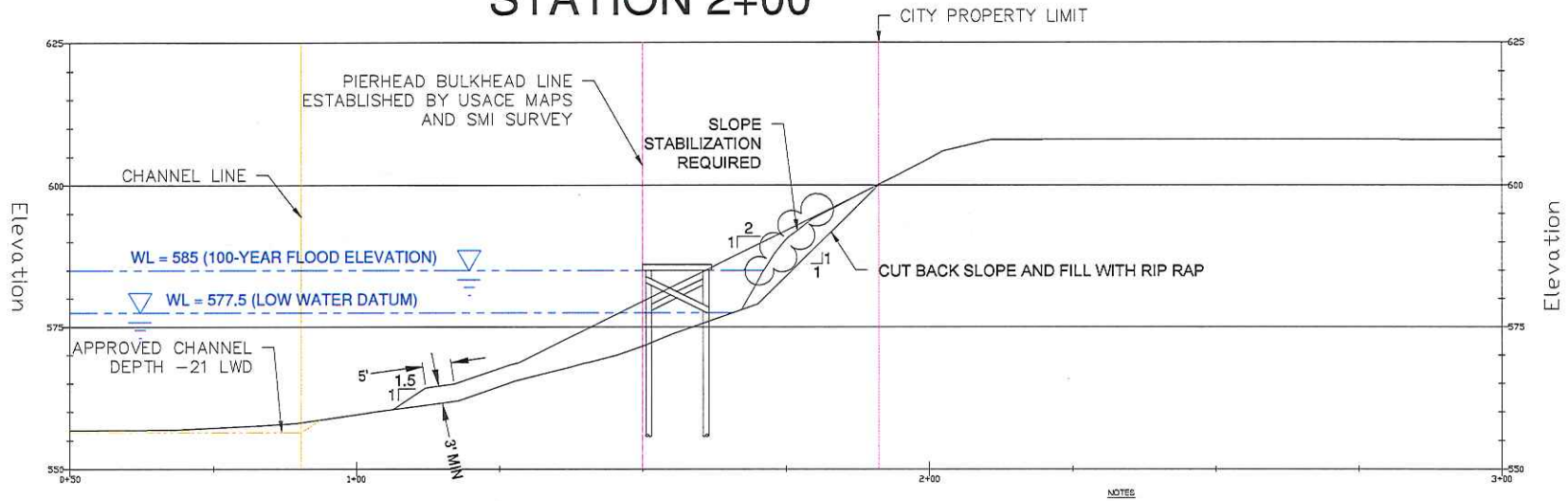

NOTES

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DATUM ADJUSTMENTS
0.00LWD = +577.5 IGLD85 = +577.66 NAVD88

10 0 10 20
1" = 10'
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SHEET TITLE
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SHEET NUMBER
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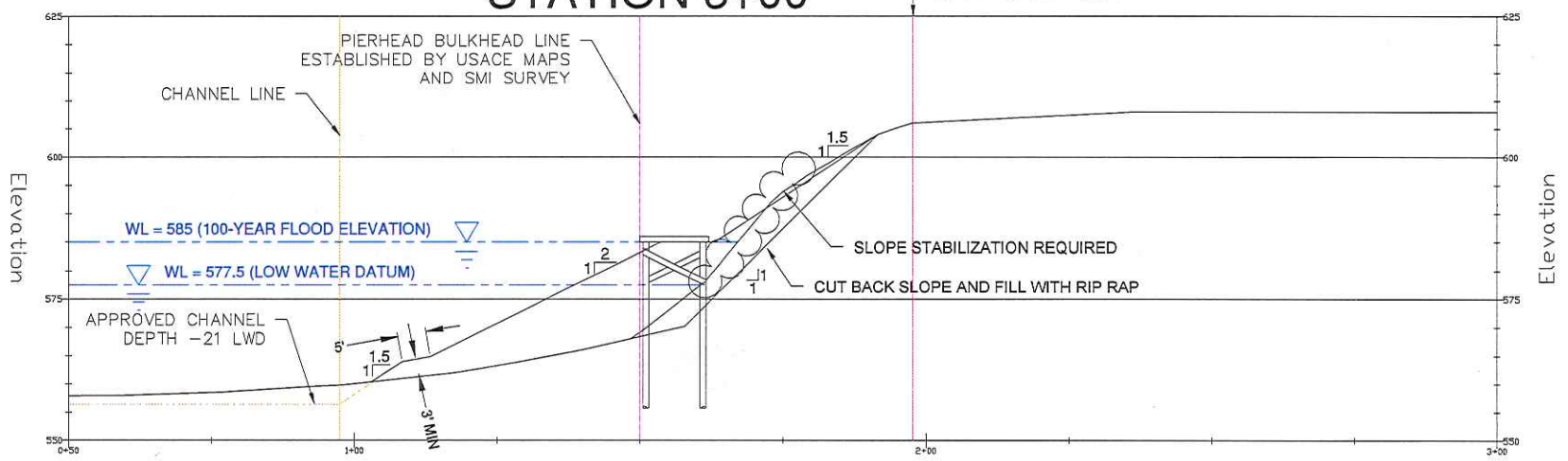

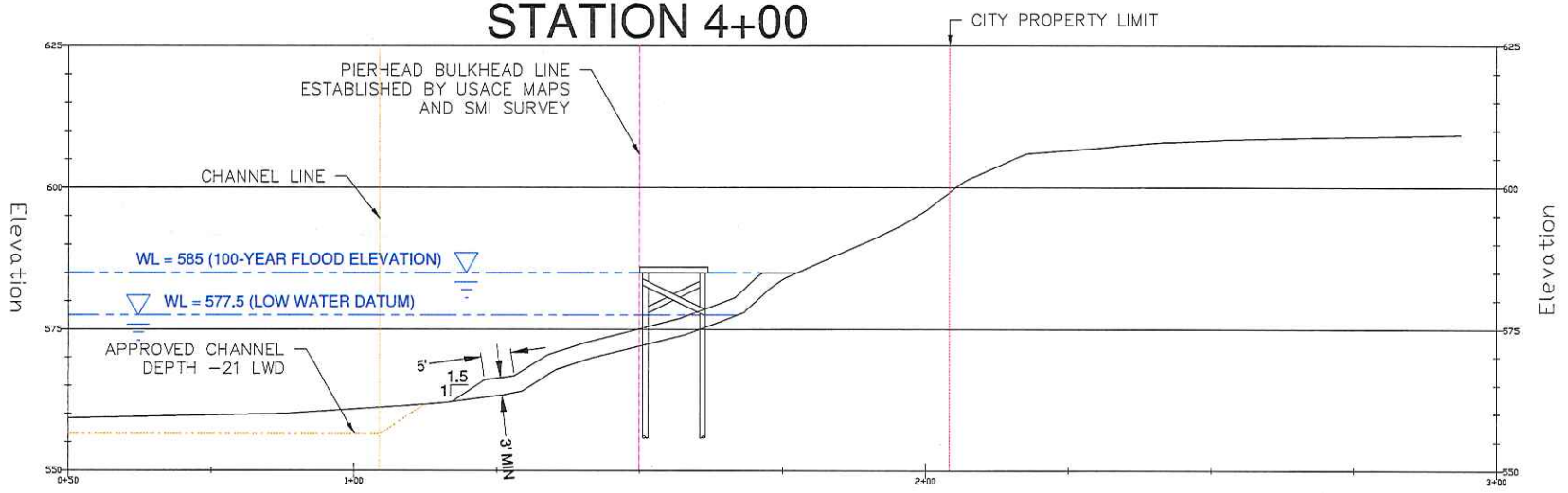

NOTES

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DATUM ADJUSTMENTS
0.00LWD = +577.5 IGLD85 = +577.86 NAVD88

10 0 10 20
1" = 10'
HORIZONTAL AND VERTICAL
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SHEET TITLE
PROPOSED CROSS SECTIONS

SHEET NUMBER
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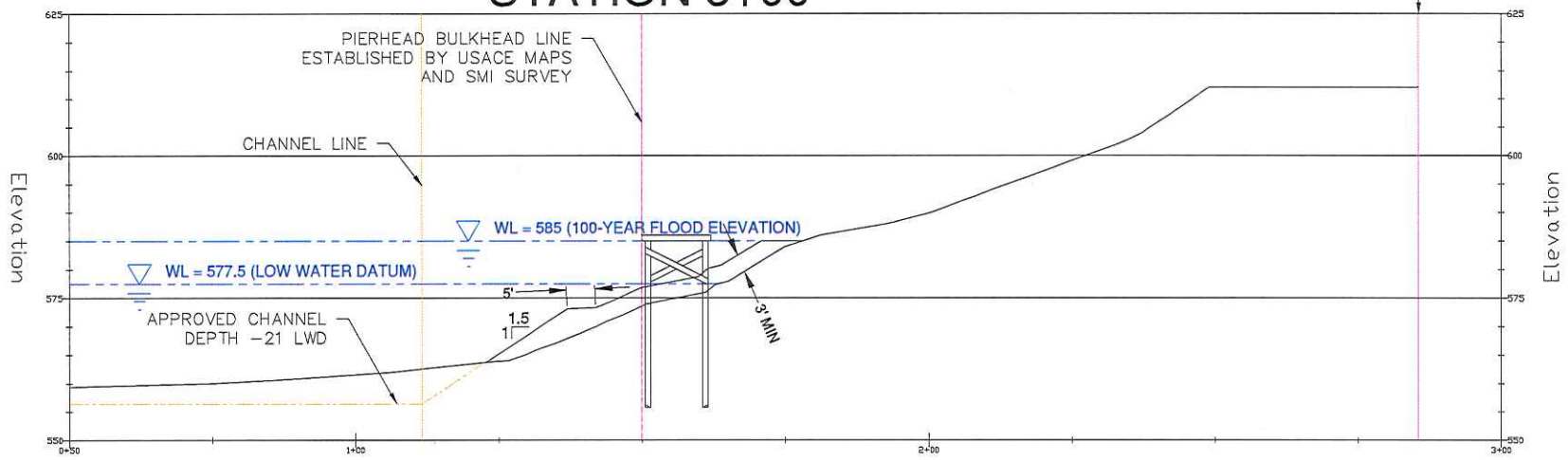

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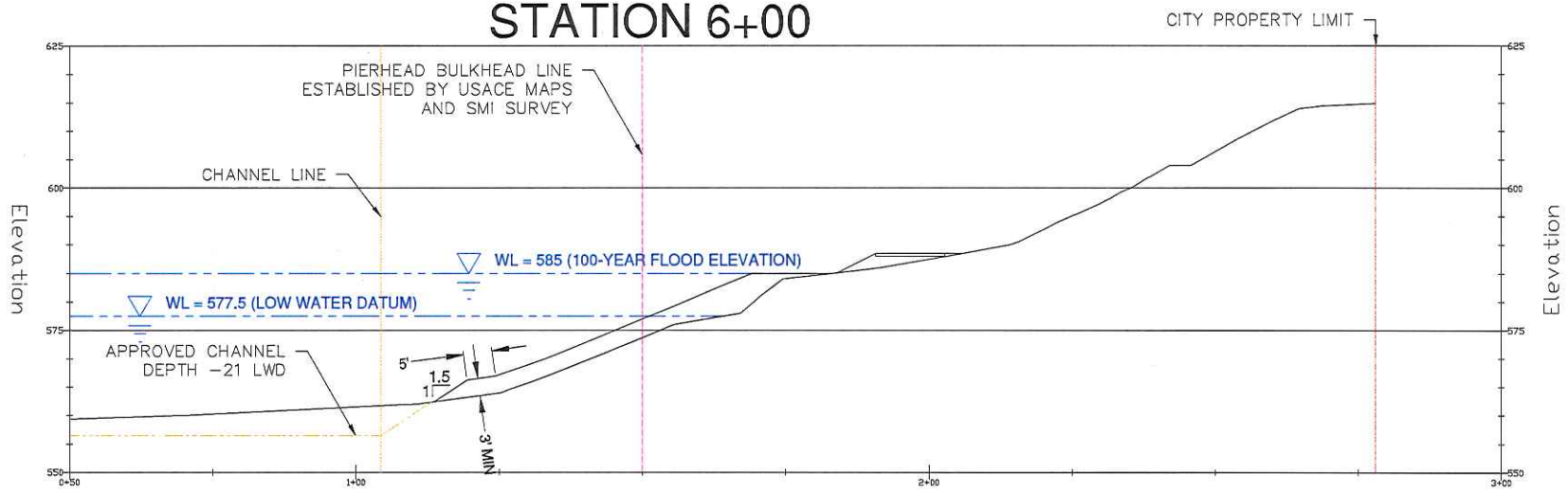

NOTES

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DATUM ADJUSTMENTS
0.0LWD = +577.5 IGLD85 = +577.05 NAVD88

10 0 10 20
1" = 10'
HORIZONTAL AND VERTICAL
SCALE FOR CROSS SECTIONS

AECOM

PROJECT
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River Walk

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SHEET TITLE
PROPOSED CROSS SECTIONS

SHEET NUMBER
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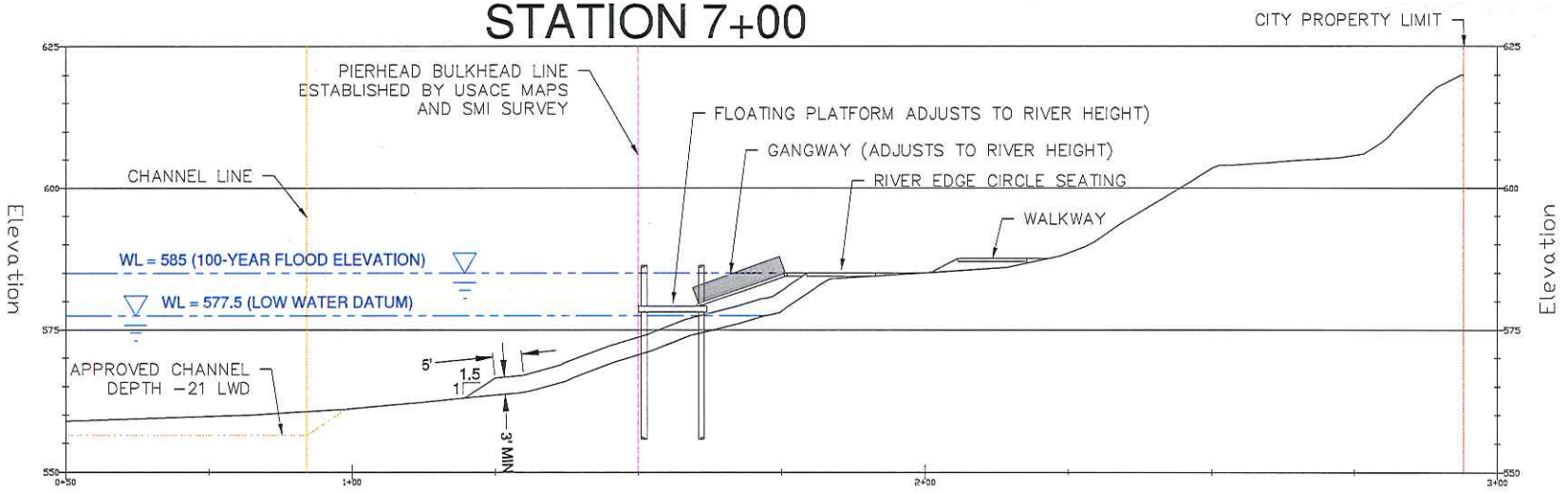

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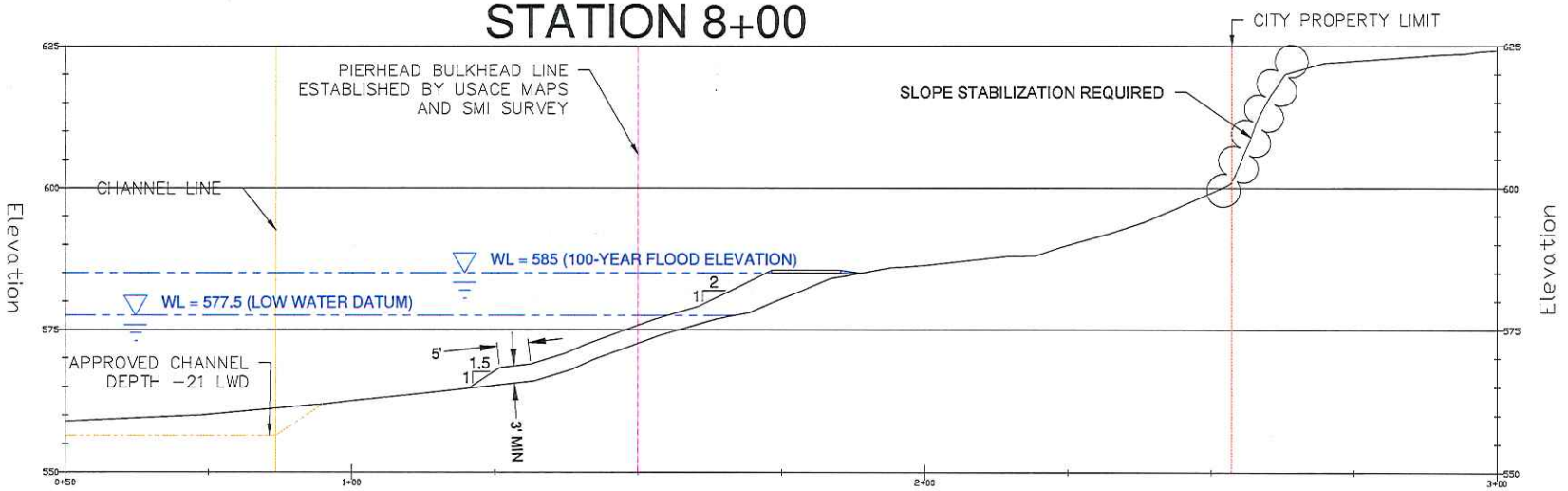

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- LOW WATER DATUM (LWD) REFERENCED TO IGLD85

DATUM ADJUSTMENTS
0.00LWD = +577.5 IGLD85 = +577.99 NAVD88

10 0 10 20
1" = 10'
HORIZONTAL AND VERTICAL SCALE FOR CROSS SECTIONS

AECOM

PROJECT
City of Manitowoc
River Walk

CLIENT
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AECOM
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Oshkosh, Wisconsin 54901
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(920) 235-0321 fax
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ISSUE/REVISION

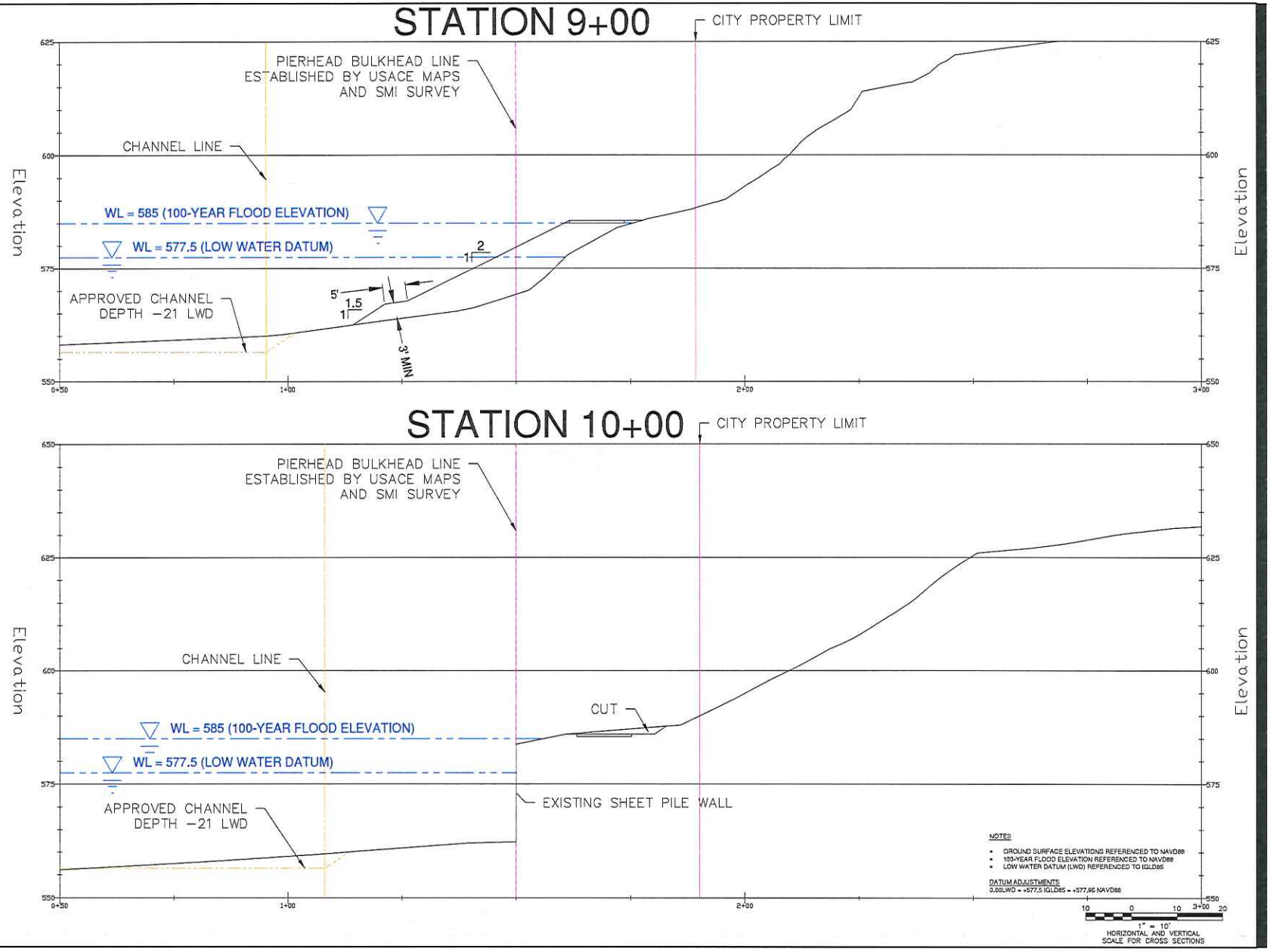
I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER
60317415

SHEET TITLE
PROPOSED CROSS SECTIONS

SHEET NUMBER
5



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PROJECT

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River Walk

CLIENT

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REGISTRATION

ISSUE/REVISION

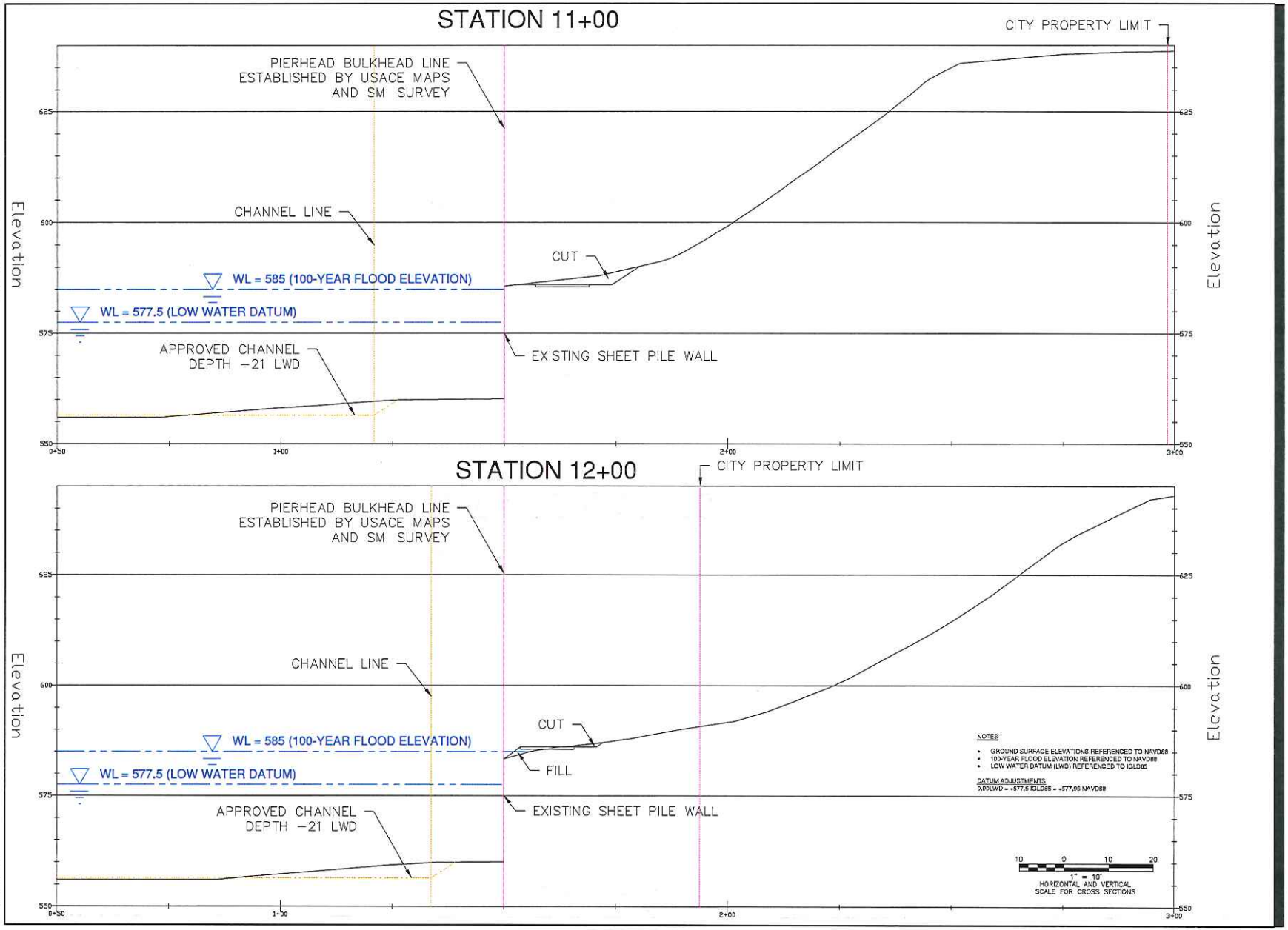
I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER
60317415

SHEET TITLE
PROPOSED CROSS SECTIONS

SHEET NUMBER
6



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Last Plotted: 2014-09-15 Project Management Initials: ____ Designed: ____ Checked: ____ Approved: ____ ANSI D 22" x 34"

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City of Manitowoc
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REGISTRATION

ISSUE/REVISION

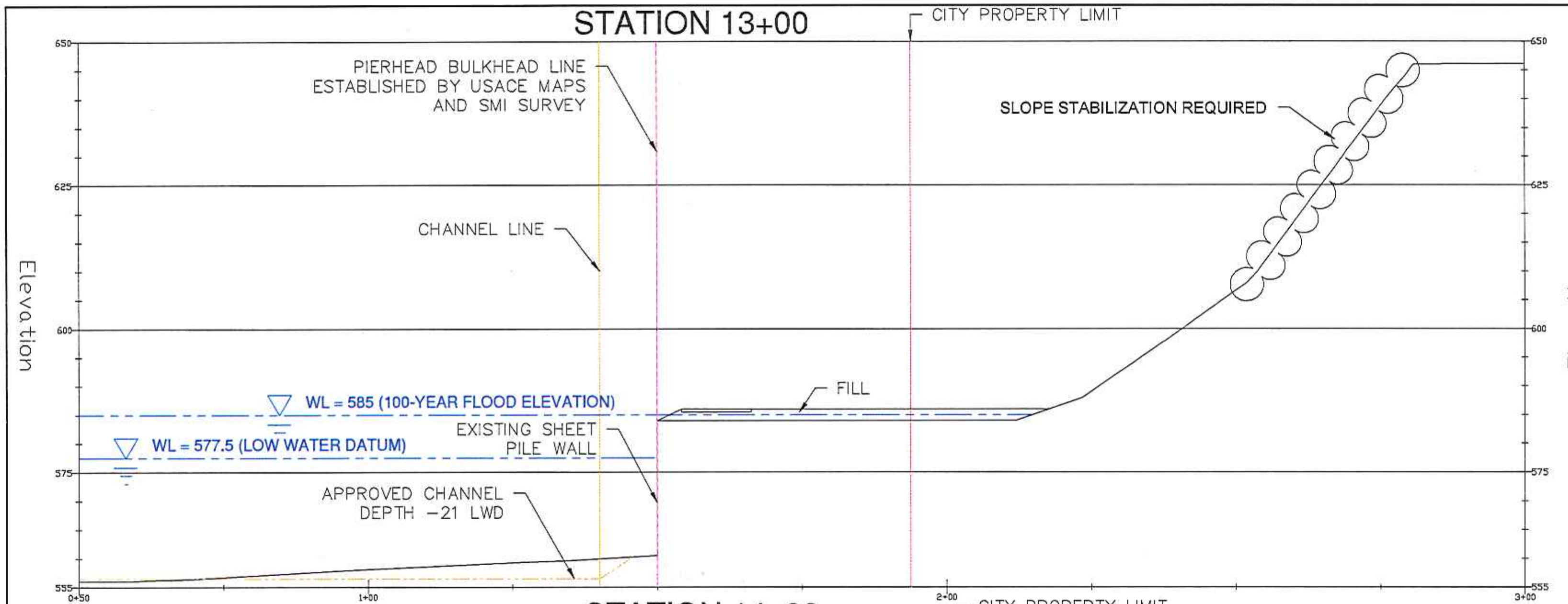
I/R	DATE	DESCRIPTION

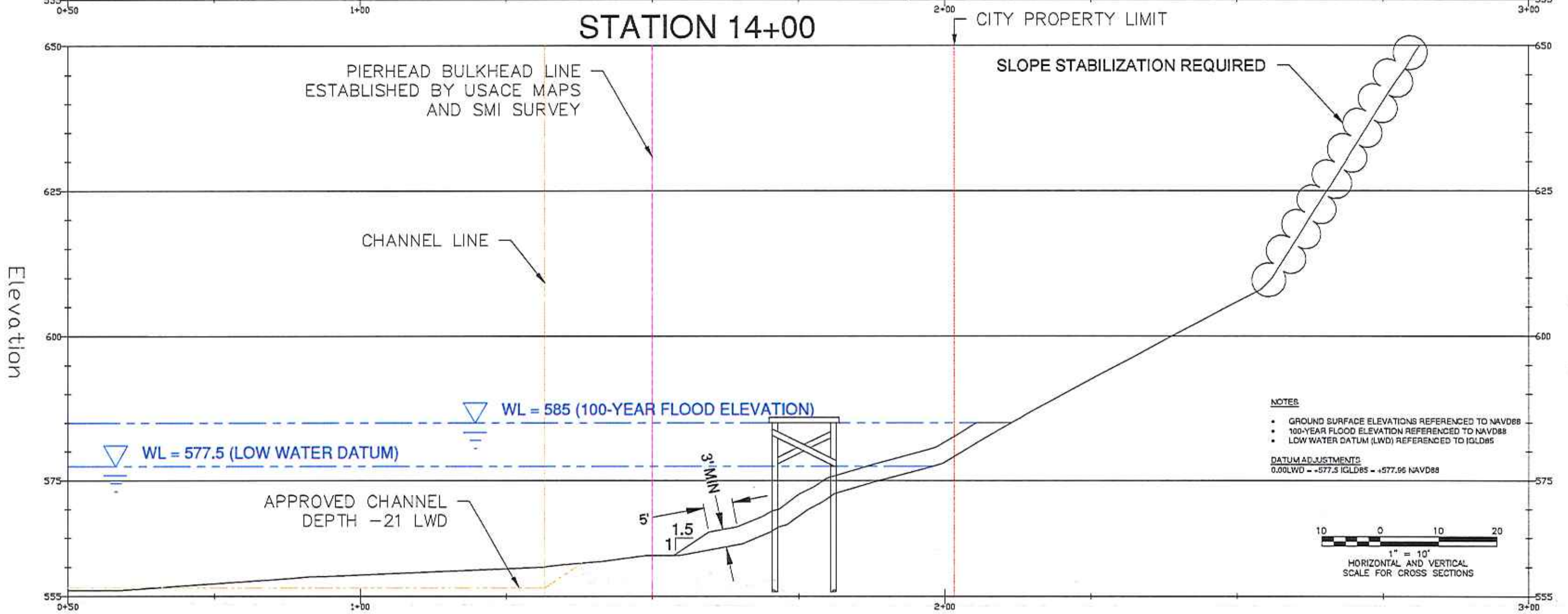
KEY PLAN

PROJECT NUMBER
60317415

SHEET TITLE
PROPOSED CROSS SECTIONS

SHEET NUMBER
7





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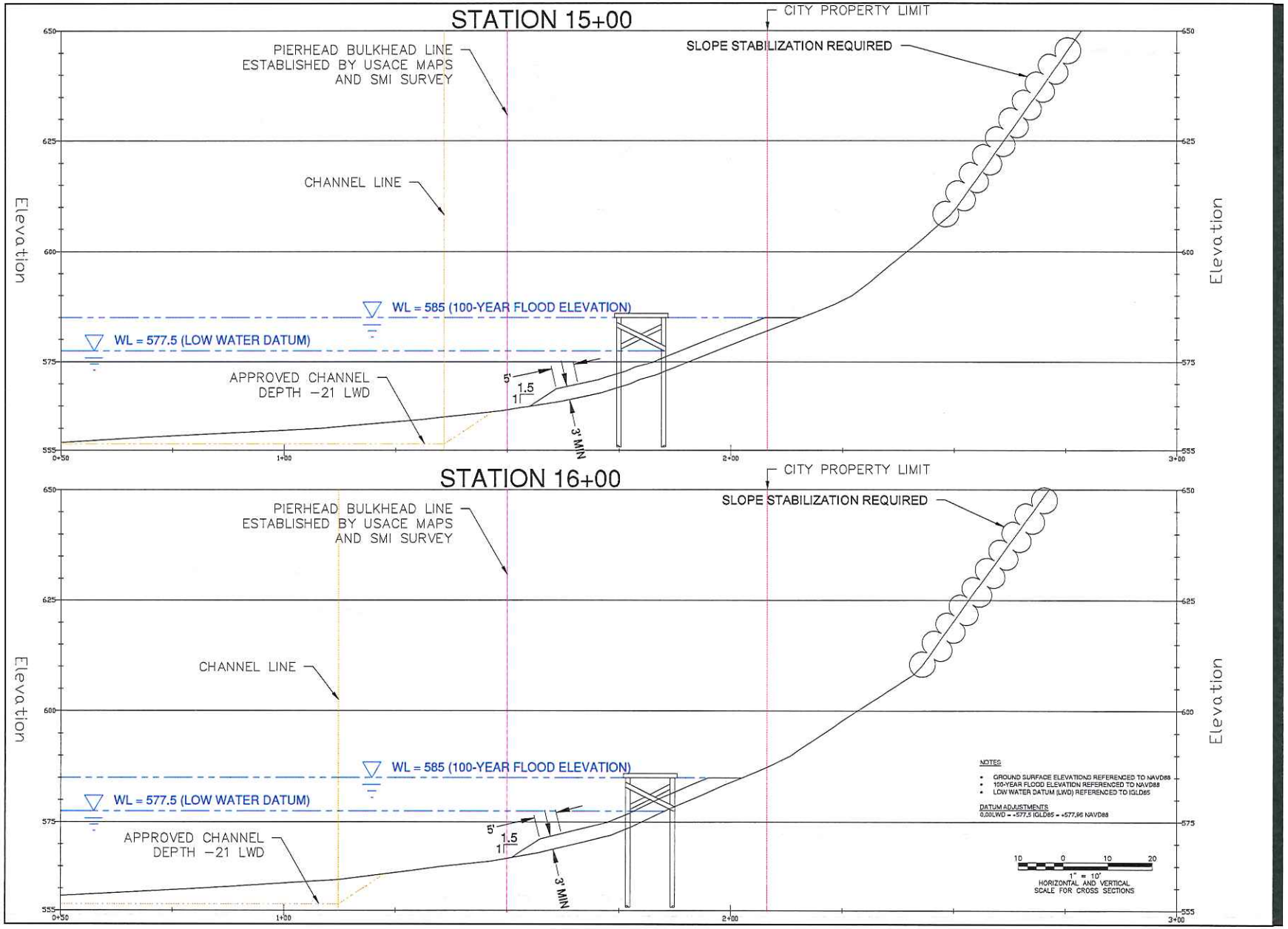
KEY PLAN

PROJECT NUMBER
60317415

SHEET TITLE
PROPOSED CROSS SECTIONS

SHEET NUMBER
8



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Last Plotted: 2014.09.05
Project Management Initials: Designer: Checked: Approved: ANSI D 22" x 34"

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REGISTRATION

ISSUE/REVISION

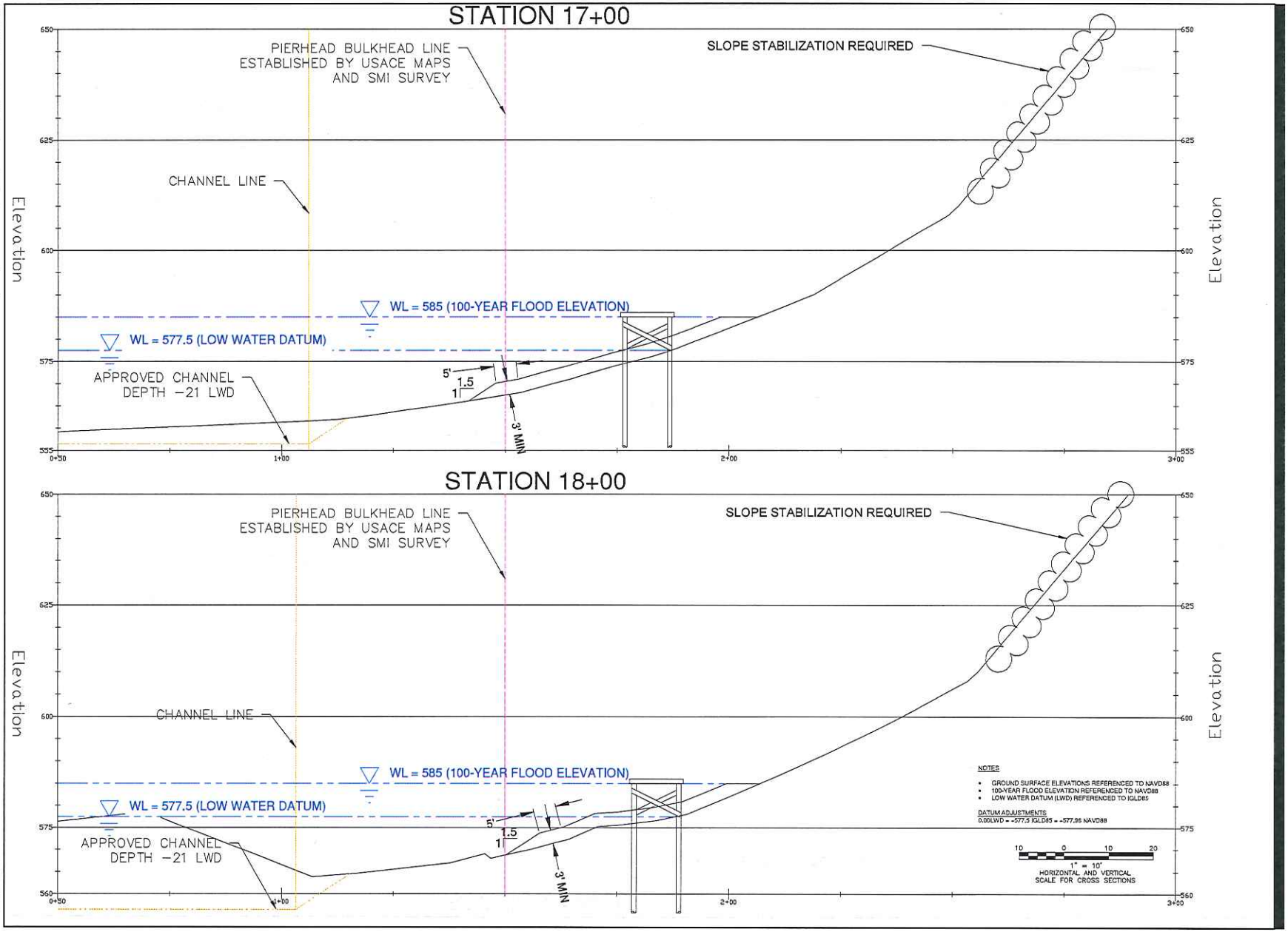
I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER
60317415

SHEET TITLE
PROPOSED CROSS SECTIONS

SHEET NUMBER
9



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List Plotted: 2014-09-05
Project Manager/Initials: Designer: Checked: Approved: ANSI D 22" x 34"

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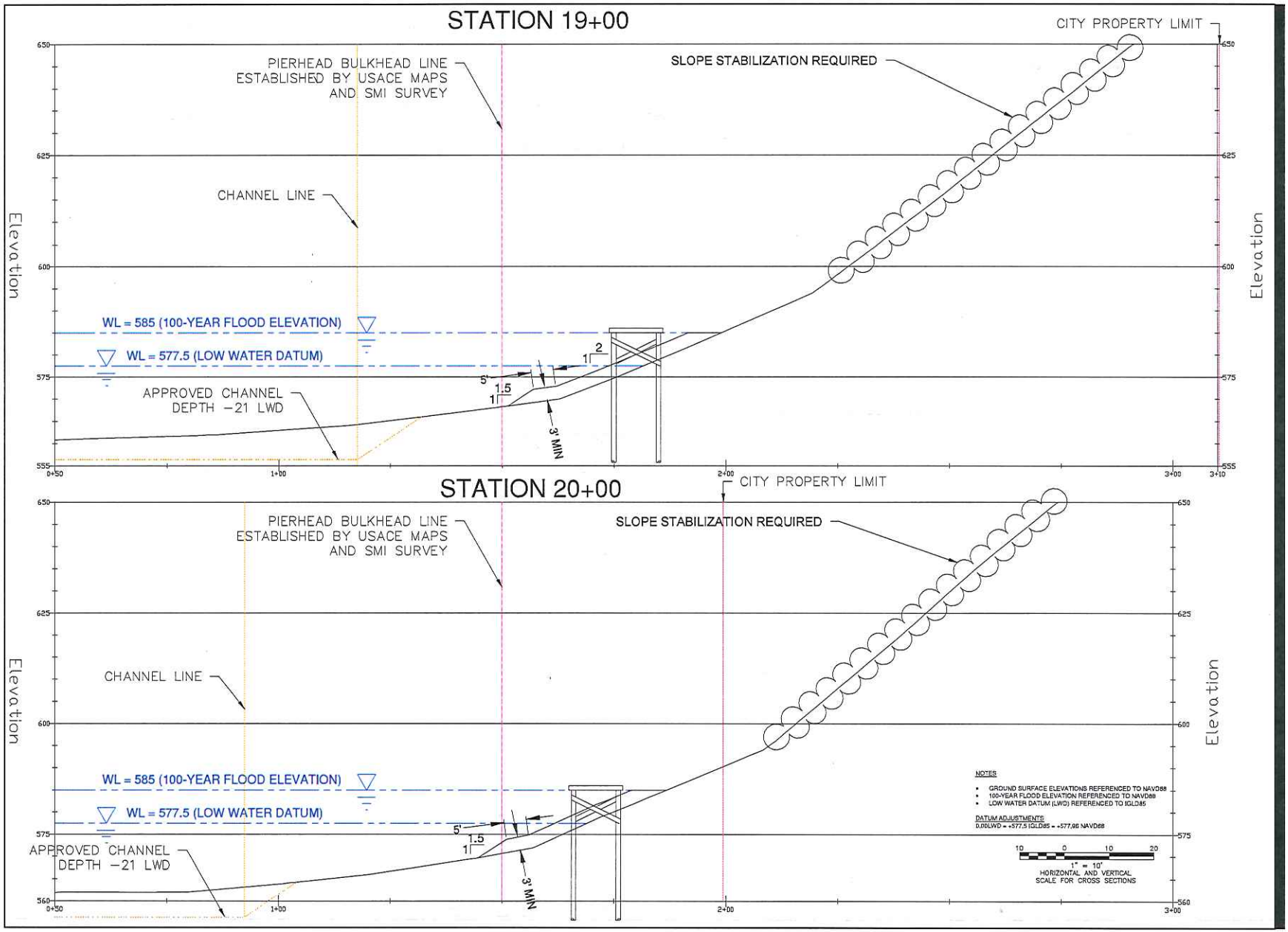
60317415

SHEET TITLE
PROPOSED CROSS SECTIONS

SHEET NUMBER
10



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Last Plotted: 2014 09 05
Project Manager: Initials: Designer: Checked: Approved: ANSI D 22" x 34"

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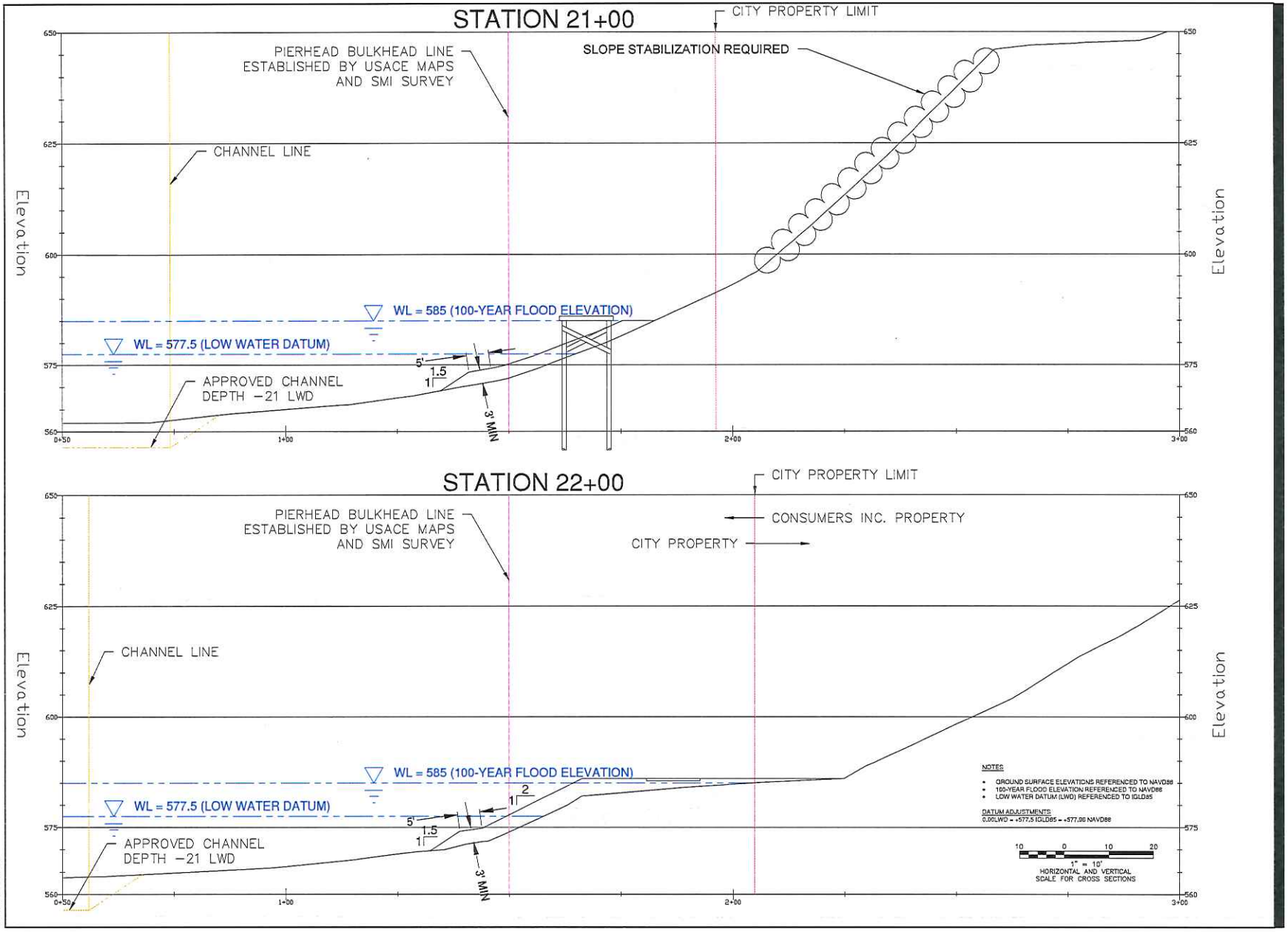
I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER
60317415

SHEET TITLE
PROPOSED CROSS SECTIONS

SHEET NUMBER
11



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Last Plotted: 2014-09-05 Project Management Initials: Designer: ____ Checked: ____ Approved: ____ ANSI D 22" x 34"

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I/R	DATE	DESCRIPTION

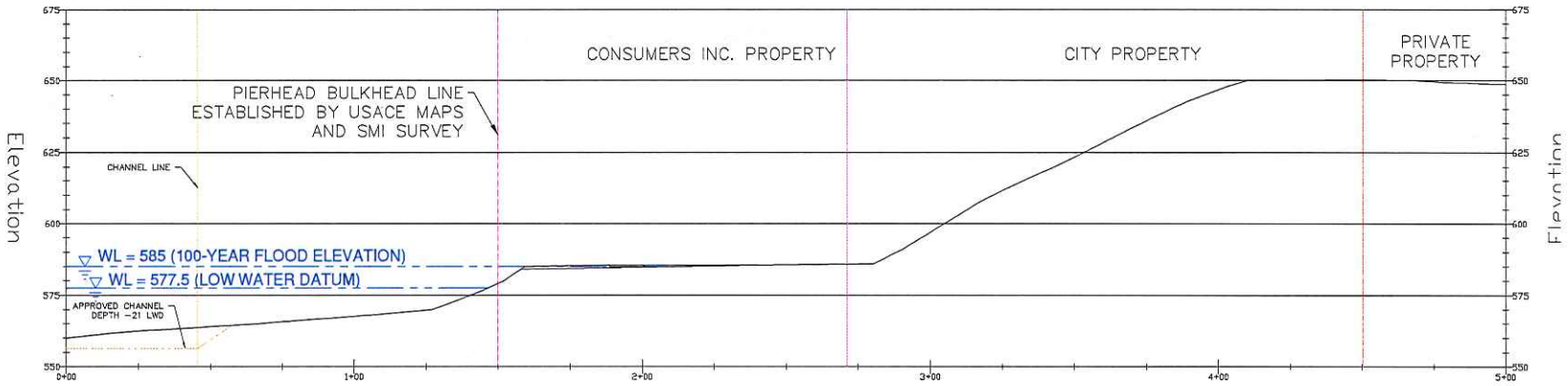
KEY PLAN

PROJECT NUMBER
60317415

SHEET TITLE
PROPOSED CROSS SECTIONS

SHEET NUMBER
12

STATION 23+00



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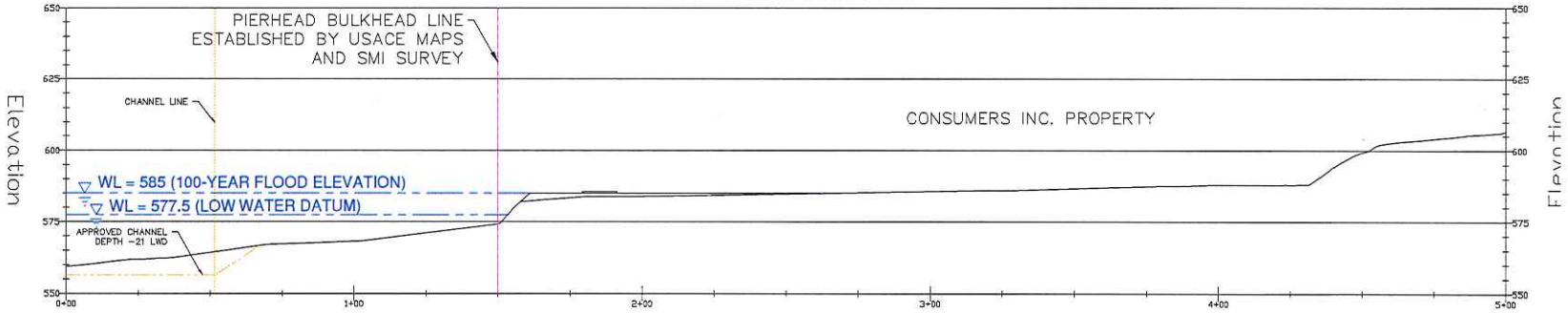

NOTES

- GROUND SURFACE ELEVATIONS REFERENCED TO NAVD88
- 100-YEAR FLOOD ELEVATION REFERENCED TO NAVD88
- LOW WATER DATUM (LWD) REFERENCED TO IGLD85

DATUM ADJUSTMENTS
0.00LWD = +577.5 IGLD85 = +577.99 NAVD88

20 0 20 40
1" = 20'
HORIZONTAL AND VERTICAL SCALE FOR CROSS SECTIONS

Filename: WISOSHEFP001\P\PROJECTS\PROJECTS\60317415_MANITOWOC RIVERWALK PRELIM DESIGN\600 WORKING DOCS-CADCOST ESTIMATE QUANTITIES\QUANTITIES.DWG Last saved by: KYLES1
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I/R	DATE	DESCRIPTION

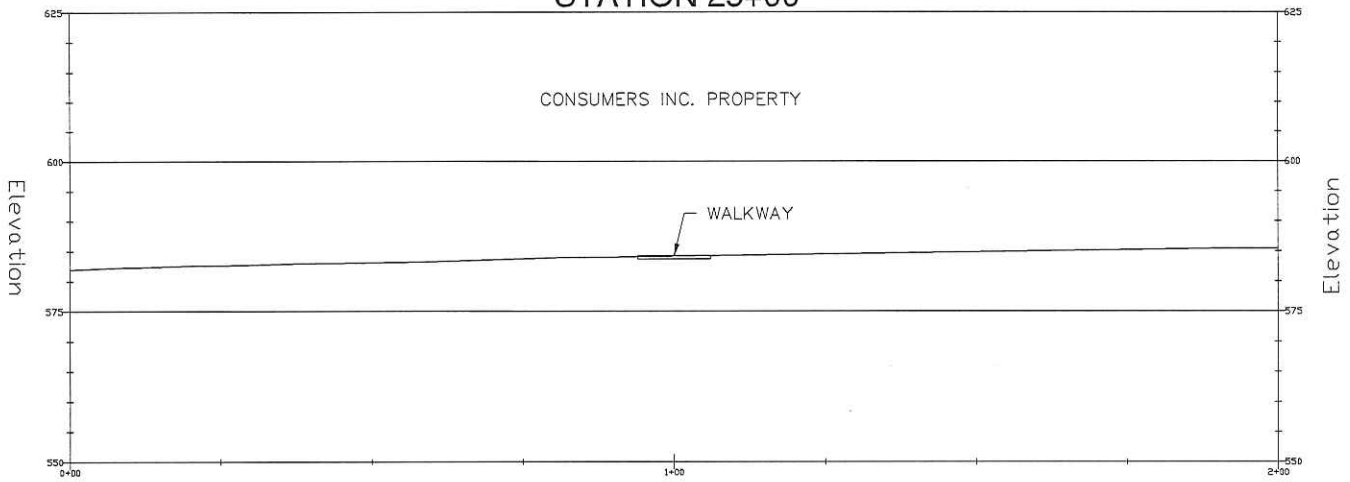
KEY PLAN

PROJECT NUMBER
60317415

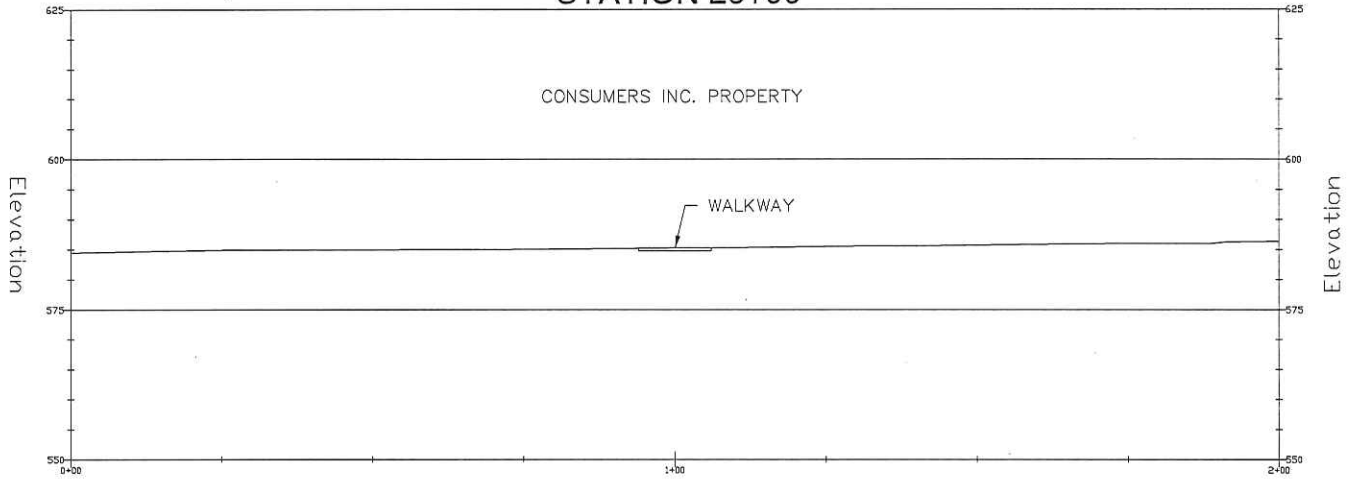
SHEET TITLE
PROPOSED CROSS SECTIONS

SHEET NUMBER
12

STATION 25+00



STATION 26+00



NOTES

- GROUND SURFACE ELEVATIONS REFERENCED TO NAVD88
- 100-YEAR FLOOD ELEVATION REFERENCED TO NAVD88
- LOW WATER DATUM (LWD) REFERENCED TO IGLD85

DATUM ADJUSTMENTS
0.00LWD = +577.5 IGLD85 = +577.05 NAVD88

10 0 10 20
1" = 10'
HORIZONTAL AND VERTICAL SCALE FOR CROSS SECTIONS

AECOM

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REGISTRATION

ISSUE/REVISION

I/R	DATE	DESCRIPTION

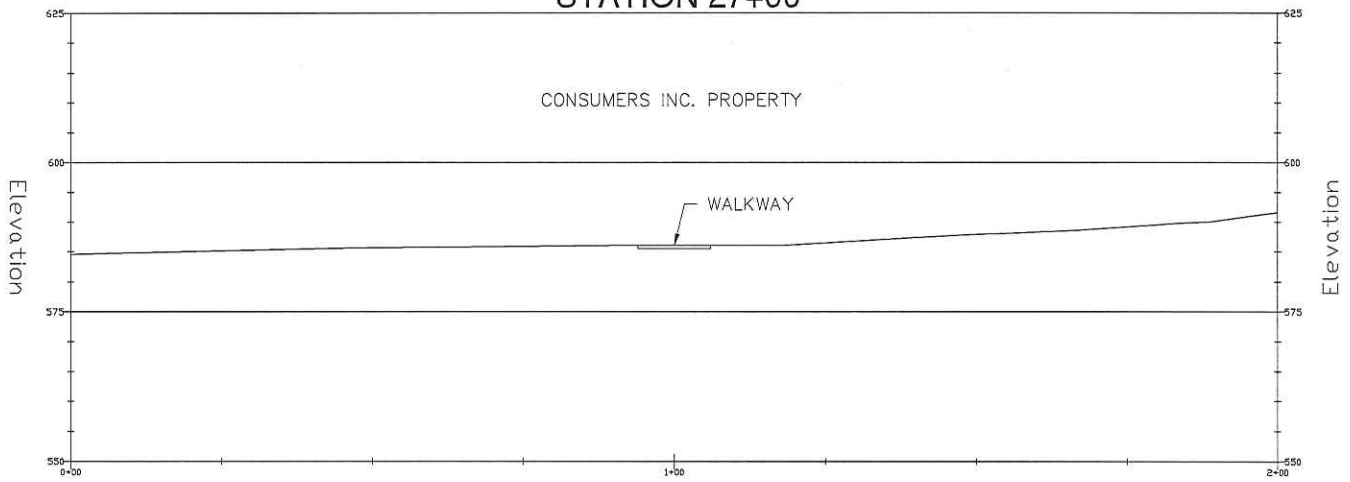
KEY PLAN

PROJECT NUMBER
60317415

SHEET TITLE
PROPOSED CROSS SECTIONS

SHEET NUMBER
13

STATION 27+00



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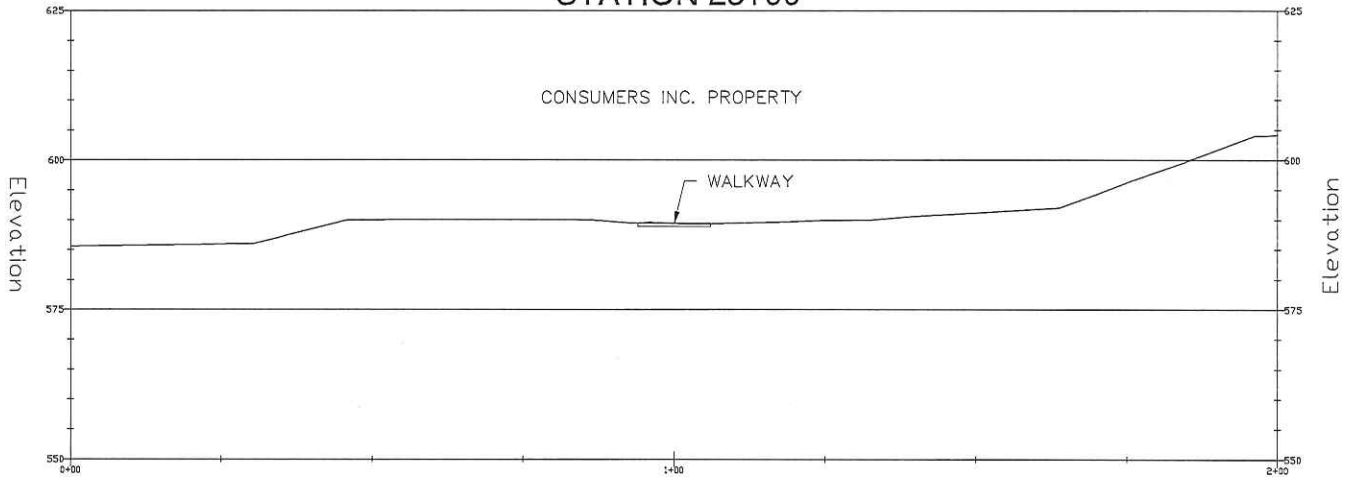

NOTES

- GROUND SURFACE ELEVATIONS REFERENCED TO NAVD88
- 100-YEAR FLOOD ELEVATION REFERENCED TO NAVD88
- LOW WATER DATUM (LWD) REFERENCED TO IGLD85

DATUM ADJUSTMENTS
0.00LWD = +577.5 IGLD85 = +577.00 NAVD88

10 0 10 20
1" = 10'
HORIZONTAL AND VERTICAL
SCALE FOR CROSS SECTIONS

AECOM

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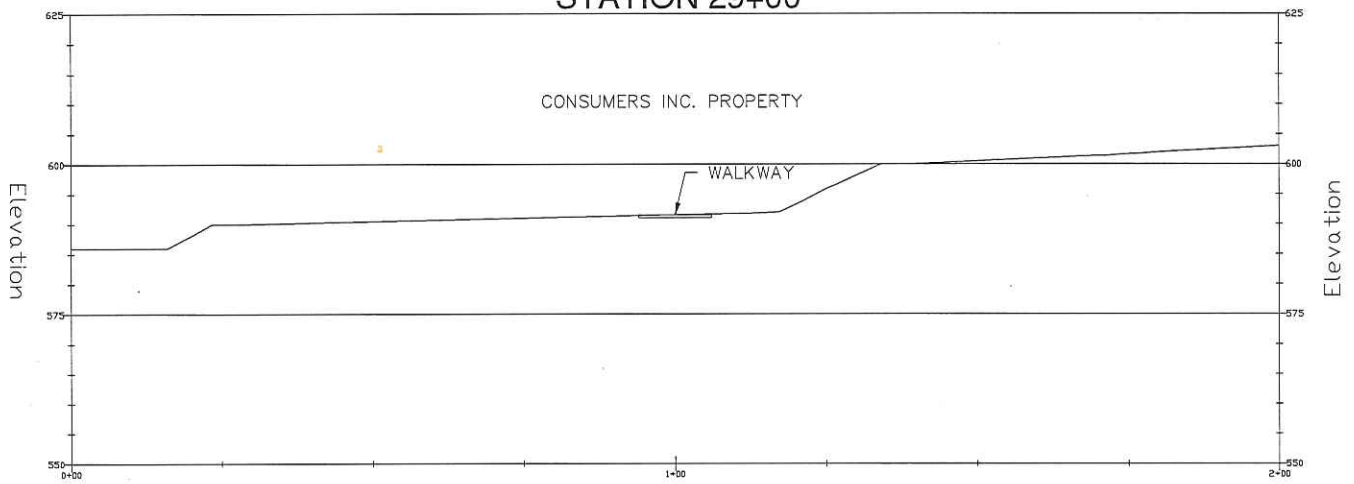
KEY PLAN

PROJECT NUMBER
60317415

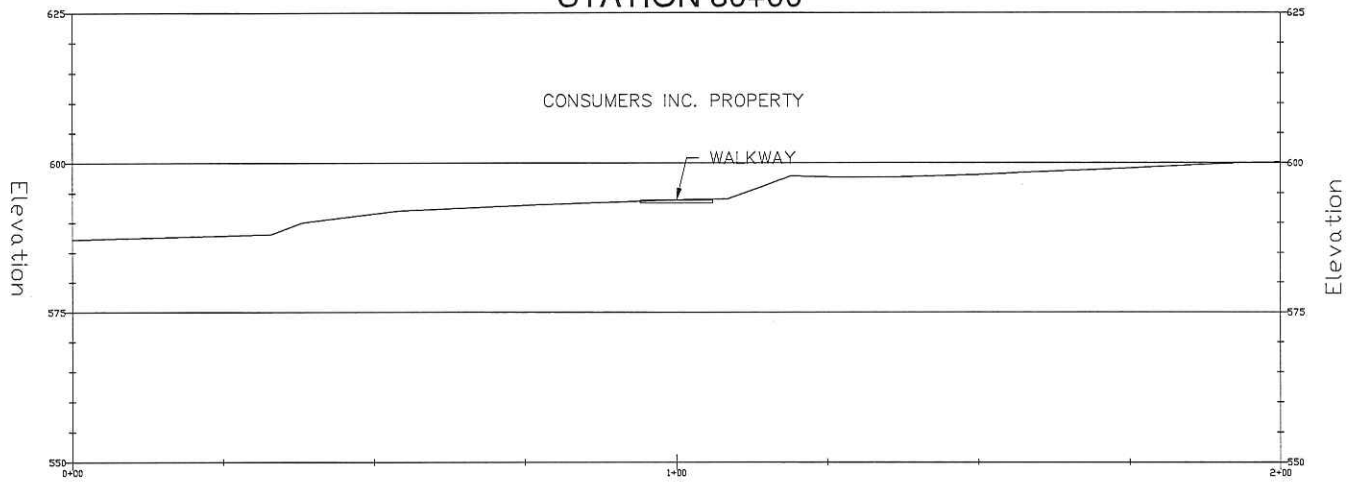
SHEET TITLE
PROPOSED CROSS SECTIONS

SHEET NUMBER
14

STATION 29+00



STATION 30+00



NOTES

- GROUND SURFACE ELEVATIONS REFERENCED TO NAVD88
- 100-YEAR FLOOD ELEVATION REFERENCED TO NAVD88
- LOW WATER DATUM (LWD) REFERENCED TO IGLD85

DATUM ADJUSTMENTS
0.00LWD = +577.5 IGLD85 = +577.95 NAVD88

10 0 10 20
1" = 10'
HORIZONTAL AND VERTICAL SCALE FOR CROSS SECTIONS

AECOM

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REGISTRATION

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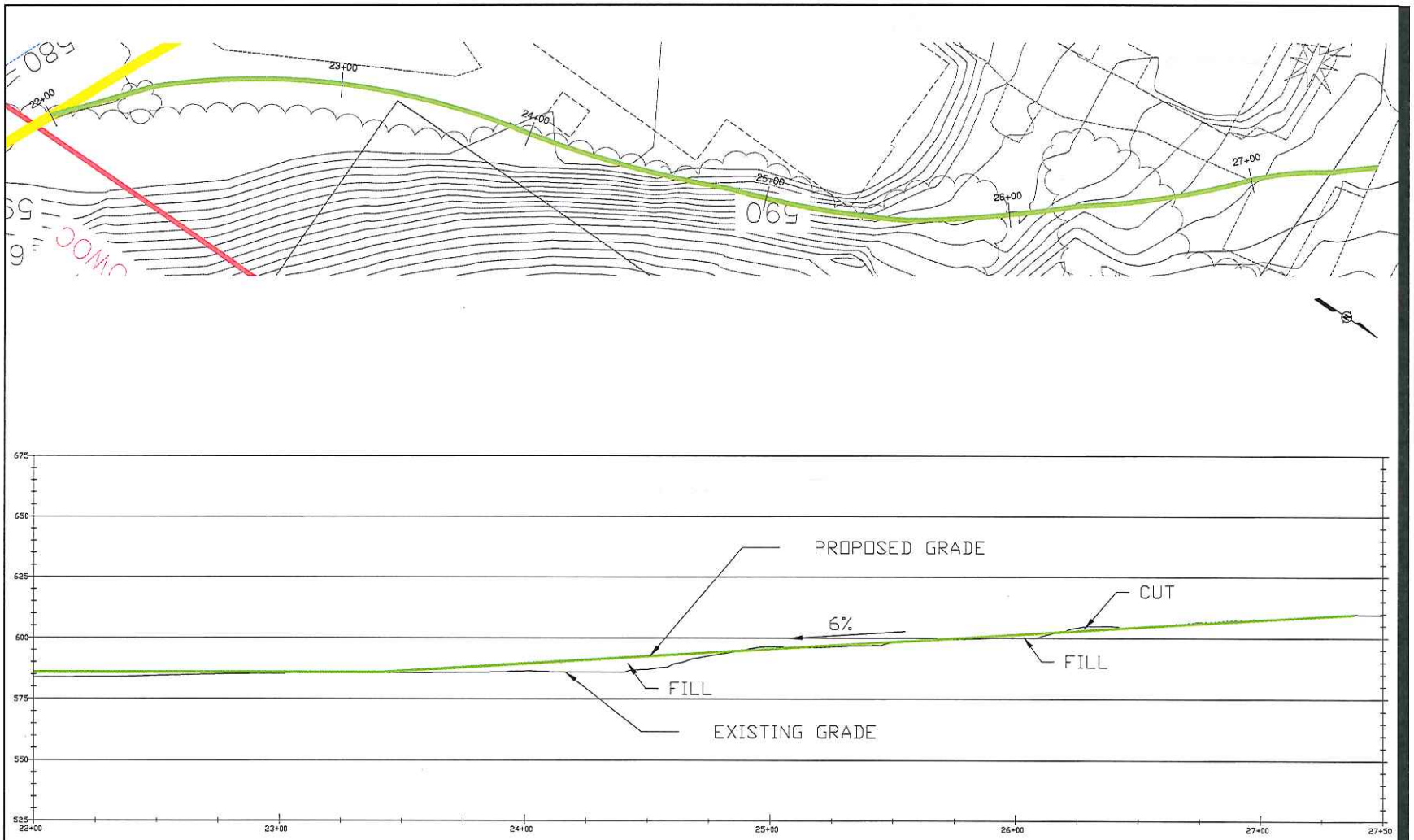
NR	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER
60317415

SHEET TITLE
PROPOSED CROSS SECTIONS

SHEET NUMBER
15



NOTES

- GROUND SURFACE ELEVATIONS REFERENCED TO NAVD88
- 100-YEAR FLOOD ELEVATION REFERENCED TO NAVD88
- LOW WATER DATUM (LWD) REFERENCED TO IGLD85

DATUM ADJUSTMENTS
0.00LWD = +577.5 IGLD85 = +577.06 NAVD88

20 0 20 40
1" = 20'
HORIZONTAL AND VERTICAL SCALE FOR CROSS SECTIONS

Filename: W:\60\317\PROJECTS\PROJECTS\60317415_MANITOWOC RIVERWALK PRELIM DESIGN\200-WORKING DOCS-CAD\COST ESTIMATE QUANTITIES\QUANTITIES.DWG
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Project Management Initials: Designer: Checked: Approved: ANSI D 22" x 34"

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ISSUE/REVISION

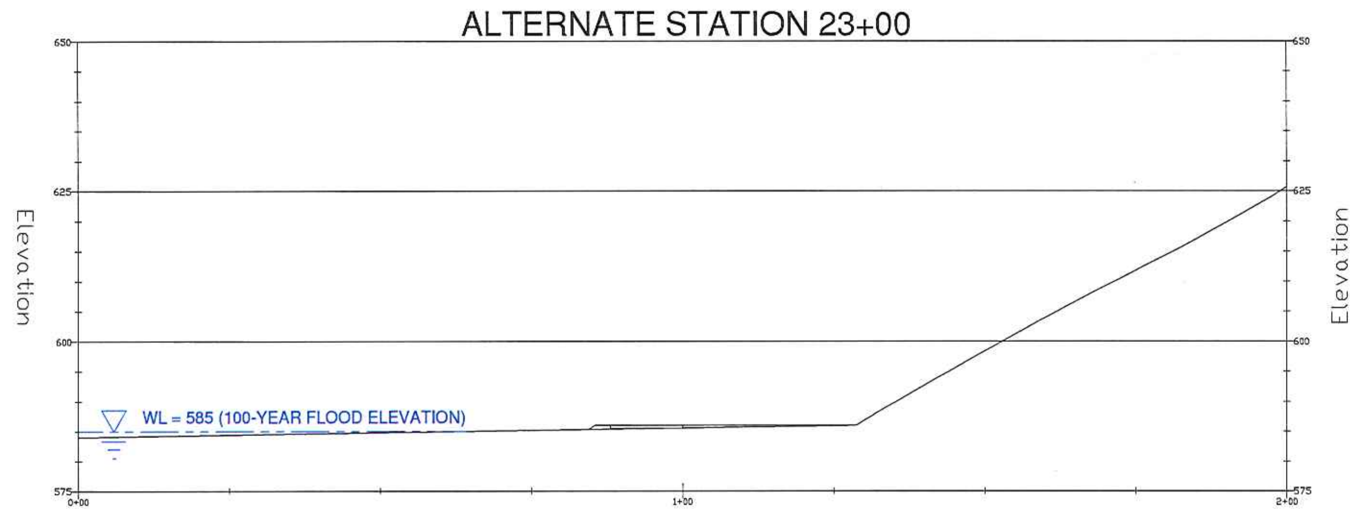
I/R	DATE	DESCRIPTION

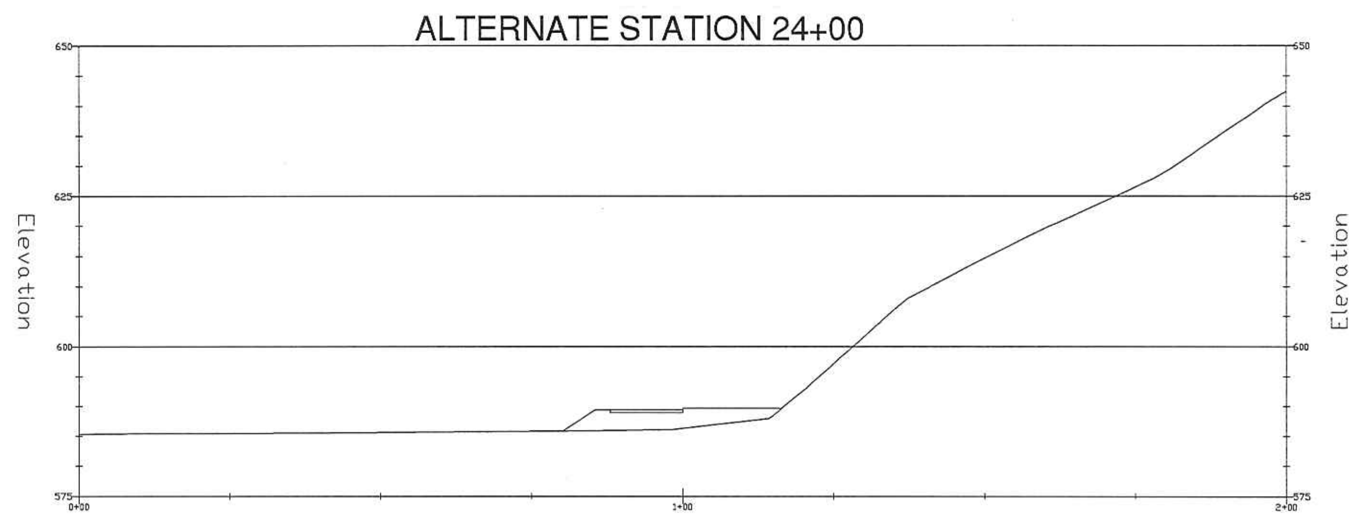
KEY PLAN

PROJECT NUMBER
60317415

SHEET TITLE
ALTERNATE CONSUMER PROPERTY ALIGNMENT PLAN AND PROFILE

SHEET NUMBER
1





NOTES

- GROUND SURFACE ELEVATIONS REFERENCED TO NAVD88
- 100-YEAR FLOOD ELEVATION REFERENCED TO NAVD88
- LOW WATER DATUM (LWD) REFERENCED TO IGLD85

DATUM ADJUSTMENTS
0.00LWD = +577.5 IGLD85 = +577.96 NAVD88

10 0 10 20
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HORIZONTAL AND VERTICAL SCALE FOR CROSS SECTIONS

AECOM

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60317415

SHEET TITLE
PROPOSED CROSS SECTIONS
ALTERNATE ROUTE

SHEET NUMBER
2

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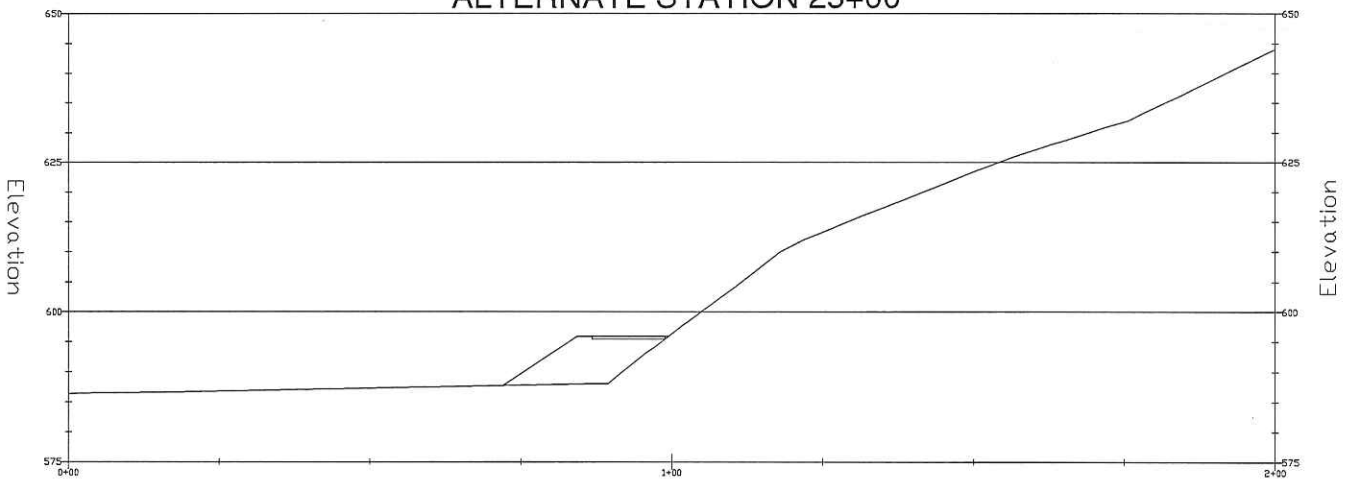
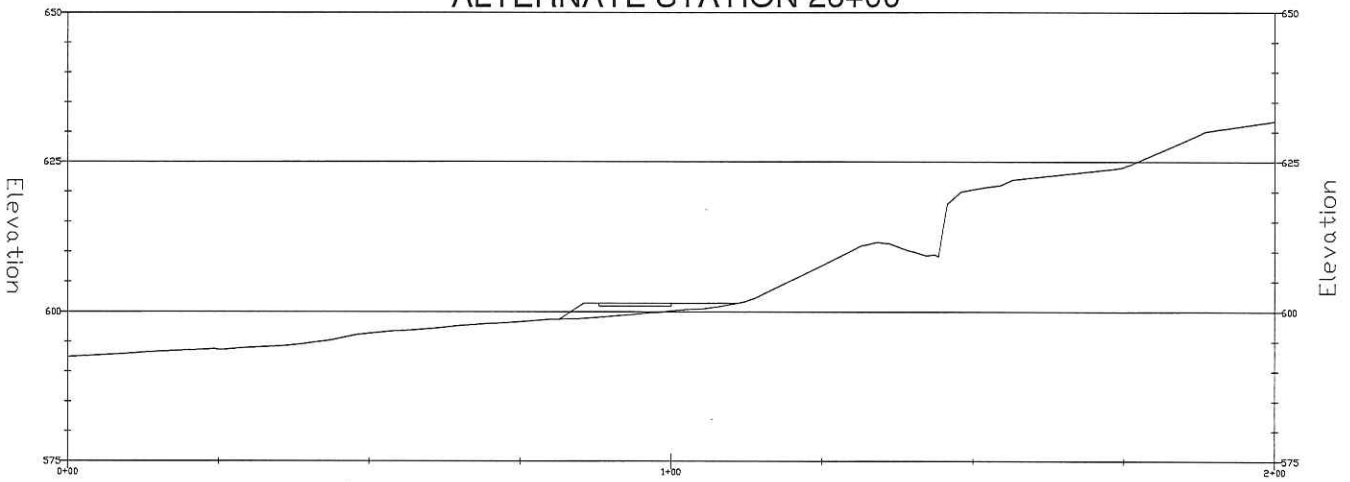
Last Plotted: 2014-09-05
Project Management Initials: Designer: ___ Checked: ___ Approved: ___ ANSI D 22" x 34"

ALTERNATE STATION 25+00



ALTERNATE STATION 26+00



NOTES

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- LOW WATER DATUM (LWD) REFERENCED TO IGLD85

DATUM ADJUSTMENTS
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KEY PLAN

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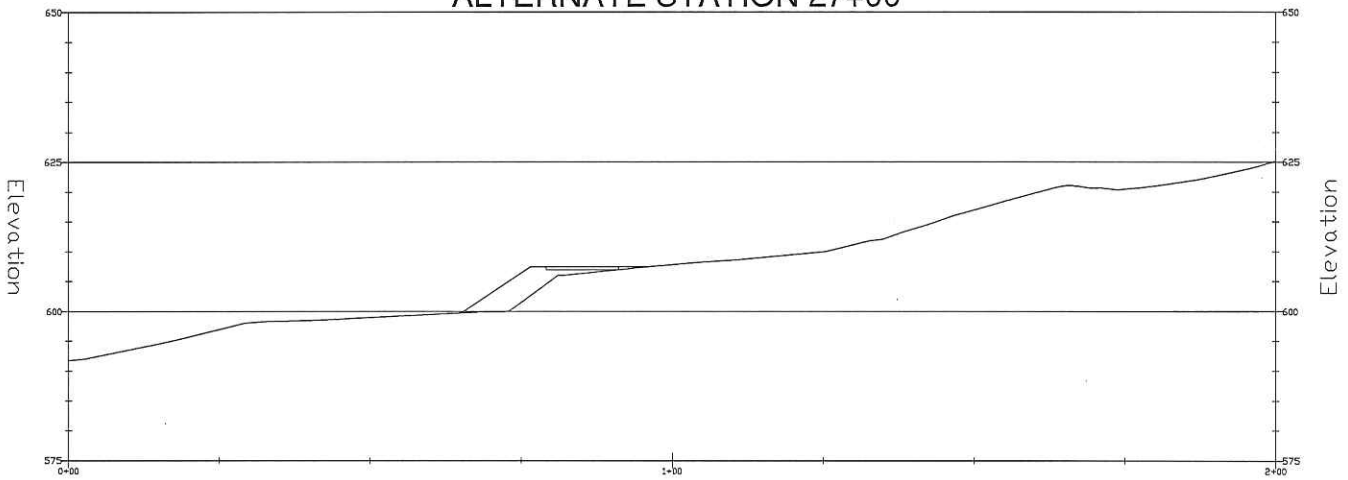
60317415

SHEET TITLE
PROPOSED CROSS SECTIONS
ALTERNATE ROUTE

SHEET NUMBER
3

ALTERNATE STATION 27+00



NOTES

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- 100-YEAR FLOOD ELEVATION REFERENCED TO NAVD88
- LOW WATER DATUM (LWD) REFERENCED TO IGLD85

DATUM ADJUSTMENTS:
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10 0 10 20
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HORIZONTAL AND VERTICAL SCALE FOR CROSS SECTIONS

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PROPOSED CROSS SECTIONS
ALTERNATE ROUTE

SHEET NUMBER
4

Schedule

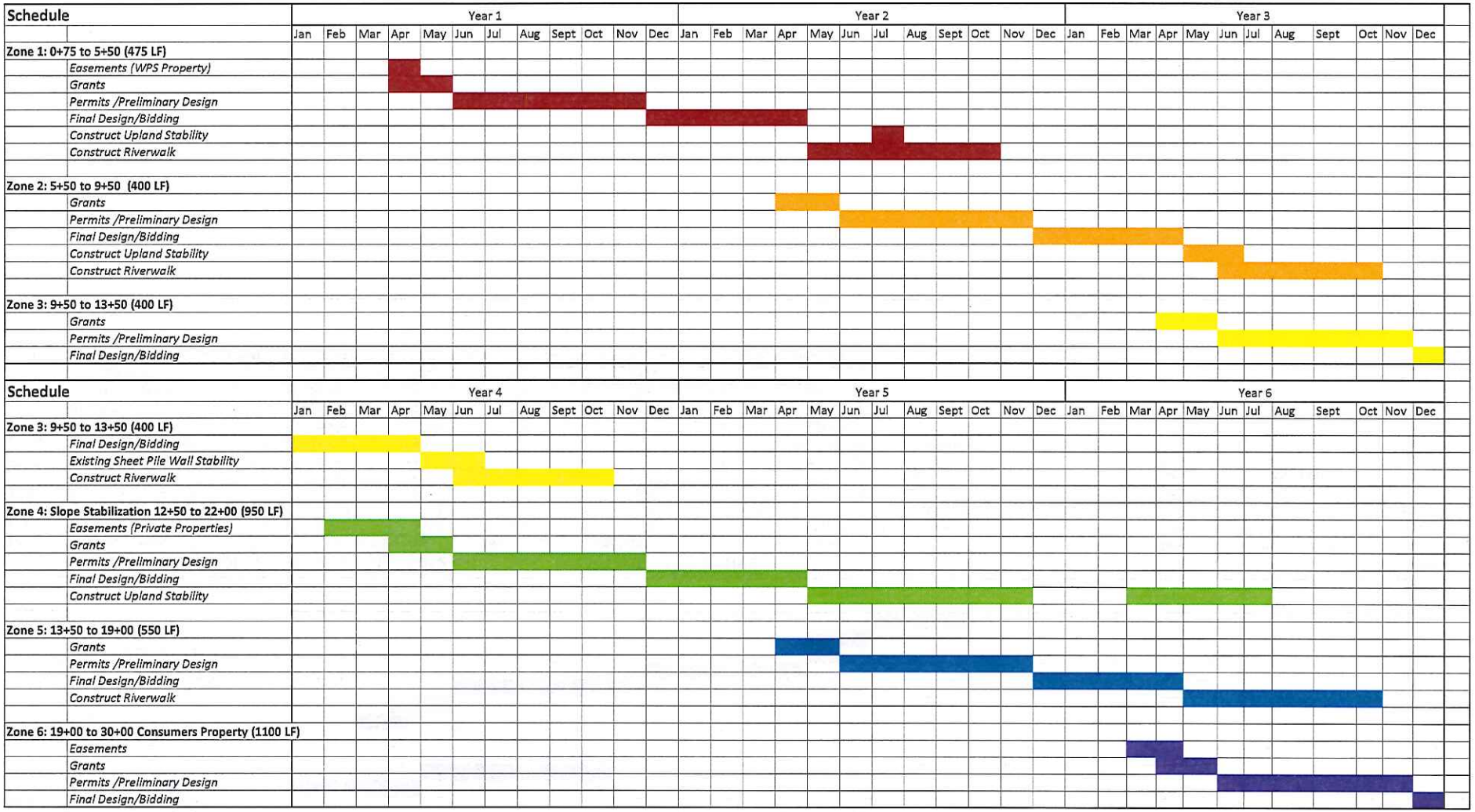
		Year 7												Year 8												Year 9											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Zone 6: Consumers Property (1100 LF)																																					
	Final Design/Bidding																																				
	Construct Riverwalk																																				
Alternate: WPS Property (205 LF)																																					
	Easements																																				
	Grants																																				
	Permits /Preliminary Design																																				
	Final Design/Bidding																																				
	Environmental Remediation																																				
	Existing Sheet Pile Wall Stability																																				
	Construct Riverwalk																																				

Plan Costs per Zone, following "Bare Essentials - Least Cost" Alternative

Zone	Riverwalk Option	Approx. Stationing			Lineal Footage	Cost/Lineal Foot	Total Cost of Zone
Zone 1	Rockfill Embankment	0 +75	to	5 +50	475	1501	$ 712,975.00
Zone 2	On Grade/Rockfill Embankment	5 +50	to	8 +25	275	1501	$ 713,700.00
	Slope Stabilization - SRT	7 +50	to	8 +50	100	1133	
	Rockfill Embankment	8 +25	to	9 +50	125	1501	
Zone 3	Existing Sheet Pile Wall Retrofit	9 +50	to	13 +50	400	1385	$ 554,000.00
Zone 4A	Slope Stabilization - SRT	12 +50	to	22 +00	950	1133	$ 1,076,350.00
Zone 5	Rockfill Embankment	13 +50	to	19 +00	550	1501	$ 825,550.00
Zone 6	Rockfill Embankment	19 +00	to	22 +00	300	1501	$ 555,100.00
	On Grade Gravel Path	22 +00	to	30 +00	800	131	
Alt WPS	Existing Sheet Pile Wall	North 11th St. to 0+75			205	TBD	TBD

Note: Costs for lighting, fishing piers, Interpretative stations (overlooks, staircases, kiosks, signage), additional access routes is not included in table above

Grant Name	Submittal Dates	Potential Grant Fund	City Match Requirements
Stewardship	May	$40,000 - $500,000	50%
Wisconsin Coastal Management	November	$60,000	50%
CMAQ	June	$200,000 - $1MM	20%
TAP	June	$200,000 - $1MM	20%
EPA GLRI	September	$250,000	50%
USACE ESSP	Continues	$100,000 - $1.5MM	35%


Schedule
Year 1
Year 2
Year 3
Jan Feb Mar Apr May Jun Jul Aug Sept Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sept Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sept Oct Nov Dec
Zone 1: 0+75 to 5+50 (475 LF)
Easements (WPS Property)
Grants
Permits /Preliminary Design
Final Design/Bidding
Construct Upland Stability
Construct Riverwalk
Zone 2: 5+50 to 9+50 (400 LF)
Grants
Permits /Preliminary Design
Final Design/Bidding
Construct Upland Stability
Construct Riverwalk
Zone 3: 9+50 to 13+50 (400 LF)
Grants
Permits /Preliminary Design
Final Design/Bidding
Schedule
Year 4
Year 5
Year 6
Jan Feb Mar Apr May Jun Jul Aug Sept Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sept Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sept Oct Nov Dec
Zone 3: 9+50 to 13+50 (400 LF)
Final Design/Bidding
Existing Sheet Pile Wall Stability
Construct Riverwalk
Zone 4: Slope Stabilization 12+50 to 22+00 (950 LF)
Easements (Private Properties)
Grants
Permits /Preliminary Design
Final Design/Bidding
Construct Upland Stability
Zone 5: 13+50 to 19+00 (550 LF)
Grants
Permits /Preliminary Design
Final Design/Bidding
Construct Riverwalk
Zone 6: 19+00 to 30+00 Consumers Property (1100 LF)
Easements
Grants
Permits /Preliminary Design
Final Design/Bidding