Final Report

May 1, 2015

Franklin Hill / Irishtown Bend

Stabilization and Restoration

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EXECUTIVE SUMMARY

Barr & Prevost was contracted by the Cleveland-Cuyahoga County Port Authority to conduct an 18 month study of the stabilization and restoration of the Franklin Hill/Irishtown Bend Hillside. The location of the study area is bordered by West 25th Street, Detroit Avenue, Cuyahoga River, Columbus Road and Franklin Avenue (as shown in Figure 1). The scope of work that was identified in phase one of a four-phased approach included:

- Evaluate geological conditions
- Determine extent of stabilization required to protect the public and existing assets
- Protect ship passage from failure of the hillside slope to prevent closure of maritime traffic
- Provide recommendations for corrective action and site use
- Integrate aquatic-friendly habitat with proposed recommendations
- Develop 30% plan documents and construction cost estimate

Additional tasks that were completed during the study included a Phase 1 Environmental Site Assessment, storm water and water systems investigations, testing and sampling of water, and extensive historical document research and data collection. Each of these items was integral in developing a comprehensive conceptual plan for site remediation.

A danger does exist for potential failure of the slope if there is a local slip at the toe of the slope along Riverbed Street, coupled with elevated ground water conditions. However, if the toe of the slope is stabilized and protected and the drainage and water issues are properly addressed, the site can be rehabilitated for use along the lower elevation of the Riverbed Street corridor. Development on top or on the hillside should be avoided, and Franklin Avenue should be partially reconstructed to correct the alignment over the historic scarp line.

1. SITE HISTORY

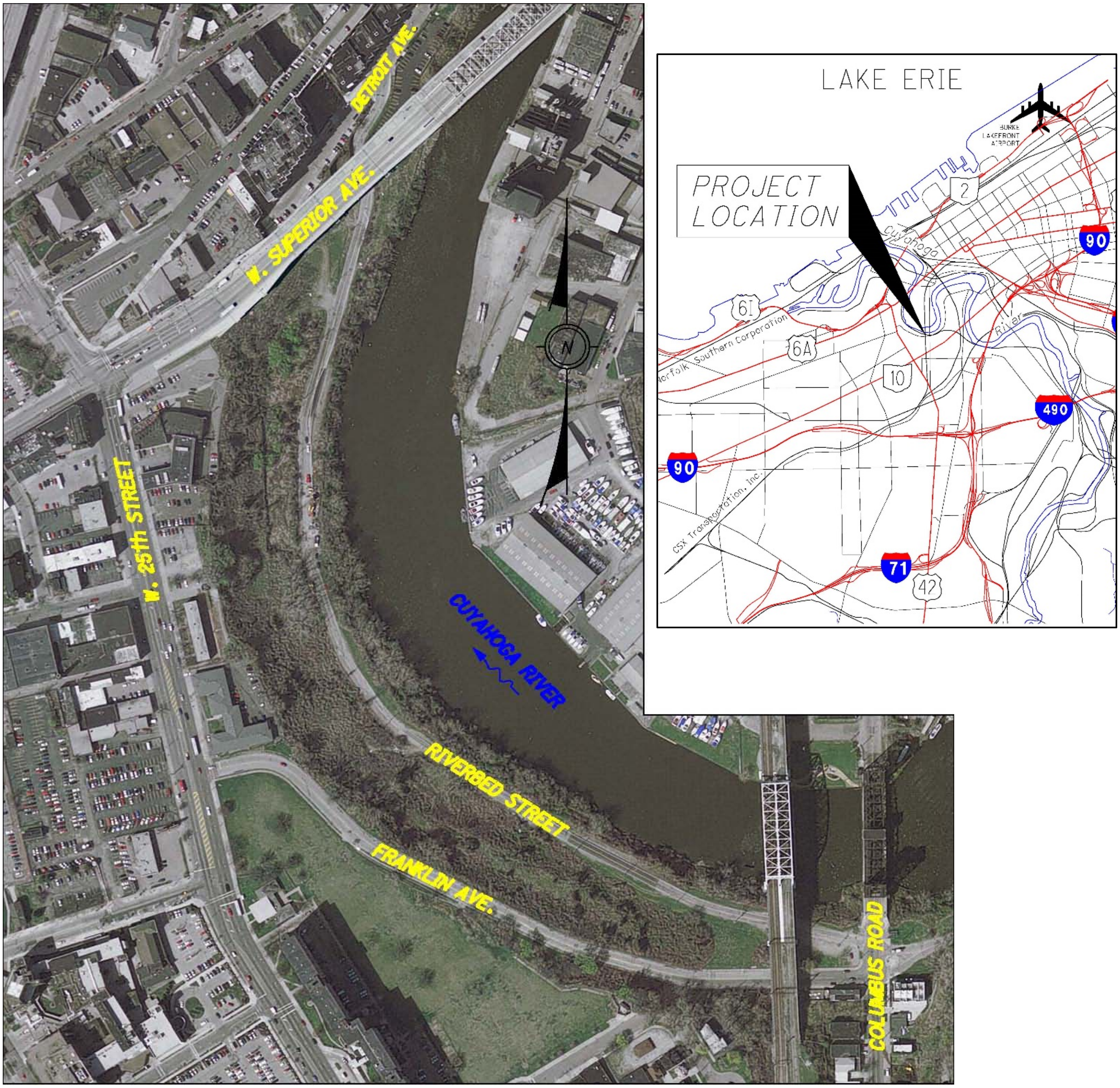
The project site has a long history as indicated from the timetable in Section 2, Historical Timeline. The site has seen many uses, including Irish Immigrant residential housing, multi-modal transportation of industrial goods to maritime traffic with as many as eight active railroad tracks. The site was extensively used and remained stable from 1890 to 1960. The first observation of site instability was a significant settlement of railroad tracks near the north end of the Lederer Terminal in the 1960's. The track settlement and landslide were attributed to broken utilities in this corner of the site.

The lower portion of the site was primarily developed to achieve a flat grade for railroad track lines between Columbus Road and Detroit Avenue. Remnants of coal docks still exist on the site and the Lederer building foundation walls. Historical artifacts are still thought to be buried in the hillside despite the massive re-grading of the site that occurred in the early 1960's. The intersection of Franklin Avenue and West 25th Street was relocated to a new location farther north in the 1960's. As a result, the roadway extended over a scarp line, shown in Figure 2. This scarp line is currently visible in the roadway.

Before dredging activities took place in the 1920's, the Cuyahoga River was only 8' to 10' deep. The original mouth to Lake Erie was located approximately 4,000' to the west of its current location. Figure 3 depicts the development along the hillside; note the narrow width of the river at the Columbus Road crossing. The Cuyahoga River is now dredged to a depth of 23' and widened in some sections to allow passage of freighters. The Irishtown Bend is a very difficult passageway for freighters to navigate. The ships use the full width of the river to navigate the turn and therefore transmit high lateral forces to the outer bend of the river's edge from the use of bow thrusters.

The site now sits relatively vacant and unmanaged. However, corrective actions can be made to repair what was once a valuable public asset.

Figure 1: Project Site Map



2. HISTORIC TIMELINE

1848:	Irish Immigrants settle in Irishtown Bend and Whiskey Island
1900's:	Historic records refer to brick sewer along Riverbed Street
1912:	Eight railroad tracks exist along the west bank of Cuyahoga River
1918:	Construction of Detroit-Superior Bridge, subway tunnels and water mains
1921:	Flourishing Irishtown Bend community
1930:	Dredging and widening of Cuyahoga River initiated
1938:	Irishtown Bend dredging project completed
1940:	Brick Low Level Intercepting Sewer installed
1958:	Historic Irishtown Bend community razed
1960's:	Fill added to top of slope and Riverview Towers constructed
1965:	Franklin Avenue relocated
1985:	Asphalt placed over railroad ballast to accommodate two lanes of traffic on Riverbed Street
1989:	Geographical study identifies Irishtown Bend as unstable for further development
2006:	Riverbed Street closed
2007:	Distress in 60" diameter Westerly Low Sanitary Sewer and liner installed
2009:	City of Cleveland seeks $218M of Federal Water Resource funds for repairs
2012:	ODOT installs inclinometers around Detroit-Superior Tunnel and Bridge

3. HISTORIC CONDITIONS

Franklin Avenue, parking lots and embankments were constructed over historic scarp line that was mapped by Sanborn Fire Insurance, see Figures 2 and 4 below.

Figure 2: Historic Scarp Line Mapped by Sanborn Insurance

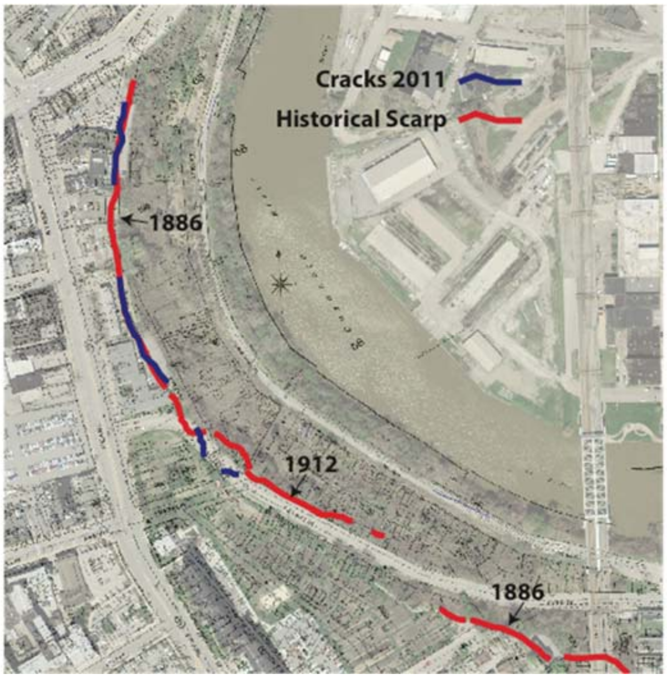


Figure 3: Irishtown Bend Industry

Irishtown Bend, 1921
Photo: Cleveland Union Terminal Collection
Cleveland State Unversity Library Special Collections

Figure 4: Graded Site with Realigned Franklin Avenue

4. SUBSURFACE INVESTIGATION

The most important task item in the scope of work was to develop an understanding of the geological conditions of the site and identify remedial options for slope stability. The comprehensive subsurface investigation report is contained in Appendix A. During the records research phase, nine reports were obtained with the assistance of the Cleveland Metropolitan Housing Authority (CMHA). The reports provided a wealth of data from 140 borings drilled and 1,000 soil samples collected. This data was entered into a searchable database that was used to characterize the soil conditions at the site. Additionally, the Ohio Department of Transportation (ODOT) installed 11 inclinometers around the Detroit-Superior Tunnel and Bridge between 2012 and 2013, and is monitoring the data. This data was also used in the geotechnical analysis.

The historic borings were carefully reviewed to supplement the data gathered from the new site testing locations. Cone Penetrometer Testing (CPT) was used to record continuous soil conditions to depths of 80' to 100'. The soil stratigraphy consists of six layers over shale: 10'-20' of fill, ~10' of fine sand, ~20' of silt, ~30' of medium to stiff clay, 20'-30' of stiff clay and 40'-60' of hard glacial till. The strata boundaries follow the landscape sloping down to the river. The areas where previous soil failures have occurred along the riverbank exhibit a shear strength of approximately 1,000 pounds per square foot (psf) at an elevation 15'-20' above the Cuyahoga River flow line, whereas shear strength values at the same elevation are 2,000 psf at the top of the hillside.

A summary of the inclinometer readings, provided in Table 3 of Appendix A, indicates movement of the hillside. A general trend is that soil movements, commonly referred to as displacements, increased to the north side of the site and toward the river's edge. The inclinometers set prior to ODOT's instrumentation were monitored for relatively short durations (7-10 weeks), but exhibited displacements up to ½" per month. If the magnitude of displacement were taken from the date of installation to 2015, it would result in a total displacement of 4'-5'. This extent of movement was not observed in the field survey investigation that was conducted in this area. Therefore, more reliance should be given to the ODOT data which suggests hillside movement along the edge of the river at 2" per year.

Visual observation along the toe of the river identified soil block failures up to heights of 15’ and tension cracks developing along the top of the riverbank as shown in Figures 5 and 6. The tension cracks will further grow as they collect water and expand under freeze and thaw cycles. The river bank failures that are occurring at the top of the slope, as shown in Figures 5 and 6, are reducing the stability of the hillside from the river’s edge up to Franklin Avenue. This type of large mass soil failure at the river’s edge and at the toe of the slope is further described in Appendix A and is known as a Retrogressive Slide Develoment. If efficient action is not implemented, the stability of the slope can be further jeopardized. Soil block failures such as shown in Figrue 5 can interfere with ship traffic.

Figure 5: Soil Block Failure

Twenty-two slope stability conditions, commonly referred to as runs, were analyzed at three different cross sections through the site. The summary of the analysis is contained in Table 6 of Appendix A. The cross sections were generated from the digital terrain model that was created from a combination of LIDAR data for the topographical features above water and the bathymetric data that was provided by the hydrographic survey company Substructure. This combination of survey data resulted in an accurate site model for sections extending from the top of the bank at Franklin Avenue to the flow line of the river. The stability runs compared the differences at the river’s edge between the existing condition and the condition with the proposed bulkhead installation under various scenarios involving normal and elevated groundwater conditions.

Figure 6: Tension Crack

Slope stability is generally described in terms of the factor of safety (FoS) against failure, where the FoS is the ratio of the forces holding the slope in place to those attempting to destabilize it. For reference, the following FoSs are typically relevant when designing or evaluating slopes:

- <1.0 general failure can be expected
- 1.0-1.1 slow movement may be observed
- 1.3 acceptable for design of a slope with light loading conditions
- 1.5 acceptable for design of a slope supporting structures

Currently, the river's edge is unprotected. In an elevated groundwater condition, it is an unstable hillside with a FoS of 0.80. Under normal groundwater conditions, the site is only marginally stable, with a FoS of 1.03. However, installation of a bulkhead under the same condition increases the FoS to 1.12 for global stability and increases the local stability of Riverbed Street to 1.3. Additional measures such as re-grading the hillside and implementing a hillside drainage system can further increase the FoS, and will be coordinated with development of the site when the future land use is determined.

This slope stability analysis illustrates how critical it is to improve the stability at the toe of the slope and how much the groundwater elevation influences the safety of the hillside. Unusually high groundwater conditions have been observed previously around the Detroit-Superior Bridge embankment and are a particular concern because there are flooded tunnels that are elevated above Riverbed Street in the vacated West Station Subway.

5. UTILITY INVESTIGATION - WATER

The unusual presence of water in the West Station pedestrian subway tunnel, continual seepage of water along the toe of the slope, and presence of wetlands along the northern portion of the site suggest that an external source of water (beyond normal groundwater conditions) is affecting this site. The following documents and reports have indicated water issues in this northern area of the site in the past. The referenced documents are contained in Appendix A and B.

- Plan Document 7957 (Appendix B): New sleeve installed in **1947** to repair break in the 16" water main
- Plan Document 7957 (Appendix B): New 45° bend installed in **1949** to repair broken bend in the 16" water main
- Plan Document 7957 (Appendix B): 45° top bend installed in **1960** to repair broken bend in the 16" water main
- Housel 1960 Report prepared for Riverview Terrace Housing (Appendix A): Presence of water emanating from the hillside on the north end of the Lederer Building was linked to **1960** railroad track settlement and attributed to a spring or broken waterline
- CUY-6-14.99 (Appendix B): **1967** construction plans to repair landslide and install horizontal drains in the hillside and construct a concrete gutter to carry upper parking lot drainage to the toe of the slope at Riverbed Street
- Stilson 1995 Report prepared for CMHA (Appendix A): Reference to **1967** landslide that was attributed to water from a broken water main or sewer
- BBC&M 2005 Report prepared for Parsons Brinkerhoff (Appendix A): Includes references to **1960's** ODOT ground water records where piezometric levels varied by more than 30' in one day due to ruptures in utilities (water and/or sewer)
- EDP **1989** Report prepared for Trigg (Appendix A): Several references to seepage along Riverbed Street
- May 3, **1995** HNTB Correspondence to ODOT (Appendix B): *"A rise in the water level and/or an increase in the intensity of the surface loading can cause slope failure. Recommendations were made in the report and in each annual bridge inspection report through 1994 that action be taken to dewater the slope prior to awarding a contract to*

rehabilitate the bridge. Although the standing water in the west station area adjacent to the south wall has been eliminated, the ground, both inside and outside the bridge, still appears damp."

- May 22, **1995** ODOT Correspondence to Cuyahoga County (Appendix B): *"Please be advised that at this time the dewatering of the slope remains the recommended course of action. Specifically, water and sewer lines should be inspected and any leaks found should be repaired and horizontal drains should be installed in the slope."*
- EDP **2005** Report for Riverview Hope VI (Appendix A): Variable water fluctuations in piezometers could be contributed to water main leakage because water temperatures mimic Lake Erie potable water supply
- CUY-6-14.56 (Appendix B): **2013** ODOT construction plans to dewater (again) the Pedestrian Bypass and Waterworks Tunnel

An investigation was conducted to try to determine the source of standing water in the tunnel system and condition of the water mains that were installed in 1918.

It was observed during the site inspection that the West Station pedestrian bypass tunnel was flooded with water (see Figure 7). Observations of water entering the tunnel were noted in the late 1980's by Cuyahoga Bridge Inspectors. It is unlikely that the tunnel would have been constructed below the groundwater elevation without means of dewatering, since the primary purpose of the tunnel was to allow subway passengers to safely cross under the railroad tracks to access the restrooms.

Figure 7: Bypass Tunnel Flooded with Water

Figure 8 shows the layout of the pedestrian bypass tunnel in relation to the access to the restrooms. The standing water at this elevation is approximately 20' below the existing grade of Detroit Avenue near the intersection of West 25th Street. Although groundwater elevations can fluctuate, an extensive sampling and groundwater monitoring program was conducted south of the tunnel system at 1477 West 25th Street between 1999 and 2006 by Hull & Associates and Delta Environmental Consultants. There are more than 25 monitoring wells installed at the property (see Figure 9) for evaluation of the groundwater associated with the underground storage tanks at this site. The groundwater depth measurements averaged 29' below grade, and the closest wells to the tunnel systems, MW-24 and MW-25, were 30.5' and 29' respectively. Therefore, there is a 10' +/- water elevation difference between the monitoring wells and the standing water in the bypass tunnel system. This means that the water in the tunnel is 10' higher than the natural groundwater, indicating an unexplained elevated water condition.

Figure 8: Pedestrian Bypass Tunnel Layout

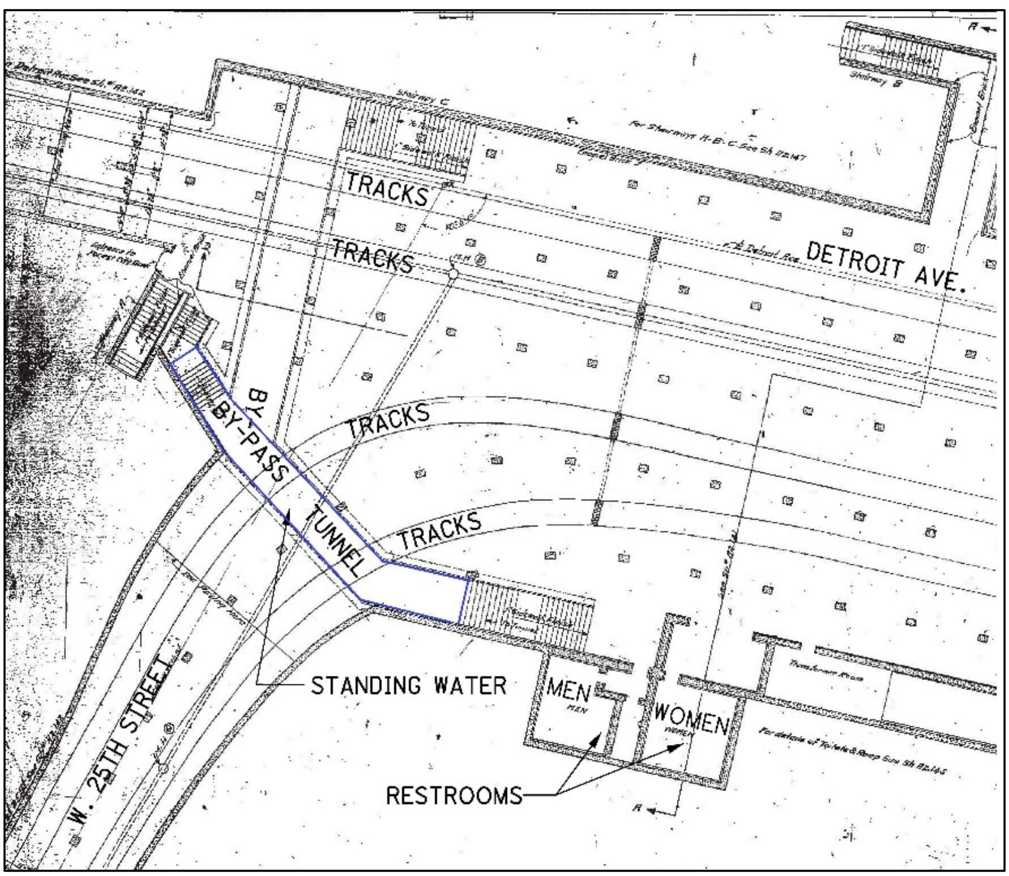
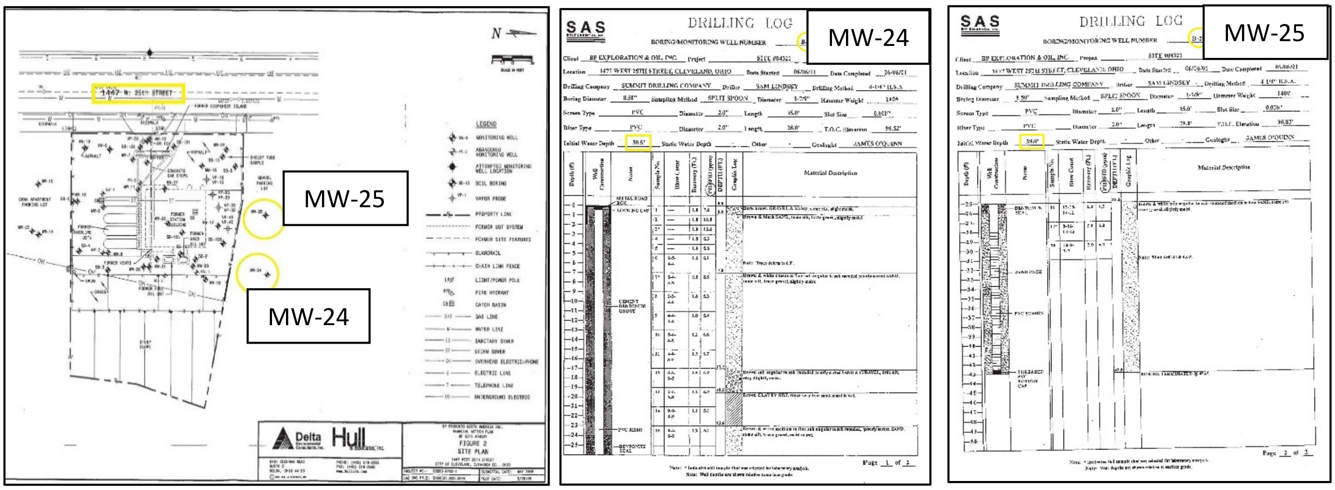
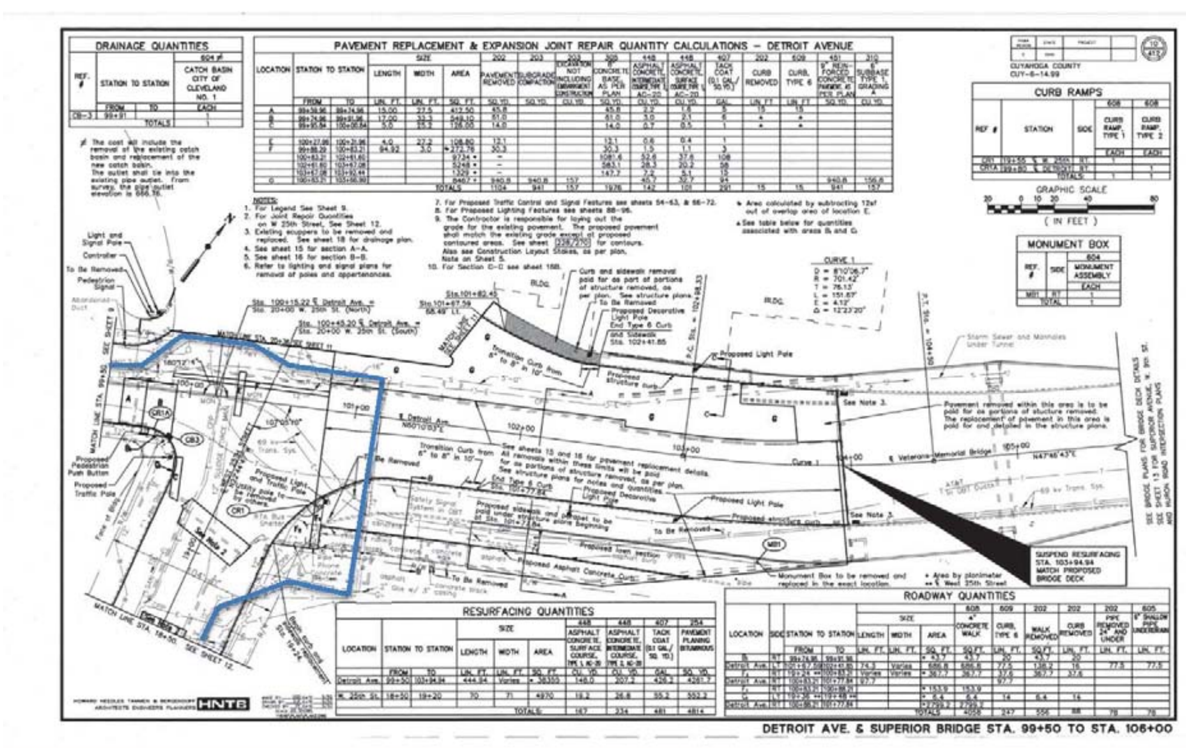


Figure 9: Monitoring Wells



A likely explanation for the water elevation difference can be the presence of two water main systems, 12" and 16" diameter lines, which run parallel to West 25th Street and cross under Detroit Avenue through a waterworks tunnel that was constructed under the subway railroad track line. The alignment of the water mains is shown in Figure 10.

Figure 10: Water Main Alignments



The waterworks tunnel is approximately 85’ east of the bypass pedestrian tunnel, but they are connected by a shared drainage system, as shown in Figure 11.

Figure 11: 2014 Project Plan Sheet from CUY-6-14.56

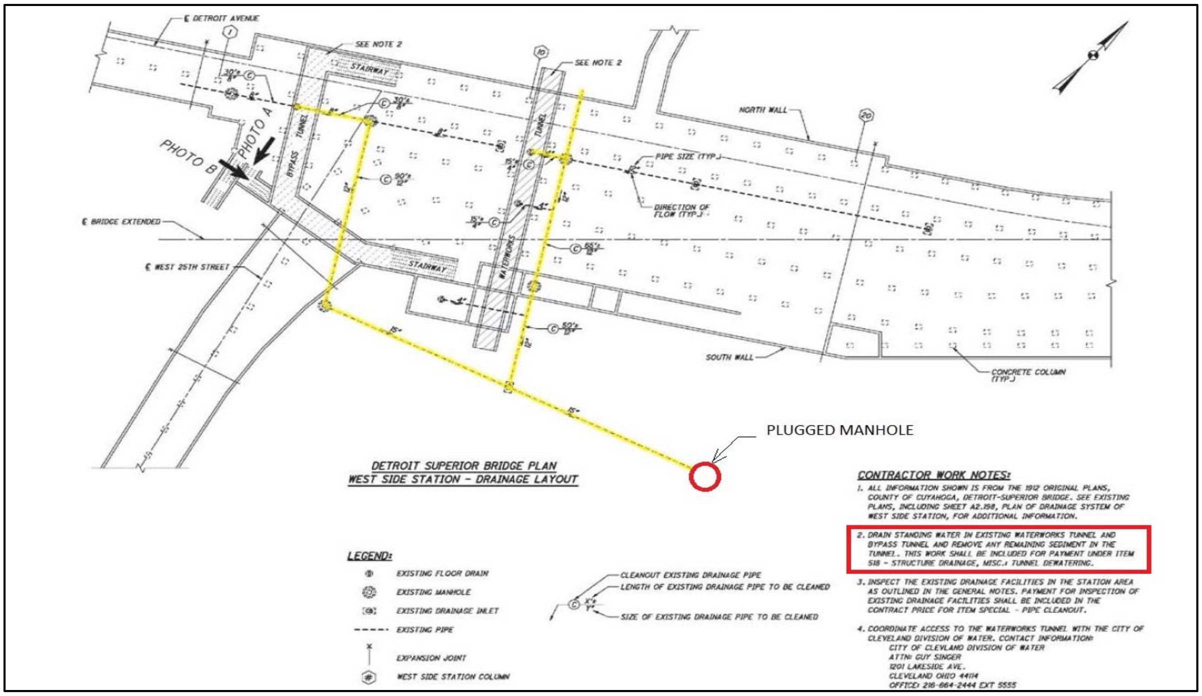


Figure 11, Contractor Work Note 2: Drain standing water in existing waterworks tunnel and bypass tunnel and remove any remaining sediment in the tunnel. This work shall be included for payment under Item 518 – Structure Drainage, Misc., Tunnel Dewatering.

Figure 11 is from the recent construction project, CUY-6-14.56 PID No. 77040, which is primarily a concrete rehabilitation of the Detroit-Superior Avenue Bridge. The highlighted conduits for each tunnel system are connected at a drainage structure that flows to a manhole that should outlet to the Cuyahoga River. However, that manhole is partially plugged and does not allow drainage of the tunnel systems. The plugged manhole (which is shown in Figures 11 and 14) is approximately 40’ deep and has 20’ of standing water in it. An attempt was made to dewater the manhole in conjunction with the contractor dewatering of the pedestrian bypass tunnel, per Item 2 in the highlighted construction work notes in Figure 11. The water in the manhole was lowered by 8’ in one week of pumping and the contractor was able to partially dewater the pedestrian tunnel. However, complete dewatering of either structure was never achieved.

The contractor hired by ODOT for CUY-6-14.56 also made an attempt at dewatering the tunnel but could only reduce the water elevation by approximately 2’-4’. A section view of the tunnel is shown in Figure 13. ODOT decided to abandon the operation and cease the work associated with draining and inspecting these tunnel systems. Inspection of the waterworks tunnel could not be performed for this phase because access was blocked and flooded with high pressure water.

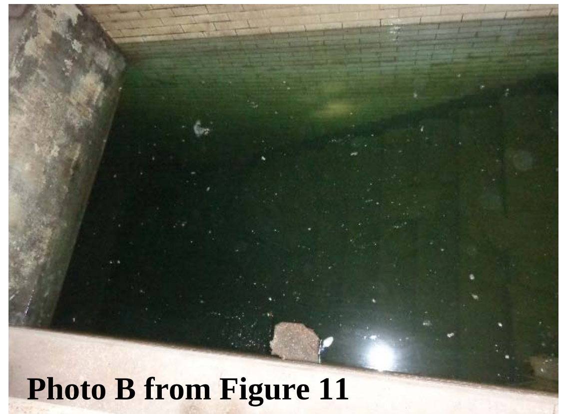
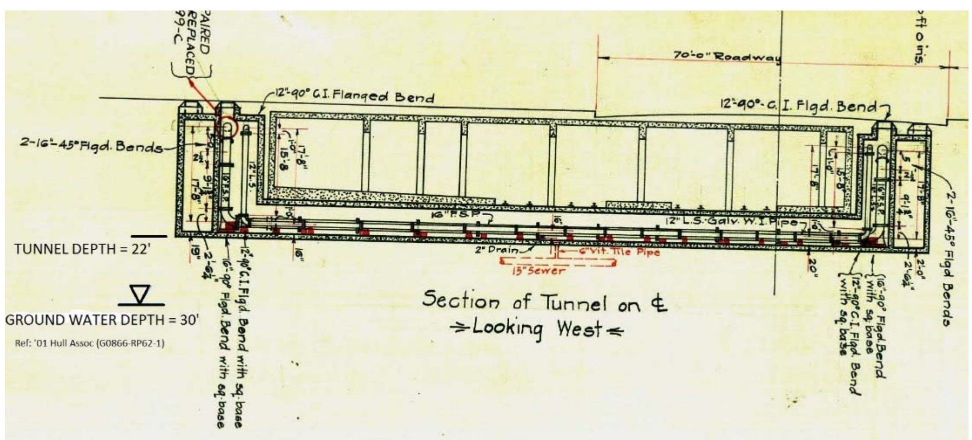


Photo B from Figure 11

Figure 12: Water Penetrating through Walls

Figure 13: Section View of the Tunnel



The fact that the tunnels have a combined drainage system that share an outlet that is partially plugged allows water to back up into the tunnel systems. Therefore, the tunnels serve as large holding reservoirs allowing water to slowly discharge through the partially plugged manhole.

Water samples were collected from the pedestrian bypass tunnel. The results indicate a presence of chlorine and fluoride (test results are included in Appendix C). The City of Cleveland collected independent samples of the subway tunnel water and concluded that the samples did not match City water characteristics. However, it is unknown how long the subway tunnel water has been collecting and mixing with the collection of street drainage and construction fuels used during the Detroit-Superior Bridge rehabilitation project. Therefore, the subway tunnel water is not expected to match exactly with the characteristics of the City water supply. The fact that there is a presence of chlorine and fluoride, despite the levels of concentration combined with the excessive additional pressure coming from the waterworks tunnel, indicates that the flooded water condition in the tunnels is associated with leaks in the 12” and/or 16” water mains. Active participation to effectively identify and solve this problem is an important factor for containing normal groundwater conditions and establishing a suitable factor of safety for the hillside.

6. UTILITY INVESTIGATION – STORM WATER

The storm sewer system associated with the drainage of the subway bypass tunnel and waterworks tunnel was investigated as were the storm systems on the Detroit-Superior Bridge, Franklin Avenue and Riverbed Street.

An attempt to dewater the partially plugged manhole that is connected to the tunnel system was made between May 5, 2014 and May 9, 2014. The depth of water in this manhole during the time of inspections was consistently 20’ and the bottom of the manhole is approximately 40’ deep. The process of dewatering the manhole with a trash pump was ceased because of the lack of advancement to lower the water by more than 8’. Subsequently, a 4,000 Gallon VAC-Truck was mobilized to the site to try to dewater and clean the debris and sediment from the bottom of the manhole. After two days of operations and three full disposals of water and sediment, the operation was halted because of lack of progress to dewater the structure. Therefore, the condition assessment of the storm conduits draining into this system from the tunnels could not be made.

Figure 14: Partially Plugged Manhole as shown in Figure 11

Figure 15: Water Depth in Partially Plugged Manhole

Existing ODOT and Cuyahoga County plans fail to show an outlet to this structure. The site was thoroughly inspected for a headwall or outlet pipe associated with this manhole, but none was found. However, the horizontal 2” diameter drain pipes installed in the slope by ODOT in 1966 per project CUY-6-14.99 were found in the field, as show in Figure 16. They were in fair condition but the outlets were dry and not discharging water. An original plan sheet provided by Cuyahoga County (see Appendix B), indicates that the manhole could be connected to a catch basin in Riverbed Street. Therefore, an inspection of the Riverbed Street storm water system was completed.

Figure 16: Horizontal 2” Diameter Drain Pipes Installed in 1966

The Riverbed Street drainage system is an independent system that runs parallel to Riverbed Street with two apparent outfalls to the Cuyahoga River on the southern and northern ends of the site as shown in the conceptual 30% plan set located in Appendix D. The first three manholes north of Columbus Road are blocked with debris and sediment, and the 30” storm sewer, for a length of approximately 600’, is non-functioning as shown in Figure 21. The 30” outfall to the Cuyahoga River is discharging drainage from the north half of the site, but the headwalls have deteriorated and the end section of the reinforced concrete pipe (RCP) is separating from the system. The drainage system flowing from the north to the 30” outfall is functioning up to the location where the sanitary low level interceptor is damaged. The northern most section of storm sewer connects to a catch basin in Riverbed Street and then outlets to an outfall approximately 500’ south of Detroit Avenue. There is no connection between the catch basin and any drainage system associated with the top of the hillside. A full report of this system is contained in Appendix E.

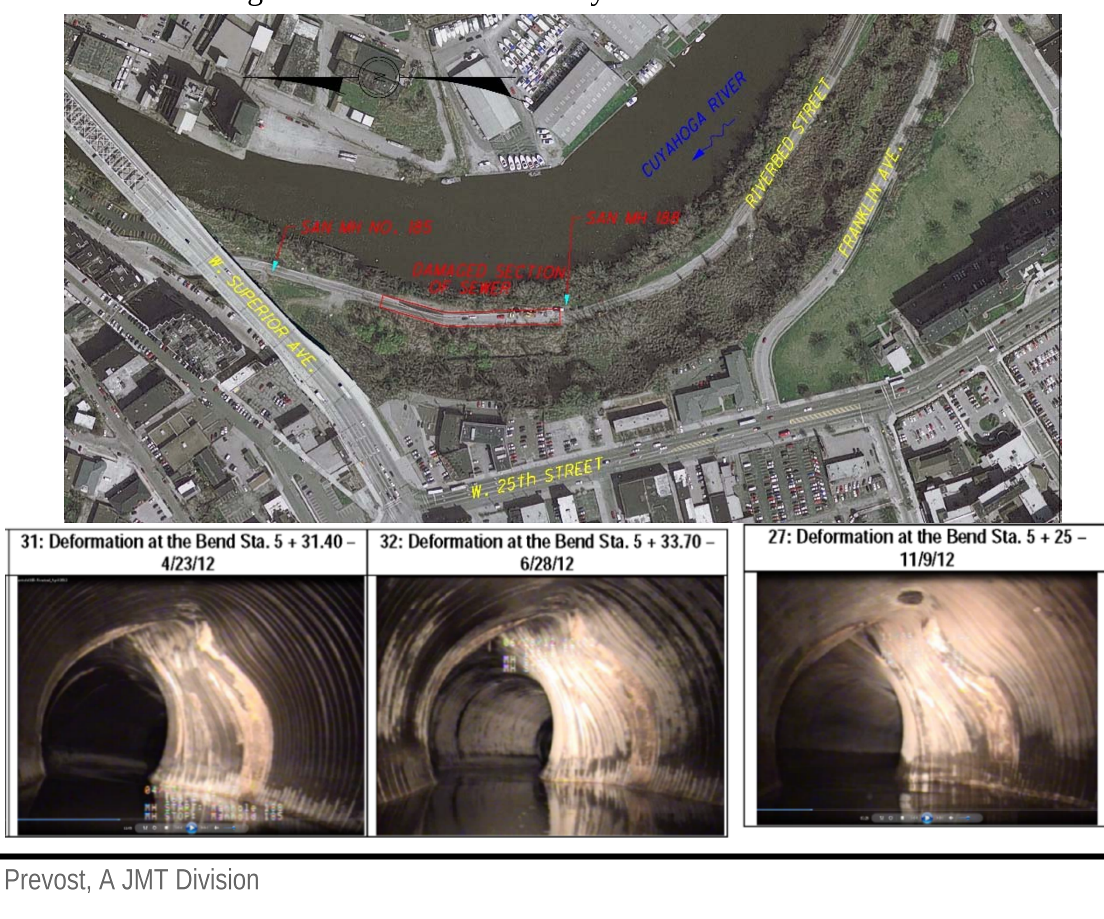
The Franklin Avenue storm drainage system consists of brick manholes and vitrified clay pipe (VCP). Despite the age of the storm drainage system, and the theory that a more progressive landslide movement has occurred up to the elevation of Franklin Avenue, the system is intact and functioning with minor displacements in the joints of the VCP. A full report of this drainage system is included in Appendix F.

The drainage system associated with the west end of the Detroit-Superior Bridge was also inspected and a full report is contained in Appendix G. The surface drainage is collected in catch basins along the curb lines of West Superior Avenue and discharged through scuppers to independent closed basin systems adjacent to substructure units along the embankment of the bridge. The system is functioning well and outlets to the Cuyahoga River via 12” RCP conduit.

7. UTILITY INVESTIGATION – SANITARY

The Northeast Ohio Regional Sewer District (NEORSD) maintains a 60” brick sanitary sewer known as the Westerly Low Level Interceptor (WLLI) through the project limits of the site. The alignment closely follows Riverbed Street and the depth of cover varies from 30’- 40’. The flow is from south to north toward the Division Avenue Pump Station that carries the sewage to the Westerly Wastewater Treatment Plant. The condition of the sanitary line was compromised in two local slips along Riverbed Street in January and August of 2006. An emergency repair project was conducted in 2007 that installed a 42” and 50” spiral wound grouted sleeve between Sanitary Manholes 185 and 190. Also, a 12” to 16” bypass system was installed in case of future failures along Riverbed Street. NEORSD routinely monitors this section of sewer with video inspections conducted approximately every six months. Review of the video indicates that the lining has deformed between the 2012 and 2013 inspections. It appears that the section under most distress is the section highlighted in Figure 17, with maximum deformation of the lining occurring in the horizontal deflection of the alignment.

Figure 17: Section of Sanitary Line Under Most Distress



The remaining length of the sewer appears to be stable and functioning as designed. The section between Manholes 185 and 188 is approximately 700’ and could be replaced in conjunction with the installation of the bulkhead system. There would be advantages to combining the construction of the tieback system with the required excavation to expose and replace the damaged section of the sanitary line. In essence, the sheet piling designed for the bulkhead deadman system could function as a shoring system so that conventional trench boxes could be used for replacement of the line as shown in Figure 22. The bypass system already in place could be used to divert flow during the replacement process. The approach and design would require close coordination with NEORSD staff. Coordinating efforts to repair the WLLI with stabilizing the hillside will reduce total cost and time necessary for global improvement to the site.

8. SURVEY INVESTIGATION

A survey was conducted to compare the existing centerlines of West 25th Street, Franklin Avenue, Riverbed Street, Columbus Road and Detroit Avenue between the centerline monuments and the recorded plats. The full survey report can be found in Appendix H. If the inclinometer measurements that were taken in 2005 indicate hillside movements up to ½” per month, prorated to 2015, one would expect to see roadway separation distances on the order of 5’.

Review of the survey information indicates that the centerline alignments are in close proximity to the recorded plats. The intersection of Franklin Avenue and Columbus Road match very well in addition to the intersection of Riverbed Street at Columbus Road. There is a centerline shift of approximately 2’-3’ along the northern section of Riverbed Street in the location where a previous soil failure occurred. Therefore, from a global perspective, there does not appear to be a centerline separation between Franklin Avenue and West 25th Street, but there is a local separation in centerlines between Riverbed Street and Franklin Avenue at the northern end of the site.

The conclusion of the survey data correlates with failures associated at the toe of the slope, between Riverbed Street and the river’s edge, but not necessarily at the top of the slope along Franklin Avenue.

9. RIGHT-OF-WAY INVESTIGATION

The project site consists of 18 acres and is comprised of 24 parcels. The majority owner is the Cleveland Metro Housing Association (C.M.H.A.), which covers approximately 70% of the site with 12 separate parcels. The other owners consist of North Cuyahoga Valley Corridor Inc., Greater Cleveland Regional Transit Authority, Westbank Develop Corp., Angio Company, Interstate Develop LTD, Cuyahoga County Board of Commerce, K&D Enterprises and Riverbed Aarque LLC. A detail of the property map is included in Appendix I. The combination of these parcels is approximately 30% of the project site area. It is anticipated that each of these parcels will be affected by the slope remediation and therefore will need to be acquired, or work permits arranged, before environmental testing can be performed. There are three parcels (Riverbed Aarque, Westbank Development Corp. and North Cuyahoga Valley Corridor Inc.) located along the river’s edge that will be most affected by the bulkhead installation.

To effectively remediate the site efficiently, it will be necessary to condense the right-of-way ownership at the lower Riverbed Street corridor to one owner for coordination of permits and eventual construction entry. Also, it will be beneficial for future maintenance of the infrastructure and safety of the site.

10. ENVIRONMENTAL SITE ASSESSMENT (ESA)

The project site was assessed by HzW Environmental Consultants for potential release of hazardous substances and/or petroleum products in accordance with Ohio Department of Transportation Environmental Phase I ESA. The comprehensive environmental report can be found in Appendix J. In summary, 6 of the 9 properties that are highlighted in Figure 18 are recommended for further study involving Phase II ESA activities. A Phase II investigation is beyond the scope of the current contract. However, when implemented, Phase II investigations will help solidify the presence and extent of hazardous substances in the soil and/or groundwater. The elements that were identified in the Phase I study were expected, due to the diverse history of the site, including coal storage facilities, lumber yards, blacksmith shops, breweries, automobile garages and gas stations. Potential remediation of the site may involve 'over excavation' to remove potentially hazardous material, but depending on the property and location, new suitable fill material may or may not be needed on the site due to grading and dewatering plans.

- Property 1: Previous experience with railroad siding has indicated the potential for compounds associated with preservation of railroad ties such as polynuclear aromatic hydrocarbons (PAHs), lead and arsenic to exist in soil at concentrations exceeding Ohio risk-based standards for construction and excavation activities.

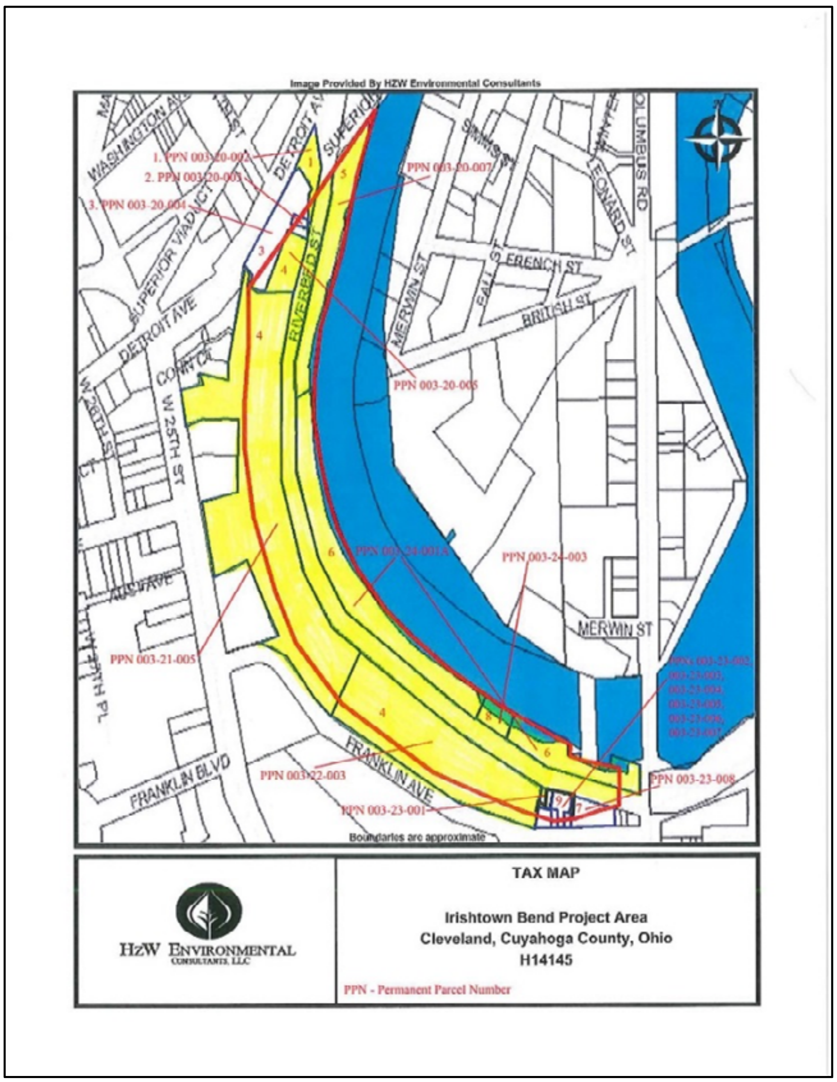
- Property 4: In 1999 soil sampling efforts identified soil and/or groundwater contamination at the site. Based on the extensive historic development of Property #4, including lumber companies, mill facilities, and an automobile wrecking yard as well as the historical presence of hazardous materials and Underground Storage Tanks (UST) on the facilities located up-gradient from Property #4, this property is recommended for inclusion in Phase II ESA activities.

- Property 5: This property was developed with railroad tracks, a coal dock, a coal chute and an iron draw bridge in 1896. Coke and coal are known to contain petroleum aromatic hydrocarbons (PAHs) and metals, which have the potential to leach out of the coal or coke during a precipitation event.

- Property 6: Consists of densely wooded land that slopes to the east-northeast towards the Cuyahoga River. Based on the historic development of Property #6 with railroad tracks and coal transportation operations, this parcel is recommended for inclusion in Phase II ESA activities, as a majority of this site will be affected by the bulkhead installation.

- Parcel 8: Consists of wooded land that slopes to the northeast towards the Cuyahoga River. Based on the historic development of Property #8 with railroad tracks and coal transportation operations, this parcel is recommended for inclusion in Phase II ESA activities, as a majority of this site will be affected by the bulkhead installation.

Figure 18: Property Map



11. WETLAND DELINEATION

The project site was evaluated for the presence of wetlands that would be classified as ‘Waters of the United States’ and ‘Waters of the State of Ohio’ by the United States Army Corps of Engineers description guidelines. To be classified as such, the suspected area has to contain three characteristics: hydrophytic vegetation, hydric soils and wetland hydrology. There are two distinct areas within the project site that meet all of the criteria. The location of the wetlands are shown in Figure 19. For simplicity, they are labeled as Wetland A and B and a summary of their hydrological composition is summarized below.

ID	Acres	Vegetation	Soil	Hydrology	Type
A	0.18	Reed	Redox Dark Surface	Saturation	Emergent
B	0.41	Reed, Canarygrass, American Tearthumb	Redox Dark Surface	Saturation	Emergent

The finding of categorized wetlands was not anticipated due to the past industrial use of the site and lack of native species that would exist after the significant grading conducted in the 1960’s (see Figure 4). For a wetland, supporting vegetation and hydric soils need to exist, and the site needs to have a continual water source to support non-native vegetation and soil conditions. Therefore, our investigation focused on the water supply to these two areas.

It is clear from overlaying the survey mapping with the wetland delineation that Wetland A resides at the bottom of a concrete drainage chute that was constructed in 1966 to carry parking lot surface drainage to the toe of the slope. The condition of the concrete chute has deteriorated, however there is a natural swale that has developed that carries parking lot and slope drainage to Wetland A. The overlay of the map also helps identify the water source for Wetland B. The area associated with this wetland is within the confines of the foundation remnants of the Lederer building. As shown in Figure 20, the Lederer building foundation is trapping water and creating a pond effect enabling wetland vegetation to grow and hydric soils to develop.

Figure 19: Mapped Wetland Areas A and B

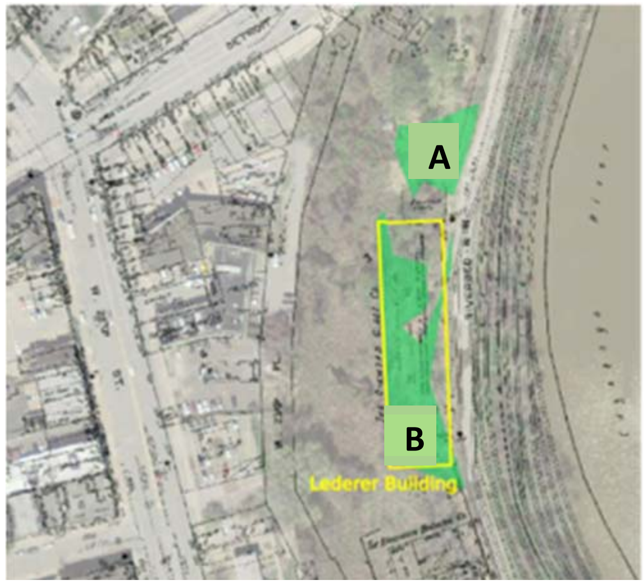
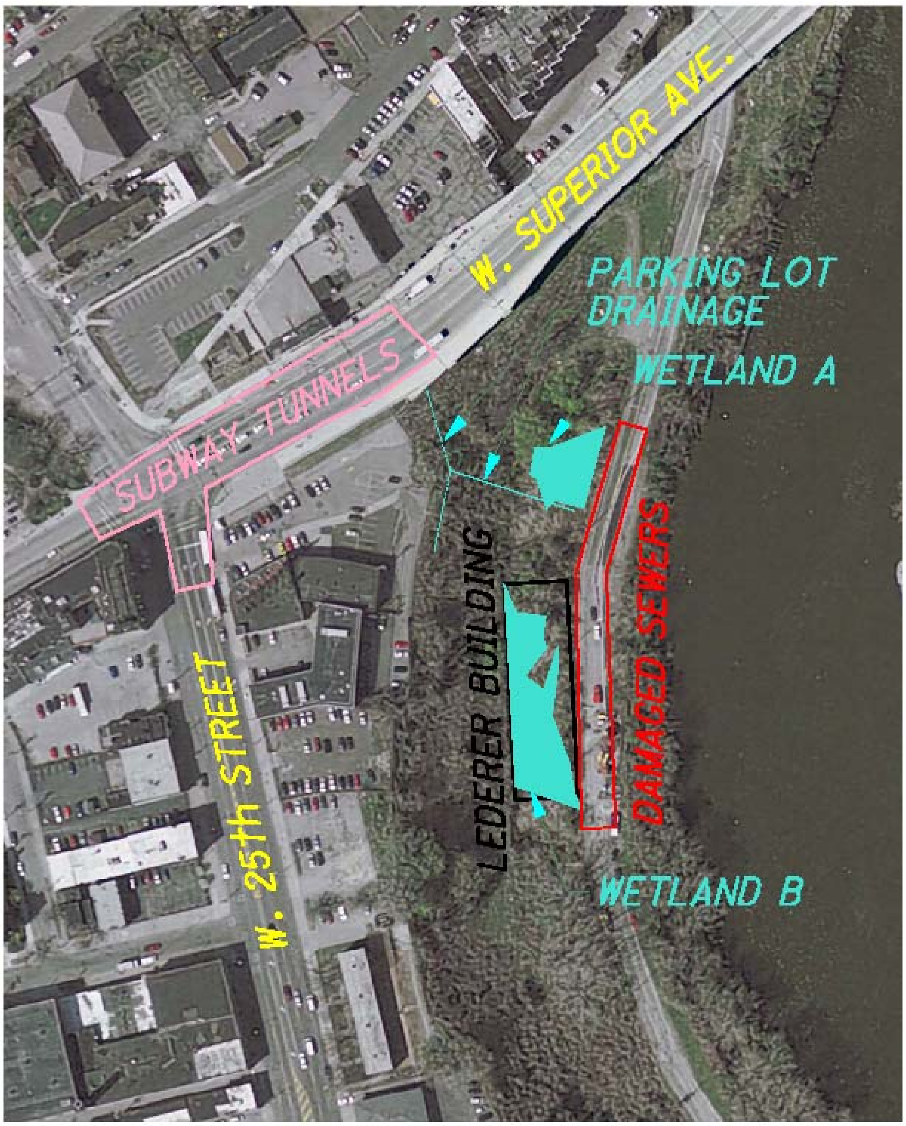


Figure 20: Lederer Building Foundation (Trapping Water)

The result of the presence of two wetlands within the project area that exceeds 0.5 acres means that completion of a USACE Section 404 Individual Permit and an OEPA Section 401 Water Quality Certification will be required prior to remediation of the site. However, if the source of water that feeds the soil and vegetation can be eliminated and the presence of each are reduced, then wetland permits may not be necessary.

Figure 21: Combined Location Map – North End



The Wetland Delineation report completed by HzW Environmental Consultants can be found in Appendix K.

12. CONSTRUCTION COST ESTIMATE AND SEQUENCE OF EVENTS

The construction cost estimate follows the Pareto Principle, or 80/20 rule (roughly 80% of the effects come from 20% of the causes). The cost estimate includes the major cost drivers in a project that account for more than 80% of the cost. Quantities were developed based on the 30% conceptual design plans (included in Appendix D), and historic unit rates were used to develop the overall cost. The conceptual plans reflect the installation of a bulkhead and tie-back system, construction of a 10' multi-use asphalt path, replacement of the interceptor sanitary sewer, removing the existing Riverbed Street storm sewer, re-grading the site, realigning Franklin Avenue, and implementing a drainage system for the trail and hillside. A breakdown of the cost estimate (see Appendix L) in conjunction with the recommended sequence of activities to restore the site for safe public use is presented in the table below.

Work Item Description	**Estimate**
Step 1. Right-of-Way Acquisition	TBD
Step 2: Environmental Remediation - Phase II ESA - Waterway permits - State Historic Preservation Office Coordination/Permits	$14,500,000
Step 3: Install Cured In-place Lining in Water Mains	$1,000,000
Step 4: Install Bulkhead and Tieback Anchor System	$16,150,000
Step 5: Replace Damaged Section of Westerly Low Level 60" Sewer	$780,000
Step 6: Relocate Utility Poles	$100,000
Step 7: Realignment of Franklin Avenue	$6,000,000
Step 8: Grade Site with Earth Benches and Install Geotextile Fabric and Drainage System	$8,000,000
Step 9: Abandon Riverbed Storm Sewer System and Install Trail Drainage	$810,000
Step 10: Re-establish Grades and Trail Development	$2,000,000
TOTAL	**$49,340,000**

13. REMEDIATION

To properly stabilize the project site, construction activities need to be carefully orchestrated with the environmental clearance, historical coordination, utility improvements and replacements, grading, and dewatering/drainage activities. The immediate course of action is to secure the toe of the slope and protect it from erosion and from the action of bow thrusters of freighters navigating the ship channel. In order to do this effectively, a steel bulkhead system will need to be constructed with a continuous deadman anchor system and tiebacks spaced at approximately 10’. Combining the needed improvements into one project will save significant costs for mobilization on a sensitive site, material transportation, excavation and dewatering activities.

Figure 22: Tieback System in Coordination with Sanitary Replacement Shoring