Supplemental Phase IA Archaeological Study Baltimore & Potomac Tunnel Replacement Program

Baltimore, Maryland

THIS REPORT CONTAINS CONFIDENTIAL INFORMATION
NOT FOR PUBLIC DISTRIBUTION

Prepared for:

Amtrak Headquarters
1 Massachusetts Avenue, N.W.
Washington, DC 20001

Prepared by:

WSP USA Inc.
1 East Pratt Street, Suite 300
Baltimore, Maryland 21202

September 27, 2023

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Prepared for:

Amtrak
1 Massachusetts Avenue, N.W.
Washington, DC 20001

Prepared by:

Jason Shellenhamer and Henry Ward

WSP USA Inc.
1 East Pratt Street, Suite 300
Baltimore, Maryland 21202

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ABSTRACT

On behalf of Amtrak, WSP USA Inc. (WSP) has prepared a supplemental Phase IA archaeological study for the Baltimore & Potomac (B&P) Tunnel Replacement Program (Program) in Baltimore, Maryland. The proposed Program will replace the 1.4-mile-long rail tunnel located along the Northeast Corridor in Baltimore. The B&P Tunnel is owned by Amtrak and used for regional and Acela intercity passenger trains, Maryland Area Rail Commuter passenger trains, and Norfolk Southern Railway freight trains. The Program extends between and does not include Baltimore Pennsylvania Station (B-3727) and North Franklintown Road and includes a tunnel extending along a gradual arc for approximately 2 miles.

To satisfy its responsibilities for the Program under Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations (36 C.F.R. Part 800), including completing archaeological historic property identification and resolution of adverse effects on historic properties, the Federal Railroad Administration, in consultation with the other signatories and consulting parties, executed a Programmatic Agreement (PA) on March 2, 2017—*Project Programmatic Agreement Among the Federal Railroad Administration, Maryland State Historic Preservation Officer, National Railroad Passenger Corporation, and Preservation Maryland Regarding the Baltimore & Potomac Tunnel Program, Baltimore City, Maryland*—that requires identification and assessment of Program effects on archaeological historic properties.

The initial Phase IA archaeological study was completed in 2015; however, the project designs had not been sufficiently developed at that time to establish an Archaeological Area of Potential Effects (APE-Archaeology). That study was therefore limited to the centerline of the alignments of each of the design alternatives. The 2015 study concluded that although large portions of the alignment alternatives have been disturbed, there was the potential for the presence of both precontact and historic archaeological sites within the alignments of each of the build alternatives. The 2015 study recommended that a supplemental Phase IA archaeological study be conducted once the Preferred Alternative was determined and the extent of anticipated ground-disturbing activities ascertained.

In accordance with Program PA stipulations VI.B, VI.C.1 and VI.C.2, WSP completed this supplemental Phase IA archaeological study to determine the sensitivity for the presence of precontact and historic archaeological resources in the APE-Archaeology for the Selected Alternative for the Program. In addition, the supplemental Phase IA study is intended to make recommendations for further survey to identify archaeological resources in the APE-Archaeology.

The APE-Archaeology consists of approximately 150 acres of discontiguous areas that comprise the Program's limits of disturbance (LOD), in which Program activities include open-cut excavation, construction staging areas, temporary access roads, and utility and stormwater management sites. Areas within the LOD excluded from the APE-Archaeology are those areas of proposed ground disturbance associated with tunnel boring or mined excavation in which ground disturbance will occur at depths where archaeological resources are not present. For the purpose of the Phase IA archaeological study, the area assessed for archaeological sensitivity included a 25-foot buffer extending around the APE-Archaeology to account for potential minor design alterations that may occur during future stages of the project.

The review of available environmental and soil data, historical background research, the results of the Geographic Information System topographical analysis, and geotechnical survey data indicate that there is a moderate to high sensitivity for encountering precontact and/or historic archaeological

resources in portions of the APE-Archaeology. The sensitive portions of the APE-Archaeology are as follows.

- *South Portal and Approach*, *from Edmondson Avenue north to the intersection of North Payson Street and Riggs Avenue*: Moderate to high sensitivity for deeply buried precontact to early nineteenth-century resources.
- *South Portal and Approach, from Riggs Avenue south to West Lanvale Street between North Payson Street and North Pulaski Street:* Moderate sensitivity for late nineteenth- to early twentieth-century resources associated with the Monroe-Riggs neighborhood.
- *Intermediate Ventilation Facility, parking lot at Linden Avenue north of West North Avenue:* Moderate to high sensitivity for late nineteenth- to early twentieth-century resources associated with the Reservoir Hill neighborhood.

The portion of the APE-Archaeology extending from Edmondson Avenue to the intersection of North Payson Street and Riggs Avenue historically contained floodplains and well-drained uplands extending along the north branch of Gwynns Run that were infilled with up to 20 feet of redeposited soil in the early twentieth century. There is the potential that archaeological resources associated with precontact and eighteenth- and early nineteenth-century habitation may be intact underneath the fill deposits. In addition, the portion of the APE-Archaeology from North Payson Street and North Pulaski Street between Riggs Avenue and West Lanvale Street has the potential to contain the infill basements and other cultural deposits associated with early residents of the Monroe-Riggs neighborhood.

WSP recommends a geomorphology survey in the areas of archaeological sensitivity in the APE-Archaeology for the south portal and approach. The goal of the survey would be to determine whether intact buried surfaces and features are present under the overlying fill deposits that have potential to contain archaeological resources. If geomorphological survey identifies intact soil horizons or features, a systematic shovel test survey or the excavation of exploratory trenches may be required to identify archaeological resources that could be affected by the Program.

WSP recommends a Phase IB/II survey in the area of archaeological sensitivity at the Intermediate Ventilation Facility site. The parking lot along Linden Avenue is on the site of several former rowhouses associated with the late nineteenth-/early twentieth-century neighborhood of Reservoir Hill. Reservoir Hill was a predominantly Jewish neighborhood during that time, and there is potential that infill basements and other cultural deposits remain intact underneath the parking lot that could contribute to the understanding of Jewish communities in Baltimore in the late nineteenth and early twentieth centuries. The goal of the survey would be to determine whether intact yard deposits and features associated with the former late nineteenth-century rowhouses are present underneath the parking lot.

The remainder of the APE-Archaeology is assessed as having a low sensitivity for the presence of precontact and historic archaeological resources. The prior modification of the landscape within the remainder of the APE-Archaeology consisted of substantial ground disturbance associated with urban development and transportation improvements. Owing to the extent of previous ground disturbance, there is a low potential for the presence of intact archaeological resources and no further archaeological survey is recommended for the remainder of the APE-Archaeology. If, in the course of consultation and project planning, the LOD for the Program is modified to extend outside the currently defined APE-Archaeology and 25-foot buffer, further evaluation would be required to determine whether the changes have the potential to impact archaeological historic properties.

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I. INTRODUCTION

A. PROJECT BACKGROUND

On behalf of Amtrak, WSP USA Inc. (WSP) has prepared a supplemental Phase IA archaeological study for the Baltimore & Potomac (B&P) Tunnel Replacement Program (Program) in Baltimore, Maryland.[1] The proposed Program will replace the 1.4-mile-long rail tunnel located along Amtrak's Northeast Corridor (NEC) in Baltimore. The B&P Tunnel is owned by Amtrak and used for regional and Acela intercity passenger trains, Maryland Area Rail Commuter (MARC) passenger trains, and Norfolk Southern Railway freight trains. Built in 1873, the B&P Tunnel is one of the oldest structures on the NEC. The existing double-track tunnel was constructed of brick and stone masonry, with additional materials added over time.

In accordance with National Environmental Policy Act (NEPA), the Federal Railroad Administration (FRA), as the lead federal agency, issued a Draft Environmental Impact Statement (DEIS) in December 2015 that evaluated the environmental impacts of three build alternatives (Alternatives 3A, 3B, and 3C) in comparison with the No-Build Alternative. FRA issued a Final Environmental Impact Statement (FEIS) on November 25, 2016. A Phase IA archaeological study for the B&P Tunnel Program's three build alternatives was completed in 2015 in support of the DEIS. The study found that areas with potential for both precontact and historic archaeological resources are present in the approximate alignments of each of the three alternatives but that the designs were not sufficiently advanced at that time to identify specific areas for archaeological survey or determine the effects on archaeological resources as a result of the undertaking.

Based on the analysis of the Program's potential environmental effects in the DEIS and public and agency comments, the FRA and MDOT identified Alternative 3B as the Preferred Alternative for the Program in the FEIS. The FRA issued the Record of Decision (ROD) in March 2017 for the Program, in which the FRA determined that the Preferred Alternative is the Selected Alternative for the B&P Tunnel Program. The FRA found that the Preferred Alternative, including the preferred Intermediate Ventilation Facility site, best fulfills the Purpose and Need for the Program while balancing impacts on the natural and human environment. In reaching this decision, the FRA considered the physical and operational characteristics and potential environmental consequences associated with the alternatives.

To satisfy its responsibilities for the Program under Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations (36 C.F.R. Part 800), FRA executed a legally binding Section 106 Programmatic Agreement (PA) for this Program on March 2, 2017, entitled *Project Programmatic Agreement Among the Federal Railroad Administration,*

[1] Since the execution on March 2, 2017, of the *Project Programmatic Agreement Among the Federal Railroad Administration, Maryland State Historic Preservation Officer, National Railroad Passenger Corporation, and Preservation Maryland Regarding the Baltimore & Potomac Tunnel Project, Baltimore City, Maryland*, Amtrak has renamed the project the "B&P Tunnel Replacement Program." The change to the term *Program* reflects that the undertaking requires execution of multiple individual projects throughout the approximately 4-mile corridor to complete the envisioned scope of improvements. Therefore, the term *Program* will be used in future correspondence. Individual projects under the Program will be referred to as projects. This does not affect the validity of the Programmatic Agreement.

Maryland State Historic Preservation Officer, National Railroad Passenger Corporation, and Preservation Maryland Regarding the Baltimore & Potomac Tunnel Program, Baltimore City, Maryland. The Program PA documents the detailed compliance process agreed upon by the signatories and invited signatories—the FRA, Amtrak, the Maryland State Historic Preservation Officer (Maryland Historical Trust or MHT), and Preservation Maryland—to satisfy the FRA's responsibilities under Section 106 and to resolve adverse effects on historic properties in accordance with the Section 106. In accordance with the Program PA, Amtrak, in consultation with the signatories and other consulting parties, is required to identify and assess Program effects on archaeological historic properties.

In accordance with Program PA stipulations VI.B, VI.C.1, and VI.C.2, WSP completed this supplemental Phase IA archaeological study to determine the sensitivity for the presence of precontact and historic archaeological resources in the Archaeological Area of Potential Effects (APE-Archaeology) for the Selected Alternative for the Program (Figures 1 and 2).

B. PROGRAM DESCRIPTION

The Program extends between and does not include Amtrak's Baltimore Pennsylvania Station (B-3727) at the east end and North Franklintown Road at the west end (referred to as north and south, respectively, for the purposes of the study), and follows the existing railroad mainline track in the Jones Falls Valley under the Howard Street Bridge to just before North Avenue, where it leaves the existing track alignment to begin its gradual arc. The alignment continues above ground until it reaches its north portal at the retaining wall next to the Maryland Transit Administration (MTA) North Avenue Light Raillink Station. As the alignment approaches the north portal, the new tracks remain close to the existing grade until reaching West North Avenue. At that point the alignment begins to descend gradually below the existing grade. At the north portal the alignment is situated approximately 50 feet below the existing grade and travels through an existing retaining wall adjacent to the North Avenue Light Raillink Station to begin its descent below ground.

The Program alignment continues below ground in a gradual arc for 2 miles, traversing below primarily residential city blocks in the neighborhoods of Reservoir Hill, Penn North, Sandtown-Winchester, Bridgeview/Greenlawn, Midtown-Edmondson, and Penrose/Fayette. The south portal will be located southeast of the P. Flanigan & Sons asphalt plant, and southeast of the existing NEC tracks. The open-cut sections will be located adjacent to the existing NEC, between the proposed south portal and Lafayette Avenue. At the south portal the open-cut section will extend approximately 45 feet below the existing grade. As the alignment continues south, the new tracks gradually ascend until reaching the existing grade as it crosses West Franklin Street and returns to the existing NEC right-of-way (ROW) near Warwick Avenue. At-grade track work within the Amtrak ROW would occur from near Edmondson Avenue to just south of the Gwynns Falls Bridge. The West Baltimore MARC Station would also be relocated slightly west of its current location to align with the new tracks, and the reduced curvature would allow reconstructing with Americans with Disabilities Act-compliant high-level platforms.

The Program also requires the construction of three facilities to ensure proper ventilation of the tunnels: one North Ventilation Facility located near the north portal; one South Ventilation Facility near the south portal; and one Intermediate Ventilation Facility located at street level, connected

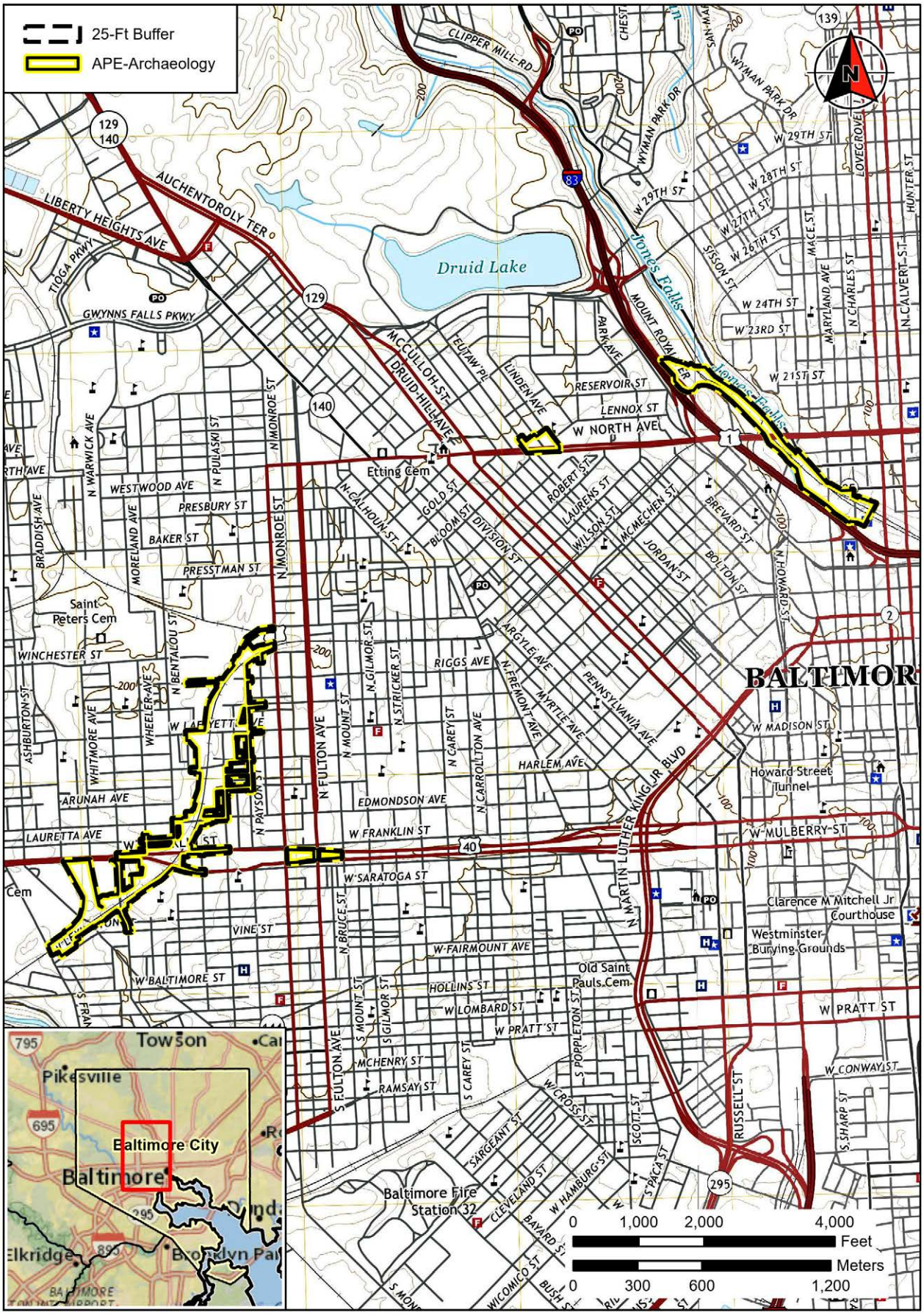

FIGURE 1: Project Location (USGS Topo 2019)

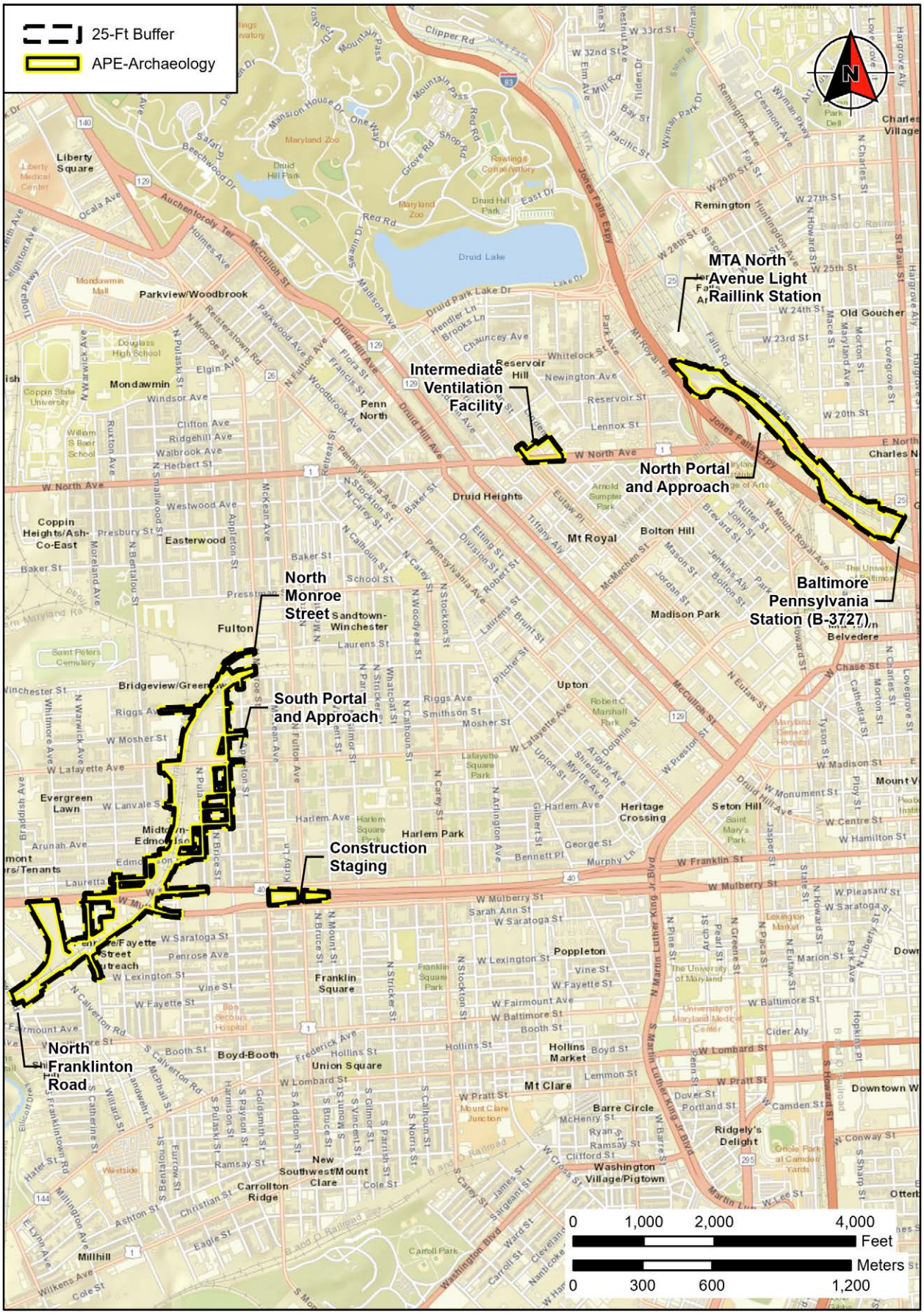

FIGURE 2: Boundaries of Project APE-Archaeology (ESRI World Street Map 2021)

to the tunnel bores by a vertical shaft and connecting tunnel (plenum), splitting the proposed tunnel into two unequal lengths. The North Ventilation Facility will be located at a site approximately 300 to 600 feet from the proposed north portal, at what is currently a Baltimore City Department of Transportation maintenance facility. The South Ventilation Facility will be located atop the south portal cut-and-cover section. The Intermediate Ventilation Facility will be located at 900-940 West North Avenue, at the intersection with Eutaw Place. The Program also includes the acquisition and demolition of additional properties in the vicinity of the south portal to facilitate the construction staging areas and stormwater mitigation sites. Two additional construction staging areas are also proposed in the median of U.S. Route 40 at North Fulton Avenue.

C. PERSONNEL

The Principal Investigator for the study was Jason Shellenhamer (Registered Professional Archaeologist [RPA] 17875). Henry Ward (RPA 12205) served as Project Manager (see Appendix A). Historical research was carried out by Mr. Shellenhamer, and the Geographic Information System (GIS) cut-and-fill analysis and graphics production was performed by Jacqueline Horsford and Rose Micke. Mr. Shellenhamer prepared this document with assistance from senior archaeologists Susan Bupp and Mr. Ward. Anne Moiseev served as technical editor. Mr. Shellenhamer, Mr. Ward, and Ms. Bupp all meet standards set out in the Secretary of the Interior's Professional Qualification Standards for Archaeology (48 *Federal Register* 44738-44739, 36 C.F.R. Part 61) (United States Department of the Interior 1983).

II. METHODOLOGY

An initial Phase IA archaeological study was completed in 2015; however, the project designs had not been sufficiently developed at that time to establish an APE-Archaeology. The 2015 study was therefore limited to the centerline of the alignments of each of the design alternatives. The 2015 study recommended that a supplemental Phase IA archaeological study be conducted once the Preferred Alternative was determined and the extent of anticipated ground-disturbing activities ascertained.

This supplemental Phase IA archaeological study served to establish the APE-Archaeology based on additional information as the design of the Program has progressed, and to assess the sensitivity for the presence of significant precontact and/or historic archaeological historic properties in the APE-Archaeology. In addition, the supplemental Phase IA study includes recommendations for further survey to identify whether archaeological resources are located in portions of the APE-Archaeology.

A. AREA OF POTENTIAL EFFECTS

The APE-Archaeology consists of approximately 150 acres comprising discontiguous areas of the currently proposed limits of disturbance (LOD), in which Program activities include open-cut excavation, construction staging areas, temporary access roads, and utility and stormwater management sites (see Figure 2). Approximately 112 acres are located between North Franklintown Road and North Monroe Street, in the vicinity of the proposed south portal. Two potential construction staging areas located in the median of U.S. Route 40 are also located close to the proposed south approach and consist of approximately 4 acres. Approximately 28 acres of the APE-Archaeology lie between Baltimore Pennsylvania Station (B-3727) and the existing MTA North Avenue Light Raillink Station and comprise the north portal and approach. Approximately 6 acres of the APE-Archaeology consist of the proposed Intermediate Ventilation Facility at 900-940 West North Avenue. Areas in the LOD excluded from the APE-Archaeology include those areas of proposed ground disturbance associated with tunnel boring or mined excavation in which ground disturbance will occur at depths where archaeological resources are not present. For the purpose of the Phase IA archaeological study, the area assessed for archaeological sensitivity included a 25-foot buffer extending around the APE-Archaeology to account for potential design alterations that may occur during future stages of the Program.

B. ASSESSMENT METHODS

1. Documentary Research

The research was conducted to establish precontact and historic contexts for the APE-Archaeology and to determine the existence of any previously recorded archaeological sites or historic properties, within and/or adjacent to the APE-Archaeology. Files available through the MHT's Cultural Resource Information System (Medusa) were checked for the presence of recorded archaeological sites and historic properties. A 1.6-kilometer (1-mile) radius around the APE-Archaeology was used for the identification of previously recorded historic properties and archaeological resources. Additional background research consisted of a review of pertinent primary and secondary sources, including land records, historical maps and atlases, and local and

county histories available online and at the Maryland State Archives in Annapolis. Previous survey reports for archaeological investigations conducted within or near the APE-Archaeology were also obtained from the MHT Library, including Shellenhamer and Kodlick (2015), Ward et al. (2006), and Ward et al. (2013). Additional archival research was carried out at the Library of Congress in Washington, DC, and the Sheridan Libraries at Johns Hopkins University in Baltimore. The review of historical maps was a key component of the analysis of historic archaeological potential.

2. GIS Methods and Topographic Analysis

GIS was used to compile and manage most sources of information consulted for the Phase IA archaeological study. The APE-Archaeology was overlaid onto aerial photographs and previously identified archaeological sites, areas of archaeological survey, mapped soils, and historical maps, and atlases were also incorporated into the GIS database. The locations of archaeological sites and survey locations are represented by polygons obtained from the MHT's Medusa database.

Many locations within the City of Baltimore, including its parks, have been previously altered through the removal of soils or addition of fill material during the historical period. Therefore, an elevation change analysis was conducted, in which historical elevation and modern elevation were compared in GIS to determine whether, and by how much, the landscape in the APE-Archaeology has changed over time. Since accurate topographical maps are not available for the years prior to the construction of the original B&P Tunnel in 1873, the analysis of the historical elevation of those areas around the original alignment was obtained from 1897 Duncan *Atlas of the City of Baltimore*. The 1897 map was created by the Topographical Survey Commission of the City of Baltimore and consists of 39 separate topographic maps, with 5-foot contours, covering individual quadrants of a pre-defined grid system covering all the areas within the boundaries of the City of Baltimore prior to the city's expansion in 1918. Each map was drawn based on individual surveys conducted over a five-year period from 1893 to 1897. The topography presented on some maps does not always accurately correspond to the topography presented on adjoining map sheets. The inconsistency on some adjoining map sheets was likely a result of a change in elevation over time of some landforms that extend across quadrants and were surveyed at different times during the five-year period. As a result, the topographic analysis was undertaken using only those map sheets that presented consistent elevation data across adjoining quadrants.

By digitizing the contour lines from the 1897 atlas in the APE-Archaeology, the data were used to create a triangulated irregular network (TIN). The TIN was then used to create a digital elevation model (DEM) of the ground surface elevation within APE-Archaeology prior to 1900. To account for the vertical datum shift since the creation of the atlas, 1.6 feet were subtracted from the 1897 elevation values. A similar procedure was used for the modern (2021) elevation data, which are available through Baltimore City GIS Open Data as 2-foot interval contours. The difference between the two DEMs was calculated, highlighting the topographic changes between the historical and modern maps.

A comparative analysis of historic cut and fill within the current alignment of the B&P Tunnel was conducted and two digital surface models were developed and derived from the current and historical contours. The ArcGIS "Cut Fill" geoprocessing tool was used to calculate the volume change between the two surfaces. The tool produced two outputs: a raster surface depicting cells as gain or loss and the attribute table containing the volume gained or lost. The results of the

analysis are an approximation, and a margin of error is expected when comparing the volume of gain and loss based on historical maps because of the less accurate survey methods of earlier periods; however, the analysis serves as a useful tool when determining areas of significant loss or gain in elevation over time. The results of the comparative analysis of historic cut and fill were depicted on color-coded mapping and served as an aid in determining the likelihood of encountering intact cultural deposits within the APE-Archaeology.

3. Review of Geotechnical Data

Boring logs from the 2017 *B&P Tunnel Preliminary Engineering Geotechnical Data Report* were reviewed to assess the potential subsurface integrity of the APE-Archaeology (Appendix B). The geotechnical borings were completed as part of the Phase 1 and Phase 2 Preliminary Design Subsurface Investigation Program conducted by WSP/Parsons Brinckerhoff /Parsons Joint Venture (PB/P JV). All borings were drilled vertically using truck-mounted drill rigs as well as all-terrain vehicle drill rigs. All borings were soft dug to a minimum depth of about 6 feet and a maximum depth of 10.5 feet to clear existing utilities by means of vacuum extraction. Phase 1 borings were typically advanced through overburden by means of 8-inch outside-diameter (OD) hollow-stem augers. Phase 2 borings were typically advanced first with 7.6-inch or 8.25-inch OD hollow-stem augers to a depth less than or equal to 30 feet, then 6.5-inch OD steel casing was installed and drilling continued using the mud rotary method. Borings conducted during both Phase 1 and Phase 2 were sampled at 5-foot intervals between the ground surface and top of rock using a standard split-barrel sampler with 2-inch OD and 1-3/8-inch inside diameter. Since continuous samples were not taken, the data presented in the boring logs were not sufficient to determine accurately whether buried ground surfaces are present in the APE-Archaeology with the potential for containing intact archaeological resources. The data presented in the boring logs do provide useful information to ascertain the location and approximate depth of fill and other ground disturbance in the APE-Archaeology.

III. ENVIRONMENTAL SETTING

A. PHYSIOGRAPHY AND GEOLOGY

The APE-Archaeology is located at the Fall Zone between two physiographic provinces, the Piedmont Plateau Province and Atlantic Coastal Plain Province (Figure 3). The Piedmont Plateau Province is an area of varied topography, ranging from lowlands to ridges of moderate altitude and relief. The province is underlain by metamorphic and igneous rocks that range from Precambrian to Paleozoic in age. These rocks have been sheared, fractured, and folded by tectonic activity. The Fall Line, which is where the Piedmont Plateau Province descends steeply to the Coastal Plain, runs along the boundary for the Maryland Archaeology Research Units 7 and 14 (Figure 4). At the point where rivers and streams cross the Fall Line, falls and rapids are typically encountered. This area is known as the Fall Zone and extends for several miles on either side of the Fall Line. The Coastal Plain Province is made up of unconsolidated sediments—silts, sands, and gravels—that create a wedge that increases from 0.0 meter (0.0 foot) at the Fall Line to approximately 3,048 meters (10,000 feet) at the Atlantic shoreline (Edwards 1981).

The APE-Archaeology lies within the James Run Formation (jg) and the Potomac Group (Kp) formations (Figure 5). The James Run Formation is mapped beneath the western and eastern portions of the APE-Archaeology, which extend through portions of the Jones Falls and Gwynns Falls stream valleys. James Run Rocks are believed to represent the debris of ancient volcanoes. The James Run metavolcanic rocks and associated plutons are best exposed in Cecil County.

The central portion of the APE-Archaeology is located within the Potomac Group. The Potomac Group marks the beginning of the Coastal Plain Province. The Potomac Group consists of inter-bedded quartzose gravels, argillaceous sands, and white, dark gray, and multicolored silts and clays. These deposits date to the Cretaceous era. Overall, the Potomac Group reaches a thickness of 0 to 240 meters (0 to 800 feet). There are four formations within the Potomac group, consisting of the following.

- Raritan and Patapsco Formations – gray, brown, and red variegated silts and clays, cross-bedded with argillaceous sands and minor gravels. These formations are between 0 and 122 meters (0 and 400 feet) thick.

- Arundel Clay – dark gray and maroon lignitic clays that are between 0 and 31 meters (0 and 100 feet) thick.

- Patuxent Formation – white or light gray to orange-brown, moderately sorted, cross-bedded, argillaceous sands and quartz gravels. The silts and clays are generally a pale gray. The formation is between 0 and 76 meters (0 and 250 feet) thick.

FIGURE 3: APE-Archaeology in Relation to the Maryland Physiographic Provinces
(ESRI World Imagery, 2020)

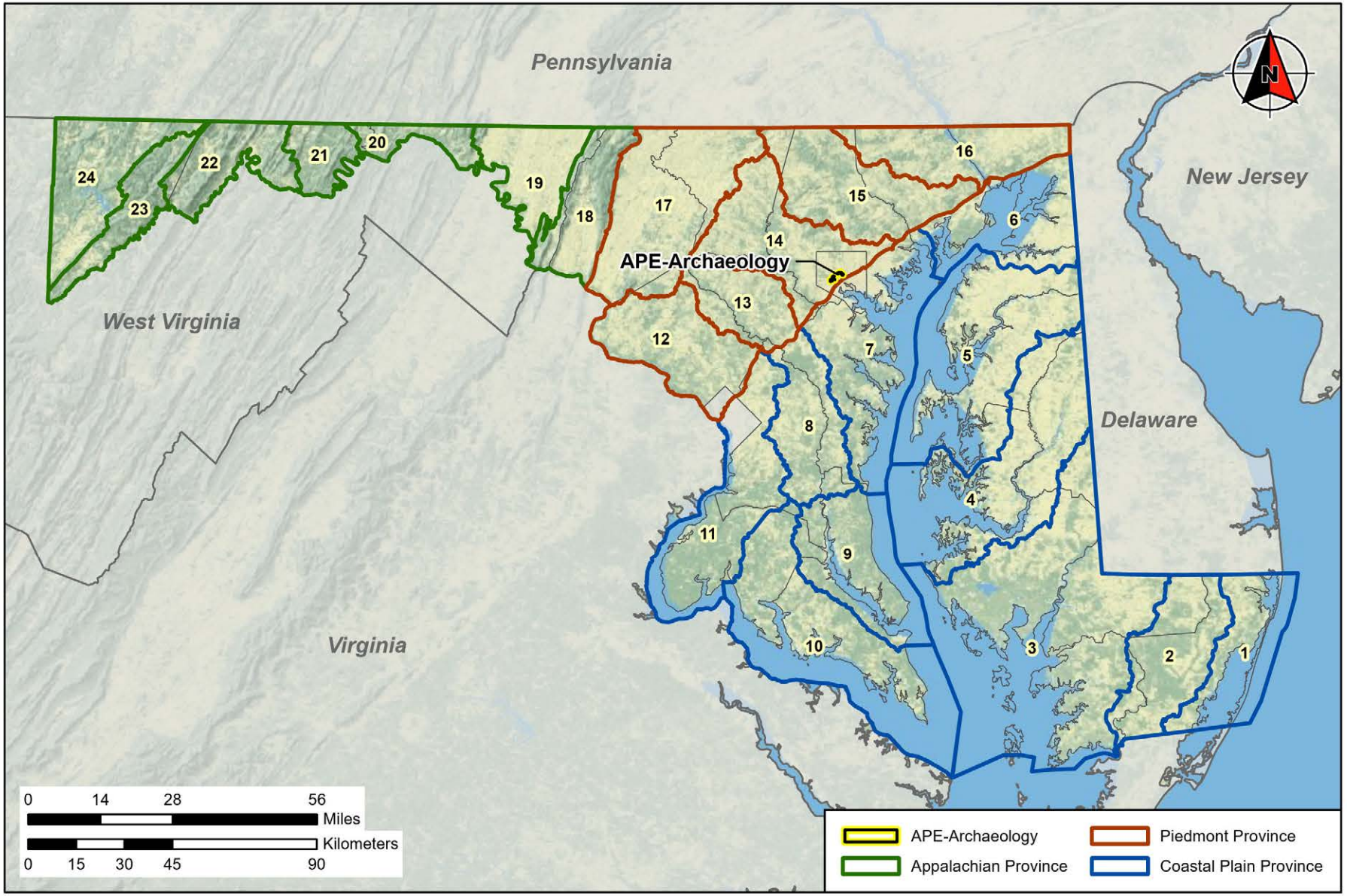

FIGURE 4: Maryland Archaeological Research Units (ESRI USA Topo Maps 2019; Shaffer and Cole 1994)

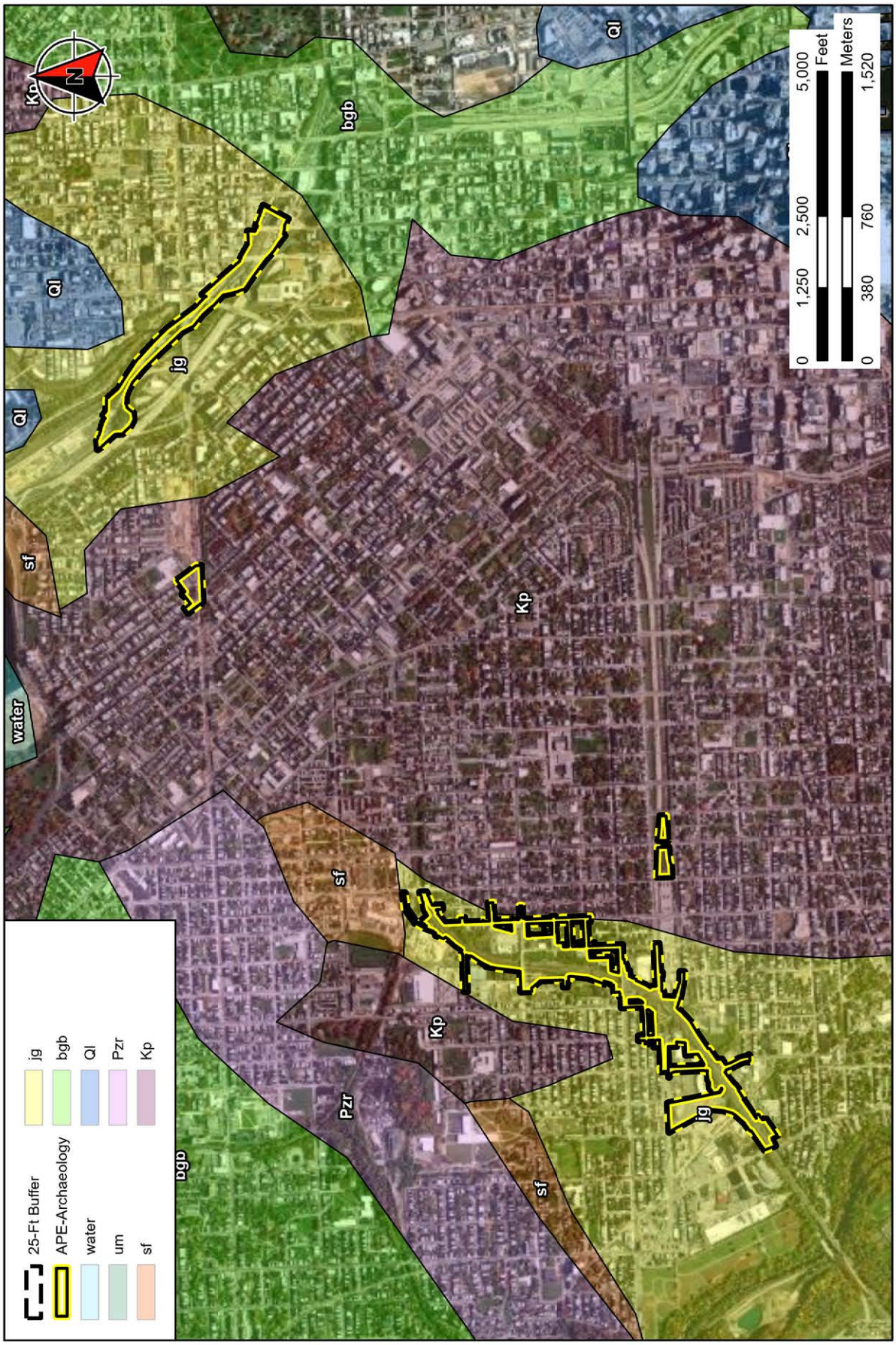

FIGURE 5: APE-Archaeology in Relation to Geological Formations (ESRI World Imagery 2020)

B. SOILS

General mapping of Baltimore City (Figure 6) places the APE-Archaeology within five major soil groups (Levin and Griffin 1998; United States Department of Agriculture-Natural Resources Conservation Service [USDA-NRCS] 2021). These are, from west to east: Legore-Urban Land Complex, Udorthents Association, Keyport-Urban Land Association, Urban Land Association, and the Urban Land-Udorthents Association.

Legore-Urban Land Complex (18UC) soils consist of moderately sloping, well-drained Legore soils that have been graded, cut, filled, or otherwise disturbed during urbanization. Approximately 45 percent of areas classified as this type of soil are relatively undisturbed. Typically, the surface layer is approximately 4 inches of a very dark grayish brown loam and the subsurface layer consists of approximately 8 inches of dark yellowish brown loam. The subsoil is typically a 10-inch-thick layer of a strong brown clay loam. Approximately 35 percent of the complex consists of urban land, which is characteristically covered by concrete, asphalt, buildings, or other impervious surfaces. In some locations entire areas of natural soil have been cut away or filled. The remainder of the soil complex typically consists of areas of Montalto and Relay soils as well as small areas of very stony soil.

Udorthents Association soils (40C; 42E) are mostly loamy fill material that has been cut or filled during grading for the construction of buildings, roads, and recreational facilities. The fill has been placed on well-drained or moderately well-drained soils on uplands of the Coastal Plain. Udorthents Association soils form approximately 20 percent of the total land in the city. The thickness of the fill varies but is typically more than 20 inches. The fill forming this soil association was generally taken from Beltsville, Matapeake, Mattapex, Sassafras, and Sunnyside soils, so it is typically a heterogeneous, mixed loamy material. In a few places, small areas of the fill consist of building rubbish, cinders, industrial waste, and ash.

Keyport-Urban Land Association soils (16UB) are nearly level to gently sloping and are moderately well drained. Keyport soil and Urban land occur together in such an intricate pattern on the landscape that separating them was not practical at the scale used for mapping. About 40 percent of this unit is relatively undisturbed Keyport soils. Typically, the surface layer is a dark brown loam about 4 inches thick. In the upper 8 inches the subsoil is mixed dark grayish brown and strong brown silty clay loam. In the lower 36 inches it is mixed yellowish red and pale brown clay that has distinct light brownish gray and dark yellowish brown mottles at a depth of 21 inches. The substratum to a depth of 65 inches or more is mixed brownish yellow and light gray clay. In some areas the surface layer is a silt loam or sandy loam, or the surface has been covered by as much as 20 inches of fill material. About 40 percent of this unit is designated as areas of Urban land. In some areas the soils are largely covered by concrete, asphalt, buildings, or other impervious surfaces or by more than 20 inches of fill material. In some areas most or all of the profile has been cut away. The fill material is most commonly from adjacent areas of Keyport soils that have been cut and graded.

Urban Land Association soils (44UC) are located in nearly level to moderately sloping areas of urban settings where more than 80 percent of the surface is covered by asphalt, concrete, buildings, or other impervious surfaces. This soil association represents approximately 20 percent of the land area in the city. Urban Land can be identified on all landscape positions of the Coastal Plain and the Piedmont Plateau and generally range from 2 to more than 1,000 acres in size. Typically,

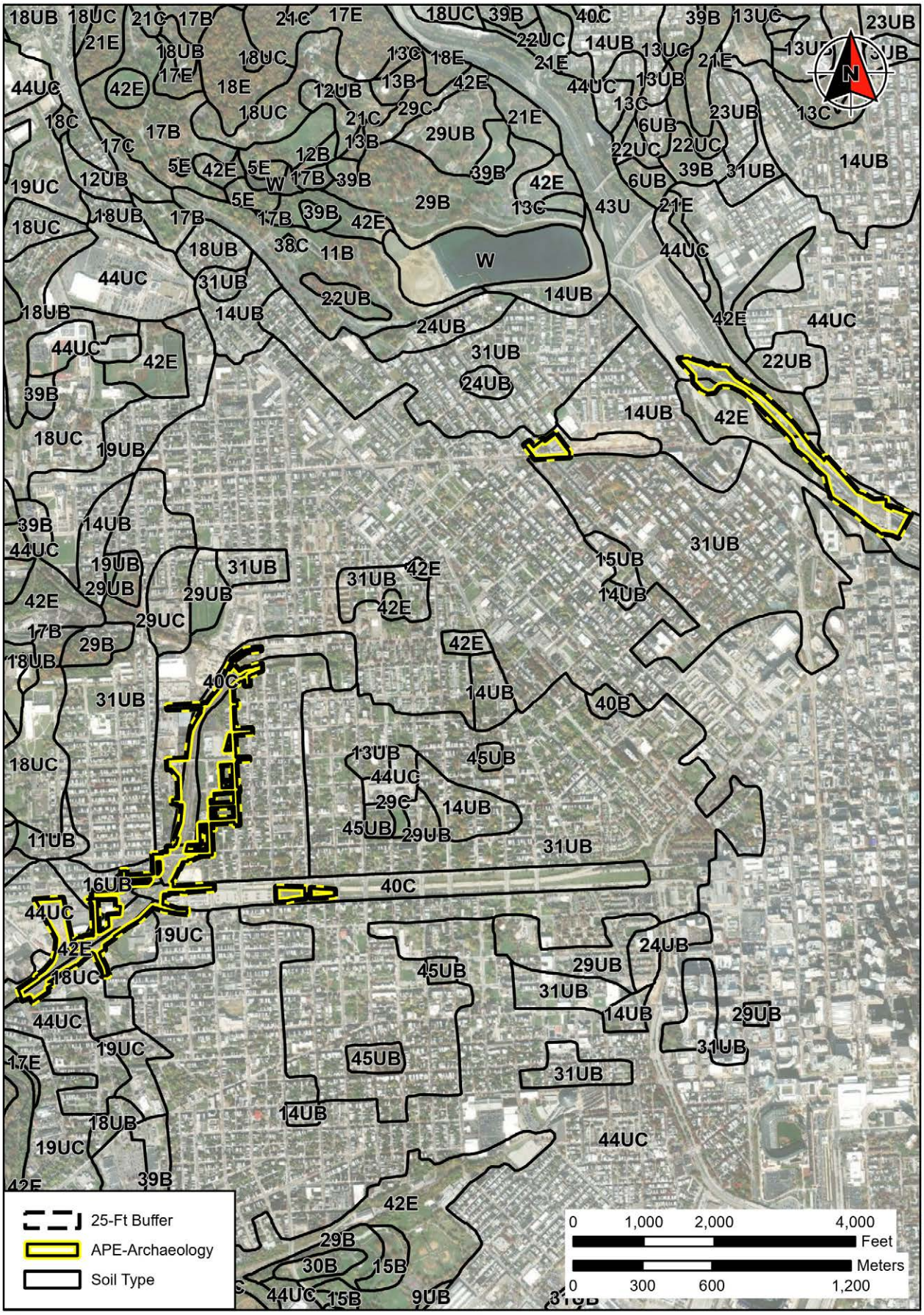

FIGURE 6: Soil Series in APE-Archaeology (ESRI World Imagery, 2020; NRCS 2020)

large areas are mostly composed of miscellaneous artificial fill. In some areas several feet of fill have been placed over streams, swamps, floodplains, and tidal marshes and are now almost completely covered by roads, buildings, or other structures.

The final association, Urban land-Udorthents Association soils (43U), are very deep to moderately deep soils. They vary from well to poorly drained in nature and are found in a variety of locations that are level to very steep. The soils are underlain by a variety of stratified alluvial sediments, dredged materials, or cut and fill deposits. This association accounts for almost a quarter of the city's soils. It is about 36 percent Udorthents, 29 percent Urban Land, and 35 percent minor soils. Minor soils include flooded Sulfaquepts in tidal marshes and in areas of dredged material deposits, and Beltsville, Christiana, Keyport, Sassafras, Sunnyside, and Woodstown soils in isolated and/or relatively undisturbed area; and fluvents.

C. HYDROLOGY

Baltimore City is located on the Patapsco River. The South Branch of the Patapsco originates at Parrs Spring, where Carroll, Frederick, Howard, and Montgomery counties meet. The North Branch originates in northern Carroll County. The two branches meet near Marriottsville on the Carroll and Howard county borders to form the Patapsco River proper. The Patapsco River has a watershed of 1,760 square kilometers (679 square miles). The last 16 kilometers (10 miles) of the river is a tidal estuary inlet of the Chesapeake Bay. The tidal area of the river is composed of the Northwest Harbor and Middle Branch of the Patapsco River (Baltimore County n.d.a).

The Gwynns Falls Watershed originates in Baltimore County north and west of the city. Its headwaters are near the village of Glyndon. The watershed encompasses 158 square kilometers (61 square miles) and includes 180.25 kilometers (112 miles) of stream that flows through both the county and the city (Baltimore County n.d.b). Several tributaries join the Gwynns Falls before it flows into the Middle Branch of the Patapsco near Carroll Park in the city. These streams include the Red Run, Horsehead Branch, Scotts Level Run, and Powder Mill Branch in Baltimore County, and the Maiden Choice, Dead Run, and Gwynns Run in Baltimore City.

The largest of the streams flowing into the Patapsco River is the Jones Falls. Two-thirds of its 64.37-square-kilometer (40-square-mile) watershed is north of the city in Baltimore County in an area characterized by low-density development and agricultural land. The stream is 28.8 kilometers (17.9 miles) in length (Baltimore County n.d.c). It flows above ground through the county but is channelized through much of the city either in a concrete-lined streambed or in a tunnel. The stream enters a tunnel beneath the Jones Falls Expressway (I-83) at North Avenue and flows into the Inner Harbor area of the Patapsco River near the intersection of Pratt Street and President Street. In the eighteenth century this stream had large areas of wetlands along its lower reaches and a delta area at its mouth known as Harrison's Marsh. The Jones Falls served as the boundary between Baltimore Town and Jones (or Old) Town in the second quarter of the eighteenth century (Olson 1980).

IV. RESULTS OF DOCUMENTARY RESEARCH

A. PALEOENVIRONMENT

Detailed paleoenvironment studies of the Middle Atlantic Region close to the APE-Archaeology include Brush (1986, 2001) and Kuzbach and Webb (2001), who studied climate change and forestation in the Chesapeake Region. Louis Berger and Associates were able to identify seven environmental zones at the Indian Creek V Site in Prince George's County, Maryland (LeeDecker and Koldehoff 1991). This site is near the Prince George's County/Washington, DC boundary on an abandoned channel of Indian Creek, a tributary stream of the Northeast Branch (which in turn flows into the Anacostia River). The Indian Creek V Site is within an 80.5-kilometer (50-mile) radius of the APE-Archaeology, and it is assumed that the paleoclimates of Indian Creek and Baltimore City were analogous.

Climatic trends documented for the area paint a picture of long-term environmental change. Between 12,800 and 10,800 years before present (BP), the region experienced a cool, moist Pre-Boreal Climatic Phase. Pollen recovered from Zone 1 at the Indian Creek V Site indicates that the area was covered by open spruce parkland that included pine and alder trees as well as herbaceous plants. Zone 1 of the site is associated with the Paleoindian period of Native American history in the Chesapeake region; however, no cultural remains associated with Paleoindian occupation were recovered during the excavation of Indian Creek V.

Based on ice cores from Greenland and northern Europe, it appears that initial human settlement of North America occurred during a period of climatic instability associated with the retreat of glaciers covering the northern portion of the continent and punctuated by occasional advances (Oeschger 1986). Data indicate that at 15,000 BP the border of the ice sheet was at the St. Lawrence River. By 14,600 BP the Bølling Allerød warm interval was underway, and by 13,000 BP essentially Holocene (or modern) climatic conditions existed in northern Europe and portions of North America. Climatic warming during this period resulted in retreat of the Wisconsin ice sheets, a rise in global sea levels, and varied local environmental responses. These changes were accompanied by occasional and sudden releases of massive quantities of meltwater from under or behind the ice sheets, which occasionally resulted in reversal of the overall warming trend. An abrupt climatic change is well documented for the northern hemisphere during the period between 12,900 and 11,500 BP, which switched the climatic system back to a cold climate mode (Fisher and Schubel 2001; Meltzer and Holliday 2010; Weaver et al. 2003). This climatic change is known as the Younger Dryas cold spell, in which almost glacial conditions reappeared across the northern hemisphere.

Global ocean circulation has been the focus of recent models for most global climatic transitions (Stute et al. 2001). The North Atlantic is about 4 degrees Fahrenheit cooler than the North Pacific Ocean (at similar latitudes). A wide divergence in the temperature of the water circulating between the two oceans has the potential to cause significant and large-scale abrupt climatic change. Stute et al. (2001) believe that the Younger Dryas cold spell was a direct result of the shutdown of the North Atlantic thermohaline circulation owing to an influx of fresh water from Lake Agassiz (a huge freshwater lake that existed in the center of North America and that was fed by glacial run off) and from deglaciation in North America. Global climate was then locked into the cold mode until around 11,500 BP, when freezing removed the fresh water from the North Atlantic Ocean

(Broecker 2006). The climate system switched back to a warm mode, a condition that has essentially prevailed (with minor alterations) since that time. According to Oeschger (1986), large amounts of continental ice and global ocean circulation played an important role in the variability of the climatic system during the Wisconsin glaciations.

Zones 2, 3, and 4 of the Indian Creek V Site are associated with Archaic period occupations of the site. Pollen samples from all three zones indicate that average annual temperatures were warm, but the amount of precipitation varied greatly over time. Pollen from Zone 2 of the site (which coincides with the Early Archaic period of Native American history) indicates that between 10,800 and 7660 BP, the region experienced a gradual warming period characterized by dry conditions. Forest cover during that period changed from open spruce parkland to mixed deciduous forests of birch and oak, with pine and alder mixed throughout. During the Middle Archaic period, which coincides with Zone 3 pollen samples (7660 to 5000 BP), the annual rate of precipitation increased. Zone 3 forest cover was dominated by species of oak, hazelnut, and alder, with a decrease in pine and a complete absence of spruce. The Late Archaic period (Zone 4 of the site) experienced a decrease in precipitation. The warm, dry conditions of this period persisted from 5000 to 3860 BP. These climatic conditions favored forests dominated by oak and hickory, with inclusions of pine (LeeDecker and Koldehoff 1991).

As the climate gradually warmed over the course of the Archaic period, the last of the Late Pleistocene glaciers began to retreat, releasing water back into the world's oceans. Global sea levels rose as much as 300 to 500 feet over several thousands of years (Whitehead 1972). During this period the Chesapeake Bay was formed as rising sea levels flooded the lower reaches of the ancestral Susquehanna River. As the marine transgression filled the Chesapeake Bay, the rivers emptying into the Chesapeake Bay assumed their tidal character below the fall line. After 3000 BP the climate and its floral and faunal associations assumed an essentially modern character.

Pollen from Zone 5 of the Indian Creek V site indicates that during the period between 3860 and 1770 BP (the Early to Middle Woodland periods of Native American history), the area surrounding the Indian Creek V Site experienced a marked decrease in the amount of arboreal pollen deposition, possibly because of increased horticultural activity. Although oaks continued to dominate the forest area, pollen in Zone 5 showed an increase in herbaceous species such as legumes, elderberry, blueberry, and arrowwood. Pollen, charcoal, and trace metals from sediment cores taken from the Nanticoke River on Maryland's Eastern Shore indicate that around 900 BP the climate was warmer and drier than current conditions. This period coincides with the Medieval Warm period that ended around 700 BP with the onset of the Little or Mini Ice Age (Fagan 2000; Fisher and Schubel 2001). Pollen in Zone 6 of the Indian Creek Site, which coincides with the Late Woodland, indicates that between 700 and 350 BP, temperatures were cooler on average and annual precipitation was approximately 5 percent higher than it is now. Mixed deciduous forests reappeared across the landscape, although nonarboreal pollen continued to make up a significant part of the pollen found in this zone. Herbaceous plant pollen and blueberry pollen dominated the nonarboreal pollen (LeeDecker and Koldehoff 1991).

During the seventeenth and eighteenth centuries, the Chesapeake Bay was almost entirely frozen during the winters of 1641-1642, 1645-1646, 1779-1780, and 1783-1784. These colder conditions lasted until approximately 100 years ago in the Chesapeake Region. These shifts between warm/dry conditions and cool/wet conditions are probably related to changes in the strength of

North Atlantic thermohaline circulation (Cronin et al. 2003; Fisher and Schubel 2001). Beginning in about 1850, world temperatures began a long warming trend, which has continued to the present day (Fagan 2000).

B. PRECONTACT CONTEXT

Research for this section concentrated on the creation of a general precontact context for the area surrounding the APE-Archaeology. The following overview of Native American regional history has been abstracted from several secondary sources including Custer (1984, 1989, 1996), Dent (1995), and Potter (1993). In addition to these book-length treatments of the subject, researchers consulted numerous journal articles, professional papers, and reports.

The APE-Archaeology falls within the Middle Atlantic Culture Area of the northeastern United States. This area is described as extending from the Hudson River estuary in New York south to the Great Dismal Swamp on the Virginia/North Carolina border and from the Atlantic Ocean west to the Appalachian Mountains (Willey 1966). The discussion below divides the regional prehistory of the Middle Atlantic Culture Area into six specific time spans, which focus on specific innovations or lifeway traditions in the Middle Atlantic Culture Area. These periods are the Paleoindian/Early Archaic (ca. 11,000 BC to 6500 BC), the Middle Archaic (ca. 6500 BC to 3000 BC), the Late Archaic/Early Woodland (ca. 3000 BC to 200 BC), the Middle Woodland (ca. 200 BC to AD 1000), the Late Woodland (ca. 1000 to 1600), and the Contact and Settlement Period (ca. 1600 to 1780). Together, these periods do not represent a simple linear cultural history but rather median dates of major changes in regional material cultural traditions. Some overlaps exist among periods.

1. Paleoindian and Early Archaic Periods (ca. 11,000 to 6500 BC)

Human occupation in the Baltimore area likely began before 11,000 BC. A few sites in the region suggest the possibility of a much earlier (pre-Clovis) human presence (e.g., McAvoy et al. 1997; Wagner and McAvoy 2004). There are also reports outside the region of pre-Clovis occupation (e.g., Callaway 2021).

Archaeologists have long believed that Paleoindians must have subsisted by hunting late Pleistocene megafauna, such as mammoths, basing this assumption on finds of large, fluted stone points of Clovis and similar types at megafaunal kill sites in the western half of the United States. During the 1960s and 1970s, however, many archaeologists began to reconsider the importance of mammoths to Paleoindian subsistence, particularly east of the Mississippi River (Griffin 1977; Jennings 1978; Willey 1966). Evidence from Meadowcroft Rockshelter, the Shawnee-Minisink Site on the upper Delaware River in northeastern Pennsylvania, the Cactus Hill Site in Virginia, the Hiscock Site in western New York, and the Higgins Site in Anne Arundel County, Maryland, all indicate an economy based on broad spectrum foraging and not on big game hunting. As Adovasio and Carr (2009:521) note, this "broad spectrum foraging lifeway is essentially indistinguishable from the succeeding Early Archaic pattern." The only place that big game hunting seems to have been important was on the northern edges of the Middle Atlantic area where there was seasonal dependence on caribou. There is evidence that Paleoindians also hunted elk and black bear (Funk 1972, 1978; Funk et al. 1970, 1990; Funk and Steadman 1994; Funk and Wellman 1984). Evidence recovered at archaeological sites in the Eastern United States over the last half

century indicate that the subsistence base also included smaller mammals such as hare, mink, and arctic fox and such plant foods as black walnut, hickory nut, acorns, persimmon, sumac, mulberry, blackberry, goosefoot, and wild grape (Dent 1995; Funk and Steadman 1994; Hollenbach and Carmody 2022; Ritchie 1957). There is also evidence of fishing from the Shawnee-Minisink Site (Kaufman and Dent 1982).

Paleoindian groups were probably seasonally mobile, exploiting new and different resources as they shifted locales. Gardner (1974, 1977, 1979) has identified several types of Paleoindian sites using data from the Flint Run culture complex in Virginia. The largest sites have been labeled base camps. They are identified by the variety of artifacts in the assemblage, the non-random distribution of stone tools and debitage (suggesting discrete activity areas), and pits and postmolds. Aggregate bands may have occupied base camps at different times throughout the year. The density of Paleoindian finds to locations of known or potential raw material sources strongly indicates that lithic sources influenced settlement patterns (Gingerich and Childress 2022). Examples of base camps include the Thunderbird Site of the Flint Run culture complex and the Shoop Site in Pennsylvania (Gardner 1974; Witthoft 1952). Smaller sites are identified as special-purpose areas, which were occupied for brief periods by smaller groups than those at base camps. These smaller sites include quarries, lithic workshops, base camp maintenance sites, and outlying hunting sites (Dent 1995).

The Paleoindian lithic tool kit from all regions of North America is specialized for hunting. It comprises scrapers, gravers, burins, denticulate flakes, utilized flakes, hammerstones, knives, bifaces, and fluted points (Custer 1984; Funk 1972; Gardner 1974, 1977). Tools are characteristically made of high-quality cryptocrystalline material such as chert and jasper, or of macrocrystalline material such as quartz or quartzite (Dent 1995). In addition, stone tools in these artifact assemblages show evidence of great care in stone tool maintenance and resharpening. One of the most distinctive artifacts associated with the Paleoindian period is the fluted point, characterized by a channel that is removed from the center of the base to the center, or distal end, of the point.

Both Gardner (1978) and Custer (1989) see the Early Archaic as part of a broader Late Pleistocene to Early Holocene adaptation continuum. Parker (1990), however, believes that the settlement and subsistence patterns of the Early Archaic are more than a reflection of resource availability. He believes that the settlement pattern was a way to mitigate the risk factors produced by unpredictable resource availability (q.v. Weissner 1982). The location and size of the sites reflect efforts to feed groups and integrate diverse populations. The smaller groups came into contact with one another at the larger sites. This contact fostered reciprocity in terms of shared resources and cultural ideas. The smaller groups would then disperse to forage and hunt, knowing that the relationships they had established would enable them to tap into the resources of other groups when needed. Parker's model and those of Gardner and Custer are concerned with human economy, which is defined by Tankersley (1998) as the process of production, consumption, distribution, and exchange of materials that sustain or reproduce human livelihood.

The major difference between the toolkits of the Paleoindian and Early Archaic periods is the replacement of fluted points by a variety of notched points. Projectile points in the Middle Atlantic are characterized by two artifact traditions: the Corner-Notched Tradition (ca. 7500 to ca. 6800 BC) and the Bifurcate Tradition (ca. 6800 BC to ca. 6000 BC). The beginning of the Corner-

Notched Tradition is marked by the replacement of fluted points with corner-notched points, reflecting changes in hafting techniques and utilization. The decline in fluted points has been largely attributed to the Younger Dryas, a brief but abrupt reversal to cooler climates at the end of the Clovis period (Gingerich and Childress 2022). During the Early Archaic, rhyolite from the Piedmont Province replaces cryptocrystalline stone as the material of choice. Point types from the Corner-Notched Tradition include assorted Amos, Charleston, Kirk, and Palmer notched variants. Those associated with the Bifurcate Tradition include LeCroy, St Albans, and Kanawha points (Dent 1995). The artifact assemblages of both major traditions are similar to those of the Paleoindian period, but there is greater regional variation.

There is also greater variation in settlement patterns, with sites found in environments that are more diverse. The consensus is that Early Archaic peoples exploited a wider variety of game, fish, and forest resources (including fruit and nuts) (Dent 1995; Funk 1978); however, the people associated with both the Corner-Notched and Bifurcate traditions probably continued to follow a seasonal hunting schedule, as suggested by their specialized toolkits and their settlement patterns. These patterns were based on large macroband base camps that were surrounded by numerous smaller microband base camps and special-use sites that included activities such as hunting, fishing, gathering, and quarrying (Gardner 1974, 1977, 1979).

Faunal remains recovered in and around the District of Columbia indicate that Early Archaic populations hunted deer and elk (Humphrey and Chambers 1977). Smaller mammals were probably included in the diet. Plant remains from the Slade Site in Virginia and the Crane Point Site on Maryland's Eastern Shore indicate that Early Archaic populations exploited a wide variety of resources. These plants included forest mast such as hickory nuts, butternut, and possibly acorns, as well as starchy seed plants like amaranth and chenopod (Dent 1995; Egloff and McAvoy 1990; Lowery and Custer 1990). Excavations at sites in the southeastern United States indicate that Early Archaic populations also used plant materials to produce basketry and other items.

2. Middle Archaic Period (ca. 6500 to 3000 BC)

The Middle Archaic began about the time that the still dominant oak-hickory forest completely replaced the boreal forest associated with the last glaciation in the northern portions of the eastern United States (LeeDecker and Koldehoff 1991; Whitehead 1972). The climate, which had begun to warm gradually during the Early Archaic, reached an average temperature level nearly the same as, if not slightly warmer than, the present era, accompanied by a rise in precipitation. Morrow Mountain and Stanley points are the diagnostic tools of the Middle Archaic (Coe 1964; Custer 1989). Toolkits generally resemble those of the previous period, with the addition of such groundstone tools as mortars and atlatl weights or bannerstones. The latter were used to balance atlatl spear throwers. These have been found in the Middle Atlantic, particularly along the Nottaway River in Virginia (Egloff and McAvoy 1990) and at the Hardaway and Doerschuk sites in North Carolina (Coe 1964). A possible bannerstone fragment was recovered at the Kettering Site in Prince George's County, Maryland (Jefferson Patterson Park and Museum 2002). Fragments of mortars and pestles of the mano-metate type were found at the Higgins Site on the Western Shore of Maryland (Ebright 1992). A substantial bone tool industry also developed during this period. Artifacts associated with this industry include atlatl hooks and projectile points (Dent 1995).

Settlement patterns apparently continued in the tradition of the Early Archaic (Dent 1995). Some researchers have suggested that coastal areas were abandoned in favor of the Piedmont during this period (Kavanagh 1982); however, the continuing rise in sea level until the end of this period may also account for the lack of coastal sites (Read 1990). Site locations include interior wetlands, areas near stream confluences, and floodplains. Until recently, there was no evidence of structures in the Chesapeake Region. A series of overlapping houses excavated at the Pig Point Site in Anne Arundel County may date to this period (Luckenbach 2010; Luckenbach et al. 2010). Sites of this period show evidence of distinct activity areas associated with processing foodstuffs, tool production, and maintenance (Dent 1995).

There were no major changes in subsistence between the Early Archaic and Middle Archaic periods. Fiber analysis of materials recovered from the Higgins Site in Anne Arundel County, Maryland, suggests that turkeys were being hunted (Ebright 1992). Shellfish were probably not a major part of the diet, as continued marine transgression hindered establishment of sizable, submerged oyster shell reefs in the Chesapeake Bay (Dent 1995).

Gardner (1978, 1980) and Custer (1984) have identified three types of sites associated with the Middle Archaic, which they feel reflect the social organization of the period. These sites include macro- and microband camps and procurement sites. In the fall when food resources were abundant, some groups of people or bands fused together into macro- or corporate bands. These gathered at macroband base camps that tended to be located at the Fall Line. Artifact assemblages recovered at these sites indicate fairly long-term occupation with a wide variety of activities. The microbands were composed of family groups who tended to live in a single river valley. They moved between the valley floor and adjacent upland areas throughout the year, living in microband base camps and using procurement sites. Microband base camps tended to be located in environmental settings that could not support the larger populations associated with macroband base camps. Procurement sites yield fewer tool types and tend to be related to a limited number of activities. Location of these sites depended on the type of resource being used (e.g., quarry sites and interior hunting sites).

3. Late Archaic Period (ca. 3000 to 1400 BC)

During the Late Archaic period indigenous groups continued to rely heavily on gathered plants, particularly tree mast, for food and other needs. Fish and shellfish became a major resource during the later portion of the period. Wetland resources were also commonly exploited during this period. The number of sites and settings for sites continued to expand. The initial portion of the Late Archaic period (3000 to 1500 BC) is marked by a suite of narrow-bladed projectile points (Bare Island/Lackawaxen, Clagett, Dry Brook, Holmes, Orient, Vernon, and possibly Piscataway types) that accompanied adaptations for exploiting hardwood trees and other sylvan resources. Assemblages include a high frequency of grooved axes, adzes, celts, gouges, and grinding stones. According to one analysis, Late Archaic period sites are strongly associated with soils that are well suited to support nut-bearing hardwood trees (Mouer 1991).

Sites during the initial portion of the Late Archaic period tend to be smaller and more diffuse than the sites that came later in the Late Archaic. A cultural manifestation associated with broad-bladed projectile points appeared during the later portion of the Late Archaic period (2200 to 1200 BC). The broad-bladed point types include Savannah River and Susquehanna types. A major change in

settlement pattern is associated with the appearance of these points, with sites focusing on the floodplains of higher-order streams (Mouer 1991). Site size can be quite large, particularly in the Coastal Plain. These large broad-bladed stemmed points are typically made of quartzite or rhyolite. It is not certain if they were used as projectile points or as specialized knives for fish-processing or some other task (McLearen 1991). Although broadspear points are sometimes found in ritual mortuary contexts, they were apparently utilitarian objects, as shown by occasional breakage and edge attrition (Custer 1991).

A noteworthy development in the later portion of the Late Archaic period is the use of carved soapstone (steatite) bowls. Soapstone was quarried during this period in the Piedmont of Virginia, Maryland, and Pennsylvania. W.H. Holmes (1897) recorded a number of soapstone quarries in Washington, DC, and nearby locales. Vessels were apparently carved at the quarries and transported in finished form, probably by canoe (Dent 1995). Some soapstone vessels were finished away from quarries at nearby camps (Johnson 2001). Soapstone pots were clearly used for cooking, but it is not yet known what foods they were used to process (fish, meat, seeds, tubers, or nuts).

Throughout most of Maryland and Virginia's Coastal Plain, archaeologists have found broad bladed points associated with shell heaps (middens) dating to around 2000 BC (Dent 1995; Potter 1982). Intensive oyster collection appears to have begun around that time, and it is believed the Late Archaic was the first period during which sites become common along tidal creeks and major waterways.

4. Early Woodland Period (ca. 1400 to 200 BC)

The introduction of pottery around 1400 BC marks the beginning of the Woodland period. In the Early Woodland life seems to have gone on much as it did during the Late Archaic, and indeed some of the same projectile points may have been used in both periods. Occupations remain focused on the larger rivers. Stabilization of estuarine areas increased the range for oyster beds and anadromous fish. By the end of the Early Woodland, oysters had become a major food source, and large oyster shell middens are a common find on coastal sites. Other estuarine resources that were gathered included gulf periwinkle that was found in cordgrass along the marshy margins of tidewater areas, ribbed mussels, and various clam species that were found in tidal mud flats (Dent 1995). Anadromous fish, such as American shad, red drum, herring, perch, and striped bass (rock fish), began to make spring runs from the Chesapeake Bay up into the freshwater portions of rivers to spawn. To take advantage of these spring runs, fish weirs, constructed from stone, cane, or wood, directed fish into traps. Boudain (2008) documented stone weirs along the Potomac River during the drought of 2007. Moeller (2005) believes that Native Americans manufactured fish spears. He suggests that many of the lithic tools recovered in the Delaware River valley that were previously identified as drills are actually barbed fish spears. Fishnets were also used to capture fish during the spring runs. Floats for fishing nets were made from gourds and netsinkers were made of stone (Fritz 1999). Regardless of the method employed, large numbers of fish were caught during these spring runs, and they needed to be processed in an extremely short amount of time. Fish were smoked on large stone platform hearths and on wood platforms constructed over hearths.

In the Piedmont Region, the Early Woodland period is associated with the invention of ceramics. Early ceramics are known as "Experimental Wares" and are often similar in form to earlier steatite

vessels. Egloff and Potter (1982) argue that early Middle Atlantic ceramics were inspired by Southeastern types. Ceramics first appeared along the Georgia and South Carolina Coast circa 1500 to 1000 BC. Many of the early Middle Atlantic wares developed in the Piedmont Region and the technology spread rapidly. Although some ceramic types may have originated outside the region, other types were probably local innovations and are unique to the Chesapeake Region. Included in this latter group are Selden Island (Slattery 1946), Bushnell, and Croaker Landing wares (Custer 1989). Dent (1995:225) notes that these wares appear to be "spatially restricted to the Piedmont Zone and sometimes the outer Coastal Plain. None are typically recovered in great quantities." Other ceramic types associated with the Early Woodland include Marcey Creek ceramics, which are tempered with crushed steatite and whose forms are reminiscent of the carved steatite bowls of the previous period, i.e., slabs built with a flat bottoms and lug handles. These wares first appeared in the southern reaches of the Middle Atlantic (Custer 1984; Manson 1948; Mouer 1991; Stephenson et al. 1963; Steponaitis 1980).

Selden Island ceramics, like Marcey Creek wares, are tempered with steatite. Unlike Marcey Creek, however, Selden Island wares have conical bottoms and no lug handles (Slattery 1946). In the Coastal Plain and Piedmont regions, Marcey Creek was eventually replaced by Accokeek wares, which were tempered with sand and quartz and employed new forms (such as conical bottoms) and coil construction (Stephenson et al. 1963; Steponaitis 1980; Wright 1973). "Clark believes that the transition to conical-shaped vessels and the shift from steatite to quartz temper suggests that around 800 B.C. the steatite quarries [of the Rocky Gorge Reservoir] had ceased to be part of the annual exploitation round of the Native Americans of the Patuxent River" (Clark and Inashima 2003:24). It is possible that other steatite quarries in regions also ceased to be an important part of the seasonal round.

Early Woodland settlement and subsistence patterns show strong continuity with Late Archaic lifestyles and a continuation of what Dent calls the "Intensification Process." The main difference is the appearance of ceramics. The chipped-stone industry reflects Late Archaic "intensification": drills, small bifaces, perforators, scrapers, and utilized flakes. Antler and bone tools have also been recovered (Dent 1995).

Local groups appear to have become more sedentary, occupying larger sites for longer periods that were served by outlying extraction sites (Gardner 1982; Mouer 1991). There is no evidence of the establishment of villages during this period; instead, habitation sites appear to have been a number of seasonal camps (Waselkov 1982). Along the coast, major base camps seem to be linked to more transient, limited-purpose interior sites. A division appears in settlement patterns associated with freshwater and estuarine resource extraction (Custer 1984, 1989; Mouer 1991; Wright 1973).

Wright (1973) postulated small family-based groups moving between forest, riverine, and tidal sites. Tidal sites supported larger populations that gathered oysters and other estuarine resources, whereas inland forest and riverine sites were used for smaller hunting and gathering camps where a variety of animals were hunted, and hickory nuts were gathered. The same pattern has been noted for the Susquehanna, Patuxent, Severn, South, and Potomac rivers (Clark and Inashima 2003; Kent et al. 1971; Steponaitis 1980; Wright 1973). Steponaitis (1980) noted an increase in shell middens along the tidal portions of the Patuxent River, as well as increase of Accokeek components as compared with the number of earlier Marcey Creek components.

Storage pits and house features have been identified at numerous sites dating to this period throughout the Middle Atlantic (Custer 1989, 1994; Custer and Silber 1994; Dent 1995). The earliest known houses in Maryland are associated with the Pig Point Site in Anne Arundel County (Luckenbach 2010; Luckenbach et al. 2010). Research at this site has uncovered the remains of a series of overlapping oval wigwam or yeehakawn structures. A combination of dating methods, including ^{14}C, ceramic seriation, and natural stratigraphy, date these house patterns from the Late Archaic (if not earlier) to the Late Woodland.

5. Middle Woodland Period (ca. 200 BC to AD 1000)

Patterns established during the preceding transition from the Late Archaic to Early Woodland continued through the early portion of the Middle Woodland period. Handsman and McNett (1974) and Potter (1993) suggest, based on their work in Virginia, that specific task groups were assigned to secure the various food sources and to bring them back to residential base camps. This type of fission-fusion cycle has been observed ethnographically (Binford 1983). Very large midden sites begin to appear after AD 550 and increase in number between AD 700 and 900. Groups grew larger, and while fission-fusion continued, some members of the group remained at the base camp/village year-round. Along the tidal portion of the Potomac River, the major Popes Creek Phase settlements were occupied during the fall and winter. Satellite sites for specialized hunting and procurement activities were located beyond the Fall Line and in the interior portions of the Coastal Plain. The main base camp sites have dense shell midden accumulations. At the Popes Creek type site, approximately 14 hectares (35 acres) of shell accumulation was spread on both sides of the creek that was between 4.27 and 7.92 meters (14 and 26 feet) deep. During the spring, part of the group would travel upriver to the Fall Zone to take advantage of the annual runs of anadromous fish (Dent 1995).

Custer (1996) notes that transient camps and small procurement and processing stations continued to be as an important part of Middle Woodland settlement patterns as they were during the Late Archaic/Early Woodland periods. Transient camps are less ephemeral than procurement and processing stations, and ceramics are frequently found in their assemblages. Rockshelters were commonly used as the locus of transient camps. Stewart (1985) has referred to rockshelters as the "prehistoric motels" of the Early and Middle Woodland. These transient camps were probably associated with specific procurement activities such as plant resources, lithic outcrops, or riverine resources (Custer 1996).

Clark and Inashima (2003:25) note an expansion of population into new geographical areas during the succeeding Selby Bay Phase and state that the Middle Woodland period is a time of "dynamic change." There is a substantial shift in population location, lithic procurement activities, and subsistence patterns between the Popes Creek Phase and the Selby Bay Phase of the later Middle Woodland. Steponaitis (1980) notes that for the tidal portion of the Patuxent River, lithic materials used during the Popes Creek Phase tend to be primarily of local origin. Most of the Rossville points associated with Popes Creek components were made of either quartzite (46 percent) or quartz (41 percent). Smaller numbers were made of Piedmont rhyolite (11 percent), chert from Pennsylvania (1 percent), or Pennsylvania jasper (1 percent). In the Upper Patuxent, Severn, and Magothy drainages, local quartz quarries were used both for lithic resources and for seasonally available resources at nearby drainages and bogs (Polglase et al. 1990, 1992; Polglase and Neuman 1991a, 1991b). Expanding populations began to move into the Fall Zone during the Selby Bay phase.

Eventually, populations residing in the Patuxent drainage began to cross the ridge near what is now Mt. Airy, Maryland, and enter the Monocacy River Valley; from there they were able to directly exploit Blue Ridge rhyolite quarries. Clark believes that at this point the old down-the-line trade network system gave way to direct procurement (Clark and Inashima 2003). Steponaitis (1980) also noted the change in lithic material preference in collections from the tidal Patuxent. Ninety-three percent of the Selby Bay Points in these collections were manufactured from rhyolite. Smaller numbers were made from argillite (3 percent), chert (2 percent), and quartz and quartzite (1 percent). Potter (1993) also noted a direct correlation between rhyolite and Selby Bay points at the Plum Nelly Site along the Potomac River in Virginia. Other items recovered from that site included bifaces made of local stone, green stone celts, and bone tools, needles, and awls.

Changes in pottery styles also characterize the phases of the Middle Woodland. During the early part of the Middle Woodland, Popes Creek ceramics were the predominant ware on the Coastal Plain of Maryland, as well as in parts of Delaware, Pennsylvania, and Virginia. Popes Creek is thick-walled, tempered with sand, and bears net impressions (Holmes 1992 [1903]; Stephenson et al. 1963). The core area for this ceramic is the tidal drainage of the Potomac River. Distribution extends to the Fall Line and into the Fall Zone but is rare in the Piedmont proper.

Popes Creek ceramics were replaced by Mockley ceramics around AD 200, found in the archaeological record until ca. AD 900. They are tempered with coarsely crushed, unburned oyster shell. The exterior surfaces may be plain, cordmarked, or net-impressed. Mockley is distributed across both the Western and Eastern shores of the Coastal Plain in Maryland and Delaware and as far south as the James River in Virginia. It is also found in the Fall Zone but is rare west of there. Small amounts have been reported from rockshelter sites in the Piedmont and Great Valley regions of Maryland (Jefferson Patterson Park and Museum 2002). Between AD 700 and 900, distinct local pottery was produced along with Mockley and Nomini in southern Virginia and Hell Island ceramics in Delaware (Custer 1996; Dent 1995; Egloff and Woodward 2006).

Initially, Selby Bay Phase settlement patterns mirrored those of the Popes Creek Phase; however, after a dry interval between AD 400 and 500, very large midden sites began to appear in the tidal portions of the Chesapeake Region's rivers next to coves or the embayments of tributary streams. Gilsen (1978, 1979) suggests that settlement and subsistence patterns during the latter portion of the Selby Bay Phase may be characterized as an "Estuarine Efficiency Model." Gilsen argues that there is a dual adaptation to both the tidewater and freshwater areas of the rivers that emphasizes shellfish as the primary food resource and anadromous fish as a secondary resource. Both sources are predictable in terms of location and timing, and both are abundant. He predicts a settlement pattern based on a main village or base camp located in the estuarine portion of the river that was occupied during the late summer, fall, and early winter. During those seasons of the year, the population gathered shellfish and supplemented their diet with turtles, fish, deer, and plant materials. Then during the late winter, spring, and early summer, a secondary village or base camp was established along the riverine portion of the river near the spawning areas. Selby Bay peoples exploited the anadromous fish runs and supplemented their diets with plants, turtles, waterfowl, small mammals, deer, and wapiti (elk). Potter (1993) suggests that this may be the last intensive gatherer and hunter era in the Middle Atlantic, and further, that the rich Coastal Plain environment may have delayed plant husbandry until much later in the Late Woodland.

McLearen and Mouer (1994) argue that between AD 200 and 800, Middle Woodland peoples gradually changed their fission-fusion cycles, staying in one place for much longer periods of time until they began to live in more permanent settlements. Mobility decreased as groups increased their focus on collecting specific resources. Large numbers of house patterns appear in the Middle Atlantic during the latter part of the Middle Woodland period. A possible domestic structure was uncovered in Calvert County along the Patuxent River (Dent 1995). At the Indian Point Site on the Schuylkill River in Pennsylvania, semi-subterranean house pits with numerous hearths and storage pits were recovered during excavation. Household clusters were identified at the Clyde Farm Site in northern Delaware. Each of these clusters contained a house and food storage/processing pits associated with an individual family. A pit house dating to this period has been identified at the Pig Point Site in Anne Arundel County (Luckenbach 2010; Luckenbach et al. 2010).

Boundary definitions between groups would have intensified as mobility deceased. Luckenbach et al. (1987) suggest that the during the Selby Bay phase the local population, represented by the Accokeek and Popes Creek people, may have been replaced and/or absorbed by a large influx of Algonquian-speaking people. Potter (1993) notes new territories on the Northern Neck of Virginia and in the Potomac Basin, along the Rappahannock River basin south to the James River, along the Patuxent River basin, and in the Piedmont west of Fall Line. Custer (1996) notes similar territories in the Delaware and Schuylkill River valleys affiliated with coastal groups to the south and east. Groups in the Susquehanna River valley were more closely affiliated with interior Piedmont groups to the north and west.

Rhyolite, which was the preferred lithic material for much of the Selby Bay phase, could only be obtained in the Piedmont. After AD 700, trade or direct access to the resource declined, effectively ending around AD 900. Rhyolite points recovered from Coastal Plain sites post-dating AD 700 are heavily reworked, and an increasing number of points are made from local quartz and quartzite. This suggests that the Fall Line became a boundary between Coastal Plain and Piedmont groups that had settled into distinct territories. This was not because of the introduction of agriculture as Binford hypothesized in 1964, but is instead a result of intensive gathering and hunting of select species. Changes occurred in the diet at the end of the Middle Woodland Period, a result of a decrease in the diversity of species in oyster shell middens and an increase in the volume of oysters. Populations focused on deer, turkey, and anadromous fish. It is also possible that horticulture started during this period (Dent 1995).

6. Late Woodland Period (ca. AD 1000 to 1600)

Agriculture was firmly established during the Late Woodland. Selig (1993) suggests that plant domestication in the Eastern Woodlands began with indigenous seed plants. These included chenopod (goosefoot), marsh elder (gall bush), squash, sunflower, erect knotweed, little barley, and maygrass. According to Selig, between 3000 and 2000 BC, significant morphological changes occurred to wild plants collected by Native populations living in what are now Tennessee, Arkansas, Illinois, Kentucky, Ohio, Missouri, and Alabama. These morphological changes include thinning of the seed coats and increase in seed size owing to manipulation by human populations who gradually changed the seeds as they were harvested and planted over a period of almost 1,700 years. Sometime between 250 BC and AD 200, small farming communities began to appear in the Mississippi and Ohio river drainages, and along the Gulf Coast and river valleys of the Southeast.

The focus of these farming villages was on indigenous crops, not on maize. This type of food production began at the same time as the emergence of Hopewell in the Midwest, a regional culture that did not reach into the Middle Atlantic (Milner 2004; Selig 1993).

Maize began to dominate fields and diets in the Southeast ca. AD 800. Maize production spread rapidly through the Eastern Woodlands, and by AD 900 it extended from Florida up the East Coast into Ontario. The transition coincided with emerging Mississippian chiefdoms in the Midwest and the beginnings of chiefdoms in the Middle Atlantic. In the Middle Atlantic, maize was part of a diet that included nuts, starchy tubers, amaranth, and goosefoot (Ameringer 1975; Dent 1995; Kinsey and Custer 1982; Moeller 1975). The diet was also supplemented by wild plants and faunal and aquatic resources, including freshwater shellfish and anadromous fish.

Lithic technology does not change appreciably during this period, although the appearance in the archaeological record of triangular stone points probably indicates the manufacture and use of bows and arrows. Other tools include stone celts and hoes, and other lithic, bone, and antler tools. Angular pipes have been recovered, as well as native copper beads and pendants, although the latter are rare (Dent 1995).

The cultural boundary demarcated by the Fall Line evident in settlement patterns and material culture before the Late Woodland persisted between the Piedmont and the Coastal Plain provinces. As Potter (1993:155) notes, the "fall line had been a dynamic place since at least 2,000 B.C., but it became particularly so during the Late Woodland." In Virginia this was particularly true in the century or so preceding the settlement of Jamestown. The Fall Line became a cultural buffer zone between the Monacans of the Piedmont and the Powhatans of the Coastal Plain. This cultural buffer is also noted in the distribution of ceramic types throughout the area.

In Maryland, Late Woodland ceramics include Shenks Ferry, Shepard, Page, and Keyser wares. All these wares have distribution patterns west of the Fall Line. Townsend Series ceramics were distributed throughout the Coastal Plain to the Fall Zone. This series of ceramics includes several defined types: Rappahannock Fabric-Impressed, Rappahannock Incised, Rappahannock Plain, Townsend Herringbone, and Townsend Corded- Horizontal. Moyoane and Potomac Creek Ceramics also have a limited distribution in the Piedmont west of the Fall Line (Jefferson Patterson Park and Museum 2002). Distribution of all of these ceramic types appears to match the locations of two distinct linguistic groups: the Algonquians and the Iroquoians. Areas that were predominantly inhabited by Algonquian speakers are associated with the distribution of Townsend series ceramics, Potomac Creek ceramics, and Shepard ceramics, whereas areas with Iroquoian/Eastern Siouan affiliations are associated with the distribution of Shenks Ferry ceramics (Custer 1996; Dent 1995; Griffith and Custer 1985; Potter 1993).

Overall settlement patterns remained much the same as during the previous period. Semi-sedentary villages appeared throughout the region, which were associated with small seasonal hunting, fishing, and gathering camps (Potter 1982). Smaller villages appeared between AD 800 and 1300; larger villages tended to appear after AD 1300. Between AD 800 and 1600, fortified villages appeared along river valleys. This may be because of the population movements through the region described above. Some villages were fortified with substantial stockades that surrounded a central building; others surrounded the whole settlement. The former may have marked precinct bounds, whereas the latter were defensive (Clark 1980; Dent 1995). Population increased and social

organization throughout the Middle Atlantic exhibited a greater range of social complexity, increased social stratification, and corresponding social inequality (Potter 1993).

Small gathering and hunting communities generally do not organize on the tribal level unless an abundance of resources exists. In the Chesapeake Region there was an abundance of shellfish and other estuarine resources that became available during the Late Archaic/Early Woodland periods. Groups tended to be more sedentary, although they were not living in villages. Seasonal dispersal of families hampered establishment of strong tribal entities as the coherence of the corporate group was continually disrupted. As communities became more sedentary through the Middle Woodland period, however, they may have begun to organize into what Sahlins (1968) describes as segmentary tribes. Segmentary tribes tended to divide into independent local communities that were the primary political units or segments. The communities and their territories were small. Individual communities could be formed from a single descent group or lineage or by an association of several different lineages. Leadership of the groups was generally in the form of either a petty chieftain or a Big Man. Neither position was hereditary. Eventually, one of these leaders might be able to gain control of a group of villages, and over time he and possibly his descendants could consolidate and centralize their political control over the group.

By the late 1400s to early 1500s, there was increasing social and political centralization in the Chesapeake Region. Potter (1993) believes that complex societies began to emerge at this time in the form of chiefdoms. Carneiro (1981:45) defines chiefdom as "An autonomous political unit comprising a number of villages or communities under the permanent control of a paramount chief." The earliest of these chiefdoms probably emerged from the Potomac Creek Complex and was composed of the Piscataway of Maryland and associated groups such as the Nacotchtanks, Pamunkeys, Nangemoys, and Potapocos, and the Patawomekes of Virginia and associated groups. This chiefdom continued until the end of the 1500s, when the Patawomekes broke away under their own chief (Potter 1993). This early chiefdom arose just east of the Fall Line on the inner Coastal Plain along the Potomac River. This is also the same setting where the Powhatan Chiefdom arose along the James River in Virginia.

Numerous explanations have been put forth as to why centralized chiefdoms emerged in the fifteenth and sixteenth centuries. These include the location of agricultural soils, population pressure on resources, control over resources (such as anadromous fish), and external pressure by non-Algonquian populations who entered the Fall Zone to exploit the area's resources. Alternative explanations include trade arrangements between Coastal Plain and Piedmont groups that allowed certain members of Algonquian society to secure trading monopolies that became hereditary. This in turn concentrated wealth in the hands of a few individuals who were eventually able to consolidate control over other Algonquian groups in the area through trade restrictions and alliances (Potter 1993). Rountree (1989) has also suggested that sporadic contact with Europeans during the sixteenth century introduced epidemic diseases among the Powhatans. She suggests that these diseases disrupted the social order and enabled an ambitious individual to establish control as paramount chief.

C. HISTORIC CONTEXT

1. Contact and Settlement (AD 1570 to 1750)

Official European settlement in Maryland did not occur until 1634, when St. Mary's City in southern Maryland was settled by a group of colonists sent to the Chesapeake by Cecilius Calvert, second Lord Baltimore. Earlier settlers, led by William Claiborne of Virginia, had colonized Kent Island illegally in 1631 (Brugger 1988; Carr 1974; Fausz 1988). Settlement in the northern Bay lagged behind that of Southern Maryland, partly because of the presence of the Susquehannocks at the head of the Bay.

Baltimore County was the sixth county established in Maryland. Formed around 1658, the county originally included parts of Anne Arundel, Howard, Carroll, and Kent counties, and all of Harford and Cecil counties and Baltimore City (Brooks and Rockel 1979). The first formal mention of the county boundaries does not appear until 1674, when Cecil County was formed. The first county seat was not established until about 1671 in "Old Baltimore" on the Bush River (now Harford County). The town included a tavern, a ferry wharf, and the courthouse. By 1695 the county courthouse at this site had been abandoned and the new seat was on the Baltimore County side of the Little Gunpowder Falls River at "Simms Choice." Since the "Simms Choice" location was difficult to reach, the county seat was again relocated, in 1712, to the town of Joppa near the mouth of the Gunpowder River (Brooks and Rockel 1979).

The establishment of Baltimore County created a flurry of interest in the unsettled land surrounding the northwest branch of the Patapsco River (Power 1992). One of the first settlers in the area was David Jones. In 1661 Jones staked a claim to 380 acres on the east side of the run that flowed into the basin from the north. His patent was recorded in the proprietor's land office in 1678 and was named "Jones his Range" (later known as Jones's Range). David Jones built a residence on the bank of the run and had his name attributed to the Jones Falls. Before Jones was able to record his 200-acre parcel with the land office, another speculator, Thomas Cole, laid claim to a portion of Jones's holdings. In 1668 Thomas Cole obtained a warrant and patented an expansive 550-acre lot called "Cole's Harbour." The parcel was cut in half by the Jones's Falls and including portions of Jones's Range. Since David Jones did not obtain a warrant for his land until 1678, his title to "Jones's Range" was secondary to Thomas Cole's patent of "Cole's Harbour," and Jones lost his claim to the parcel.

In 1700 the county population was under 2,000. Like the majority of seventeenth-century Chesapeake residents, the settlers in Baltimore County were tobacco planters. For mid-seventeenth-century Maryland as a whole, labor for tobacco plantations was supplied primarily by white indentured servants. Importation of enslaved Africans increased rapidly after 1680, while importation of white indentured servants decreased. About 96 people were enslaved in Baltimore County in 1699; by 1715, when the population of the county had reached about 3,000, approximately one fifth or one sixth were of African descent (Brooks and Rockel 1979; Brugger 1988; Scharf 1881). Baltimore County ended the seventeenth century as a vast, under-populated area. The eighteenth century would be a period of rapid growth and economic expansion.

2. Rural Agrarian Intensification (1680 to 1815)

The tobacco economy spurred settlement along the Patapsco and Gunpowder rivers and the Chesapeake Bay because each planter needed access to deep water for shipping his tobacco to England. Land speculation was also a major force in the local economy. Speculator-settlers who arrived in the area included Charles Carroll and Jonathan Hansen. The land that became Baltimore's Inner Harbor and downtown was the same originally patented by Thomas Cole in 1668. From 1695 to 1701, a Baltimore County gentleman, James Todd, purchased all of "Cole's Harbour" as well as two adjoining parcels on the east side of the Jones Falls: the 200-acre "Mountney's Neck" and the 160-acre "Bold Venture." Todd resurveyed "Cole's Harbour" in 1698 and renamed the tract "Todd's Range." By 1701 James Todd had acquired approximately 900 acres and immediately began selling portions of the massive property (Power 1992).

In June of that year, James Todd sold approximately 600 acres to Charles Carroll and the remaining 300 acres to John Hurst. This division laid the groundwork for the subsequent parceling out of Baltimore during the eighteenth century. Carroll's portion of "Todd's Range" became the location of Baltimore Town, and the Hurst tract became the site of Jones Town, commonly known today as Old Town (Power 1992). Jonathan Hansen purchased part of "Todd's Range" from Charles Carroll in what is now the Baltimore Inner Harbor area and established the first gristmill on the Jones Falls in 1711 (Brooks and Rockel 1979; Greene 1980; Olson 1980; Power 1992). Hanson also patented 200 acres called "Mount Royal" farther up the Jones Falls in what is today part of the Reservoir Hill neighborhood. He surveyed the property in 1720 on escheated land called "Saint Mary Borne," which was originally patented by George Hickson in 1672. Other portions of Reservoir Hill lie within three other original land grants: "Hap Hazzard" (ca. 1717), "Ivy Hills" (ca. 1754), and "Spicer's Stoney Hills" (ca. 1761).

Several other large tracts patented during the late seventeenth to early eighteenth century were located west of Carroll and Hanson's holding near the Jones Falls. The earliest was Edward Lunn's 200-acre acquisition located west of and adjacent to "Todd's Range." The 200-acre parcel, named Lunn's Lot, was a somewhat crescent-shaped tract with its north apex near the present-day Chase Street and Howard Street and the southernmost point near the Patapsco River below Federal Hill. To the west of "Lunn's Lott" was a massive 950-acre tract called "Chatsworth." Patented by Capt. William Lux in 1757, the enormous parcel consisted of nearly a half dozen smaller lots originally patented by his father-in-law, George Walker, and other earlier Baltimore County land speculators between 1717 and 1749. Captain Lux consolidated those parcels by 1755 and eventually built a grand plantation and gardens near the present-day intersection of Pennsylvania Avenue and W. Franklin Street. For a time his Chatsworth estate encompassed a large proportion of present-day Baltimore City, including the neighborhoods of Harlem Park, Upton, Sandtown-Winchester, Bridgeview-Greenlawn, Coppin Heights, Rosemont, Mosterk, and parts of Edmondson. Over the remainder of the eighteenth century, the Lux family sold portions of their estate to other planters who established their own farms along the roads west of Baltimore Town. After Captain Lux's death, his house and garden were sold and became a public pleasure garden called Gray's Gardens.

At the beginning of the eighteenth century, the county's population clustered along the coast of the Chesapeake Bay and the lower navigable portions of the county's rivers. Settlement in the Piedmont region was slower, partly because of the lack of good roads into the interior regions of the county. In addition, the soils in the interior were not as well suited to tobacco cultivation (Gibb

and Read 1992; Lukezic 1990). Few settlements were made in the interior of Baltimore County before 1695. In that year a garrison fort for Maryland Rangers was erected at the junction of the Susquehanna and Delaware roads in what is now Garrison, Maryland. These wagon roads extended into the hinterland of western Maryland and southern Pennsylvania. The presence of the rangers at the garrison encouraged settlement in the interior. Southwestern Baltimore County (including what is now southwestern Baltimore City) was part of a massive tract of land known as "Hunting Ridge." This tract occupied the uplands area between the Gwynns Falls and the Patapsco River. Few land grants were surveyed in "Hunting Ridge" before 1695 (Brooks and Rockel 1979; Keidel 1982).

In the early eighteenth century the increase of plantations and businesses along the Patapsco led a group of local planters to petition the Maryland General Assembly for formation of a town. The original site selected for Baltimore Town was Moale's Point on the Middle Branch of the Patapsco River. John Moale, the tract owner, objected, however, as iron ore deposits had been found there. Daniel Carroll of Dudington and his brother, Charles Carroll of Annapolis, agreed to sell 60 acres of "Cole's Harbour" or "Todd's Range" to the town commissioners. Lots in Baltimore Town were laid out in December 1729 and sold in January 1729/1730. Two years later, Jones Town was laid out across the Jones Falls from Baltimore Town (Greene 1980; McGrain 1985; Olson 1980).

While Baltimore was in its formative years, the economic base of Maryland underwent a profound shift. Wheat began to emerge as the cash crop of the Eastern Shore and the new western Piedmont settlements, although tobacco continued to be the dominant crop in southern Maryland. Local wheat production resulted in the development of mills for grinding flour. Flour proved a lucrative export to markets in England and other colonies. In addition to wheat farming, iron furnaces were developed, giving Maryland an early industrial base. In 1731 the Carroll brothers (Daniel and Charles), Dr. Charles Carroll, and Daniel Dulaney the Elder formed the Baltimore Iron Works Company. The furnace was located along the Gwynns Falls, close to Moale's Point (McGrain 1985). The diversification of Maryland's economy drove the development of Baltimore's economy.

Growth in the area prompted the merging of Jones Town with Baltimore Town in 1745 (Olson 1980). By 1750 Baltimore had approximately 200 residents. John Moale (son of the John Moale of Moale's Point) drew a sketch of Baltimore Town in 1752. The sketch shows a small hamlet with 25 houses, St. Paul's Church, Payne's and Kaminsky's taverns, and a small wharf at the current base of Calvert Street (Greene 1980; Moale 1752). Twenty-five years later, the number of houses in Baltimore had increased from 25 to 564 (Olson 1980). Fells Point was patented, surveyed, and settled between 1761 and 1770, contributing to the area's increase in population.

Population increase was fueled by the growth of Baltimore's economy. Flour and iron production meant the development of commercial outlets and warehouses on the town wharves, an increase in maritime exports, and the formation of ancillary businesses connected to maritime trade. After 1745 the economy expanded, in large part a result of the Seven Years War (or French and Indian War) (1756 to 1763). The Baltimore harbor was large enough to accommodate numerous vessels and wharfs. Like Joppa, the former county seat, it was along the Fall Line between the Coastal Plain and Piedmont provinces; however, Baltimore also had numerous waterways, along which to build the mills associated with the growing grain economy (Brooks and Rockel 1979). In 1768

Baltimore Town became the seat of Baltimore County. Joppa continued to decline in economic importance and remained a quiet country village through much of the nineteenth century.

Between 1745 and 1783, Baltimore Town made 12 separate annexations of adjacent county lands. The first annexation in 1745 was of the 10 acres that comprised Jones Town. The other 11 annexations, with the exception of Fells Point, were all of undeveloped land. These annexations each averaged approximately 65 acres in size. The owner of the tract was responsible for laying out the lots and streets in the new subdivisions within the town (Arnold 1978). Baltimore was a major port by the late eighteenth century. Lombard Street and Water Street, between Charles Street and the Jones Falls, extended along the City's original waterfront and were populated with shops, counting houses and banks, and warehouses, shipping offices, and their associated wharves. Ships once lined the wharves and rode at anchor in the harbor (Greene 1980; Norman 1987; Olson 1980). The waterfront along what is now Lombard Street was fully developed by 1781.

Tobacco prices rose in the early 1760s, and the county's merchants and planters had expectations of high economic returns. At the same time Britain began strict enforcement of its Navigation Acts, which included duties on iron. Exports of iron dropped rapidly, sending the area's economy into a decline. The Currency Act of 1764, which prohibited the issue of paper money by the colonies, also had a detrimental effect on the county's economy. The Stamp Act of 1765 precipitated the formation of a local Sons of Liberty group. The group included many of Baltimore's prominent merchants; however, members of the planter class tended to avoid involvement with this group. Sons of Liberty groups throughout the 13 colonies were successful in their campaign to have the Stamp Act repealed. After the repeal of the Stamp Act, prosperity returned to Baltimore's merchants and ironmongers. When the Townsend Acts were passed in 1767, few merchants in Baltimore County raised protest because their coffers were full (Brugger 1988; Greene 1980; McGrain 1985; Olson 1980).

Economic prosperity continued until the early 1770s, when capital gains from tobacco and grain exports to Britain began to decrease. British creditors began pressing their American clients for payment of debts, and many merchants faced ruin as the economy went further into decline. Tensions rose, culminating on April 30, 1773, in a clash between Baltimore Town citizens and Robert Morton, a British customs official. Morton had impounded a ship's cargo for non-payment of duty. Morton managed to escape the mob, but two of his assistants were grabbed by the crowd, coated with tar and feathers, and marched through the streets of Baltimore (Read and Anderson 2003).

On July 4, 1776, the Continental Congress met in Philadelphia and formally declared independence from Britain. The former colonies adopted new constitutions. Although the new Maryland Constitution placed the government in the hands of the propertied (the minimum amount of property required of a member of the lower house was £500), it did expand suffrage (Brugger 1988). During the ensuing War for Independence, Baltimore County contributed a number of military leaders to the revolutionary cause. These men included John Eager Howard, who fought at Germantown and the Battle of Cowpens, and Mordecai Gist, son of Richard Gist of Milford Mill. In July 1776 Gist's troops reinforced Washington during the Battle of Long Island. Refusing to yield to the British during the battle, Gist and the Maryland Line's accomplishments earned Maryland the nickname, "The Old Line State" (Brogan 1985; McCullough 2004).

After the war Baltimore returned to the business of mercantile capitalism. The town's rival, Annapolis, went into a slow and steady economic decline. By the late eighteenth century Annapolis had become primarily a center of government as the state capital. Baltimore continued to grow, linked to the world through trade networks (Ward et al. 2006). By 1792 Baltimore Town had spread from the original core around the Inner Harbor east along the shoreline to Fells Point. In addition, the town had spread north, inland and away from the harbor. Development in the harbor area had spread as far north as what is now Saratoga Street. Streets in East Baltimore had been laid out as far north as the current location of Fayette Street (then Pitt Street) (Folie 1792; Olson 1980). In 1793 a group of Baltimore merchants was able successfully to lobby the General Assembly for a charter of incorporation as a city, which was granted in 1796 (Greene 1980).

In 1803 Britain and Napoleonic France began a war with one another. Britain was the largest trading partner of the United States. For four years the United States managed to stay neutral in the British and French altercation. Then, in July 1807, the British frigate *Leopold* opened fire on the frigate USS *Chesapeake*. The British suspected the *Chesapeake* of harboring British deserters. The *Chesapeake* sustained 22 shots in her hull and 21 casualties. She surrendered after firing one shot. The British boarded and removed four men; one was hanged, one died in captivity, and two were freed four years later (Toll 2006). The British continued to board United States ships looking for deserters.

In December 1807 President Thomas Jefferson got the legislation he desired from Congress, a trade embargo on all foreign countries until the sovereign rights of the United States were recognized (Brogan 1985). In a port city like Baltimore, the embargo spelled disaster for many merchants. The embargo was harder on the United States than on her trading partners. In 1809, two days before leaving office, President Jefferson reluctantly signed a repeal of the Embargo Act. It was replaced by the Non-Intercourse Act, which allowed some trade with Britain. In 1810, under President James Madison, this act was replaced by Macon's Bill number 2. Trade with both Britain and France was restored for three months, provided one or the other of them recognized the principles of neutral trade. Napoleon managed to convince Madison that France did indeed recognize neutral trade. Normal trade relations were restored with France, while Britain was barred from trade (Brogan 1985, Perret 1989).

Britain was boarding more ships by 1811—3,800 American sailors were impressed by the British before war began. The Northwest Territory (Michigan, Wisconsin, Ohio, Illinois, and Indiana) was in turmoil with fighting between settlers and British-backed Native Americans. President Madison concluded he had no other recourse than to declare war on Britain. He sent a war resolution to Congress on June 1, 1812. Seventeen days later, Congress passed a declaration of war. At the time Baltimore was the fourth largest and third richest city in the United States, and a top target for the British. Over the course of the war, Baltimore privateers would take over 500 British ships (Perret 1989; Toll 2006).

On the night of September 13-14, 1814, the British attacked Baltimore. The attack was, for the British, a complete failure. Adm. Alexander Cochrane sent five bomb ships into Baltimore. As the historian Geoffrey Perret (1989:125) has commented, Cochrane's bomb ships had enough firepower, if "properly handled, to flatten any port in the world. He made only one mistake. Fearful of losing any of his ships to Fort McHenry's guns, he kept them at maximum range, two-and-a-half miles. Cutting the fuses to fit that distance was virtually impossible. He provided the people

of Baltimore with the greatest fireworks display they would ever see, and the country with a national anthem." The War of 1812 lasted two and a half years. The Treaty of Ghent was signed on December 24, 1814.

3. Agricultural – Industrial Transition (1815 to 1870)

Between 1776 and 1816, the population of the Baltimore area had expanded outside the city limits into an area of the county known as "the Precincts." This area surrounded the city on the west, north, and east sides and covered an area of over 13 square miles. Figure 7 shows part of the APE-Archaeology in relation to this area. The population in this area stood at approximately 12,000 people, or one-third of Baltimore County's population. Baltimore City annexed this area to the city in 1816 (Arnold 1978).

At the beginning of the nineteenth century, neighborhoods in Baltimore City began to be heavily segregated by class and race. The houses along the main streets of the older areas of the city were occupied by the working class and shop owners. The wealthier shipyard owners and merchants began to settle in the emerging upper-class neighborhoods in the downtown area, north along Broadway and in the area surrounding Mount Vernon (Etherton 1994). African Americans in Baltimore City were pushed to the periphery of living areas. In 1810 less than 20 percent of the free Black households in the city were located in alley dwellings; by 1835 approximately 40 percent of these households were living in alley dwellings.

Economic opportunities for free Blacks were also restricted. A large population lived in Fells Point working as skilled laborers (caulkers) in the shipyards (Clem and Sheehan 2004; Ernstein 1992; Farnham and Jones 2002). In 1865 Isaac Meyers founded the Chesapeake Marine Railway and Dock Company on Philpot Street. This African American owned business was founded in response to hostility by white shipyard laborers toward black laborers. The company operated until 1884.

By the 1840s immigrants began pouring into Baltimore. The 1840s and 1850s were decades of intense development for the city. Its location at the Fall Line had spawned a dense concentration of mills and other industries along the Jones Falls and Herring Run earlier in the century. By the middle of the century, the city was a leader in manufacturing. City factories produced new transportation technologies (rail and steamship), furnishings, clothing, and even baked goods. During the 1830s the canning industry arrived in Baltimore. Oysters, fruits, and vegetables were packed in canneries across the city. Periodic influxes of immigrants supplied the labor needed for factories, rail lines and housing construction (Greene 1980; McGrain 1985; Olson 1980).

Despite the increase in population, development was slow west of the city limits. The land containing present-day west Baltimore was largely agricultural during this period. Large plantations and smaller tenant farms occupied the landscape west of Freemont Avenue and north of Wilson Street. A preliminary street plan, in anticipation of the eventual urban expansion of Baltimore into this area, was devised in 1823 by Thomas H. Poppleton for the Baltimore Board of Commissioners and depicted in *Plan for the City of Baltimore, Maryland* (Sidney and Neff 1851) (Figure 8). Poppleton's 1823 plan laid out streets primarily on a north-south grid, but in a few locations, most notably along Pennsylvania Avenue, Columbia Avenue, and Fort Avenue, the grid followed diagonal streets as those roads were preexisting turnpikes laid out during the eighteenth

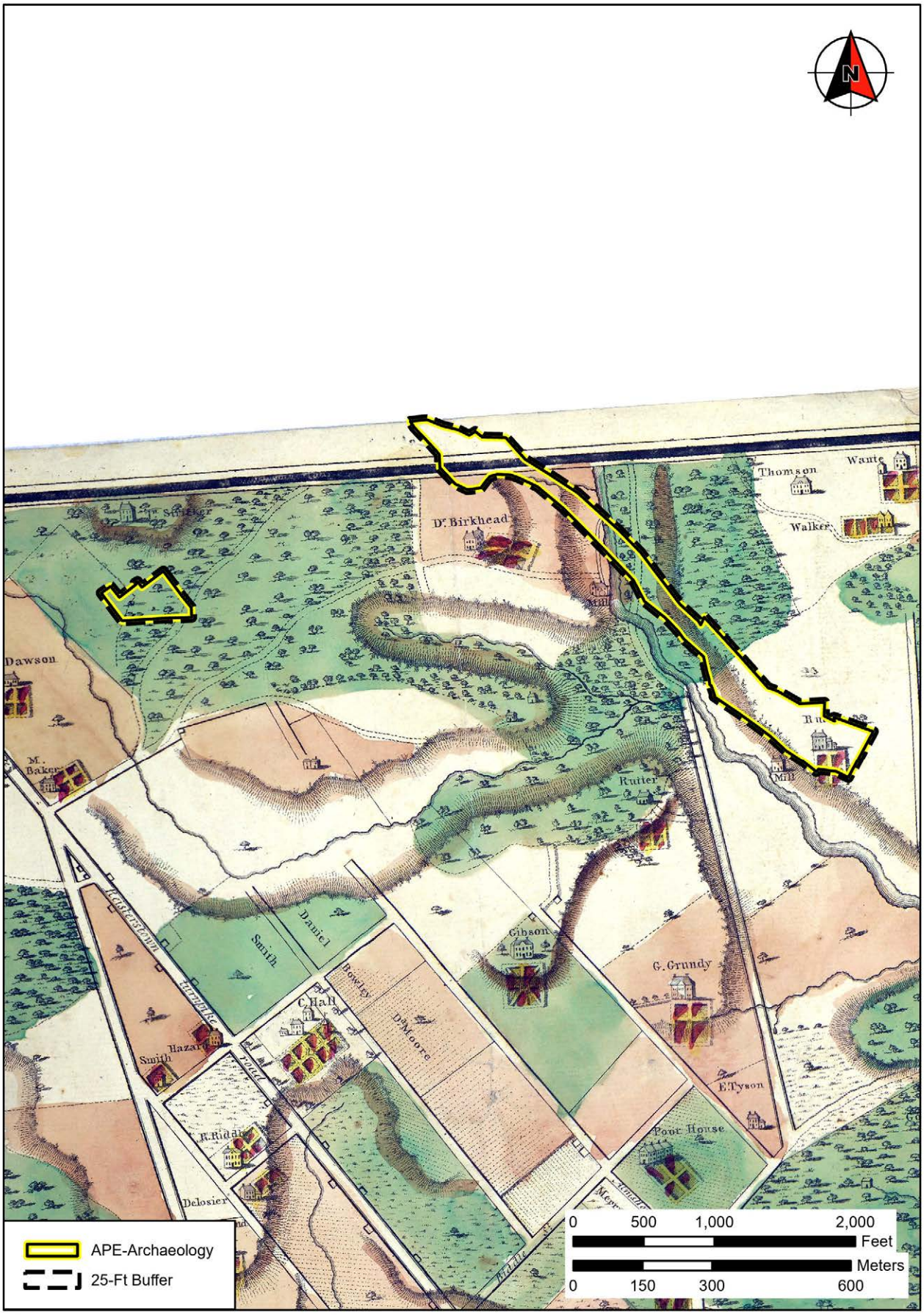

FIGURE 7: Project Vicinity in 1801 (Warner & Hanna 1801)

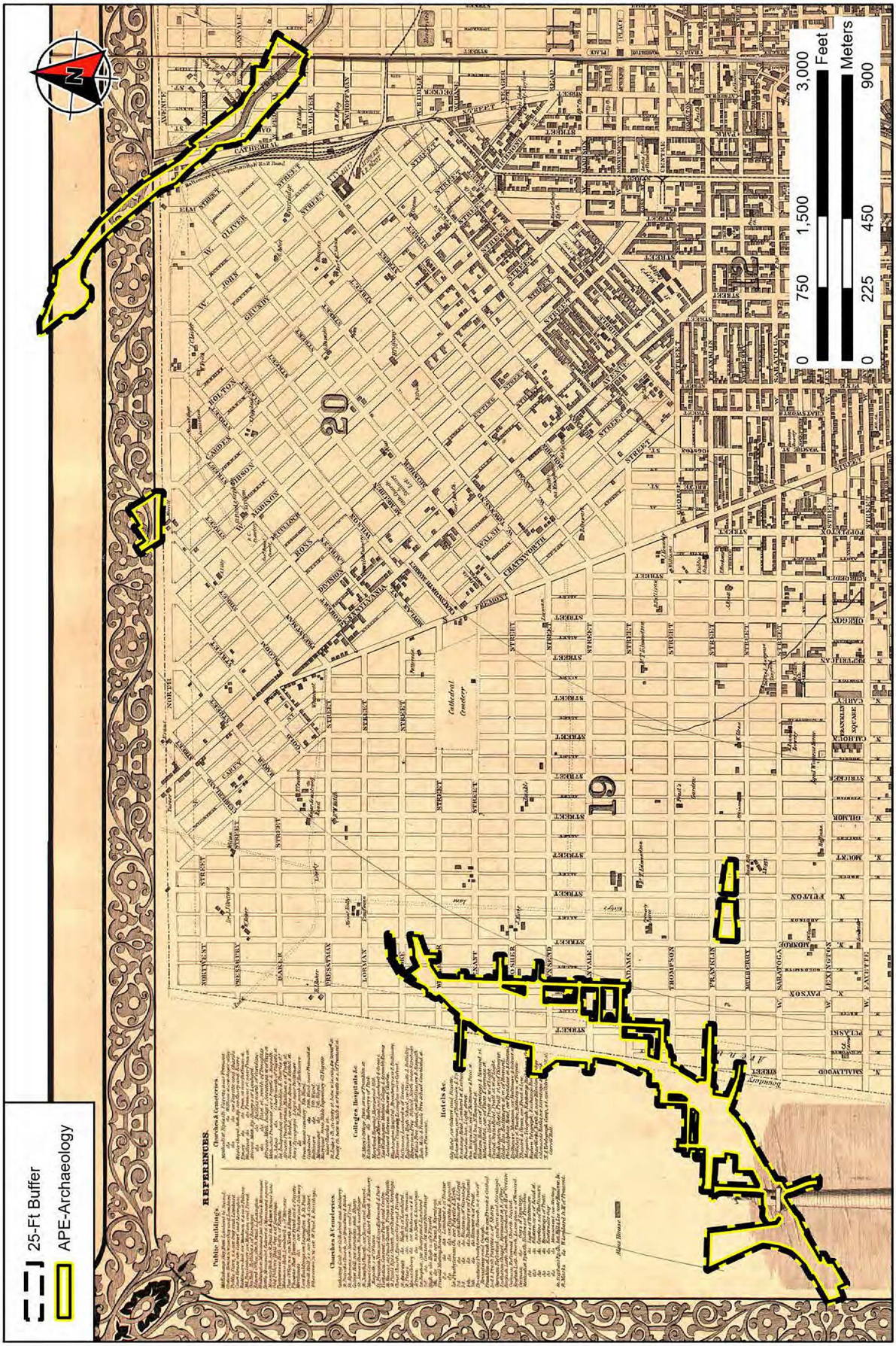

FIGURE 8: Project Vicinity in 1851 (Sidney and Neff 1851)

century. Although the street pattern dates from 1823, few houses were built in the area prior to the Civil War (Figure 9).

Baltimore City was not the only area of the county to experience industrial growth in the early nineteenth century. Gunpowder was manufactured in the county as early as the War for Independence. Mills continued to be built along the Gwynns and Jones Falls rivers after the war. Production of gun powder was dangerous. On August 28, 1820, an explosion at the Bellona Powder Mill produced shockwaves that were felt as far away as Washington, DC (Brooks and Rockel 1979). Textile mills appeared in the nineteenth century; the two earliest were the Union Manufacturing Company on the Patapsco River and the Powhattan mill on the Gwynns Falls. Other textile operations followed, and by the 1830s small mill towns dotted the banks of the Patapsco, the Little Gunpowder Falls, and the Gwynns and Jones Falls.

Flour mills continued to be an important part of the county's industrial base. The Ellicott brothers erected their first mill on the Patapsco River in 1772. By 1833 the town of Ellicotts Mills (now Ellicott City) had three merchant mills that ground 200 barrels of flour and 300 bushels of grain daily. Samuel Owings began a mill complex in northern Baltimore County in the eighteenth century. The mills were run by several different individuals throughout the nineteenth century. Another long-term miller was William Painter, who along with Samuel Owings is prominently remembered in the area in the place names of Owings Mills and Painters Mill Road (Brooks and Rockel 1979; McGrain 1985).

Isaac Tyson, Jr. began operating a chrome mine along the North Branch of the Patapsco in 1817, on a stretch of the river just north of Liberty Road. Tyson eventually extended his operations north along the river and into Pennsylvania. Between 1828 and 1850, he was the main producer of chrome worldwide; Tyson's chrome works in Baltimore was the first to produce chromium compounds (Arnett et al. 1999). In addition to the chrome deposits in Baltimore County, there were deposits of copper, steatite, quartz, magnetite, and cobalt minerals (Weed 1907). Mines were operated before the War for Independence, most notably at the English and Liberty mines, but intensive mining did not start until the nineteenth century. The Tyson family operated the Mineral Hill Mine near Louisville in Carroll County (at that time part of extreme western Baltimore County).

Improved transportation routes through the area enabled the mines and mills to ship their products to Baltimore and to the new settlements in the western United States. On February 27, 1827, the Maryland Legislature granted a Charter to the Baltimore and Ohio (B&O) Railroad (Jacobs 1995; Reynolds and Orszi 2000). The cornerstone was laid on the Fourth of July 1828, and construction began soon afterwards. On May 13, 1830, the first 22 kilometers (13.5 miles) of railroad track in the United States, between Mount Clare Station in Baltimore City and Ellicotts Mills in upper Anne Arundel County (now Ellicott City in Howard County), were officially opened. From Ellicott's Mills the B&O would eventually head west along the Patapsco River. At the confluence of the North Branch and the South Branch, the railroad continued west along the South Branch. By mid-1831 the railroad reached Parr's Ridge (now Mt. Airy in Carroll County) and was in Frederick by the end of the year. Other milestones in the construction of the railroad included reaching Point of Rocks along the Potomac River in April 1832, Harpers Ferry in December 1834, and Cumberland on November 5, 1842. In December 1852 the B&O reached its terminus at Wheeling (then in the Commonwealth of Virginia), 379 miles west of Baltimore.

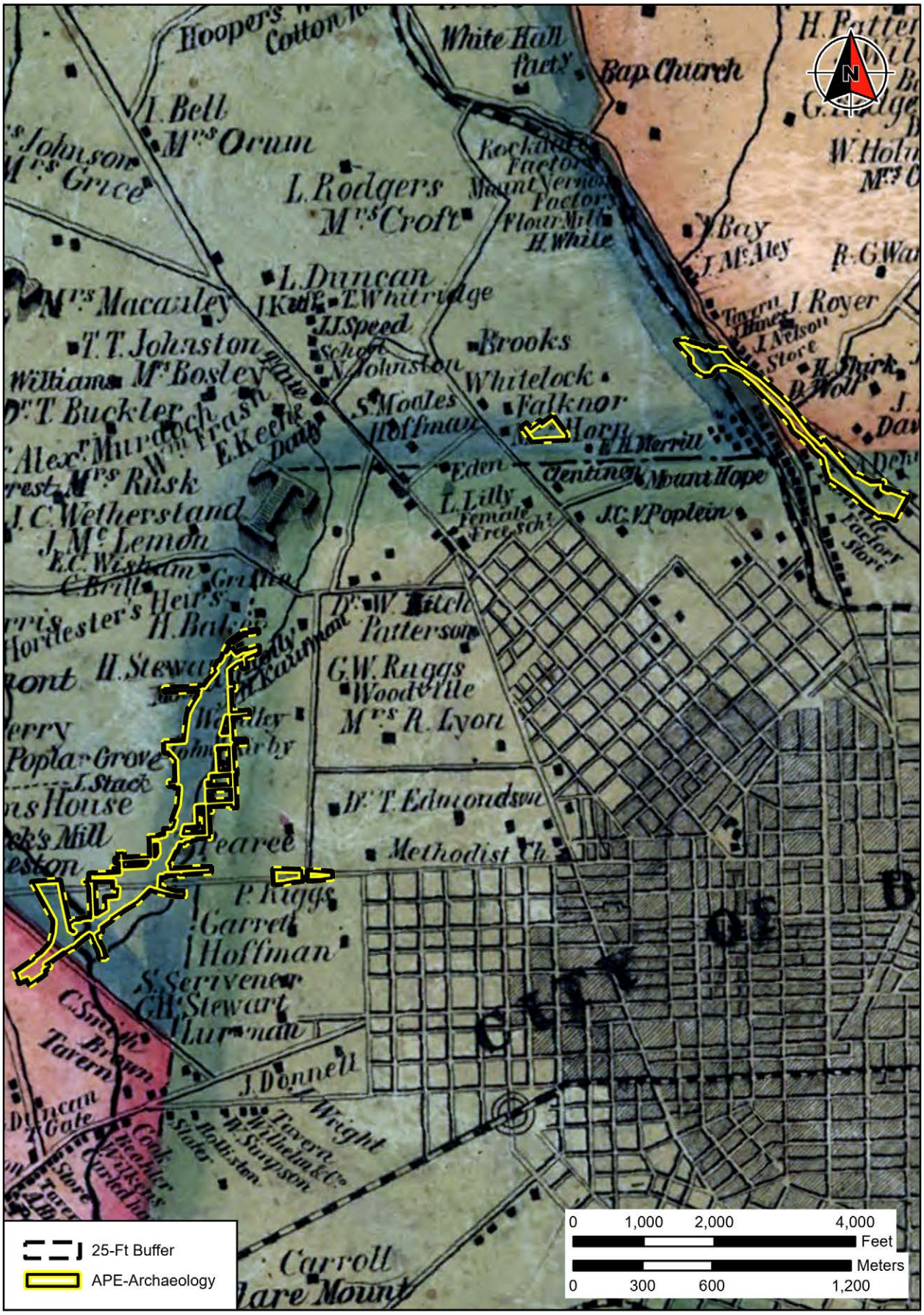

FIGURE 9: Project Vicinity in 1857 (Sidney 1857)

The Baltimore and Susquehanna (B&S) Railroad was a north-south line (Figure 10). This railroad line was chartered in 1828, with construction underway by 1831. A portion of the line was built along what would become the western border of the village of Lutherville. The rail corporation hoped to run a line into Pennsylvania but struggled to extend its lines north of Cockeysville. The B&S eventually ran a line northwest from the Jones Falls into Westminster, but from there also struggled to extend lines to the north. After some corporate changes, track was extended from the Cockeysville area into north-central Pennsylvania in the early 1850s. This rail line became part of the Northern Central Railroad (NCR) in 1854 (Gunnarsson and Harwood 1991). In 1861 the Pennsylvania Railroad Company acquired a controlling interest in the North Central Railroad stock to better compete with their rival, the B&O. After the acquisition, the North Central operated as a subsidiary of the Pennsylvania Railroad until the late twentieth century. The Philadelphia, Wilmington, and Baltimore Railroad (PW&B) was chartered as the Philadelphia and Delaware County Rail Road in 1831 but changed its name to the PW&B in 1836. The original line in Baltimore was serviced by horse-drawn cars on wood rails with iron stretchers; the remains of these rails are still buried in the yard of the President Street Station (Lane 1997). The PW&B's line ended at President Street Station. To continue south, passengers disembarked and traveled across town to the Camden Street Station on the B&O line.

On April 19, 1861, the Union Army's Sixth Massachusetts Regiment arrived in Baltimore on the PW&B and disembarked for the Camden Street Station, where they were to take the B&O to Washington, DC. They were on their way to protect the capital in the early days of the Civil War. Baltimore, which was very much a pro-Confederacy town, erupted in violence as the Sixth began their march across town on Pratt Street. Four soldiers and 12 civilians were killed in the riot that ensued. This encounter is regarded as the first bloodshed of the Civil War (Perret 1989). After the Civil War, the PW&B was able to expand its service, and by 1866 it had built a wood truss bridge across the Susquehanna River; before that time rail cars were ferried across the river. The demand for passenger and freight service along the Washington, DC-New York corridor spurred the growth of the company, and by 1870 it was the only independent rail line in the region. Both the B&O and Pennsylvania Railroad attempted to purchase the PW&B railroad, and in 1873 the Pennsylvania Railroad succeeded (May 2008).

The Baltimore & Potomac Railroad Company (B&P) was chartered in May 1853. The objective of the railroad was to unite the railroad system in Maryland and Pennsylvania with that in Virginia by building a rail line from Baltimore southwest across the Potomac River to form a junction with the Richmond, Fredericksburg and Potomac Railroad at Aquia Creek. Construction on a spur of the B&P between Baltimore and Washington, DC began in 1860, but the outbreak of the Civil War halted any further construction until the war ended in 1865. In 1867 the project of building a branch of the B&P Railroad to Washington took definite shape (Scharf 1881). The Pennsylvania Railroad had long desired to secure a southern outlet for its North Central Railroad subsidiary, which it had acquired 12 years earlier. Construction of the B&P afforded the opportunity. To create a junction with the North Central Railroad and the proposed B&P Railroad, the Pennsylvania Railroad invested nearly all the capital for construction of a tunnel through northwest Baltimore. The B&P Tunnel was 1.5 miles long and wide enough for a double track. Work began on the B&P Railroad from Washington to the western outskirts of Baltimore in 1868 and was completed in less than four years (Scharf 1881). Trains began running on the B&P Railroad from Lafayette Station in Baltimore to Washington on July 2, 1872.

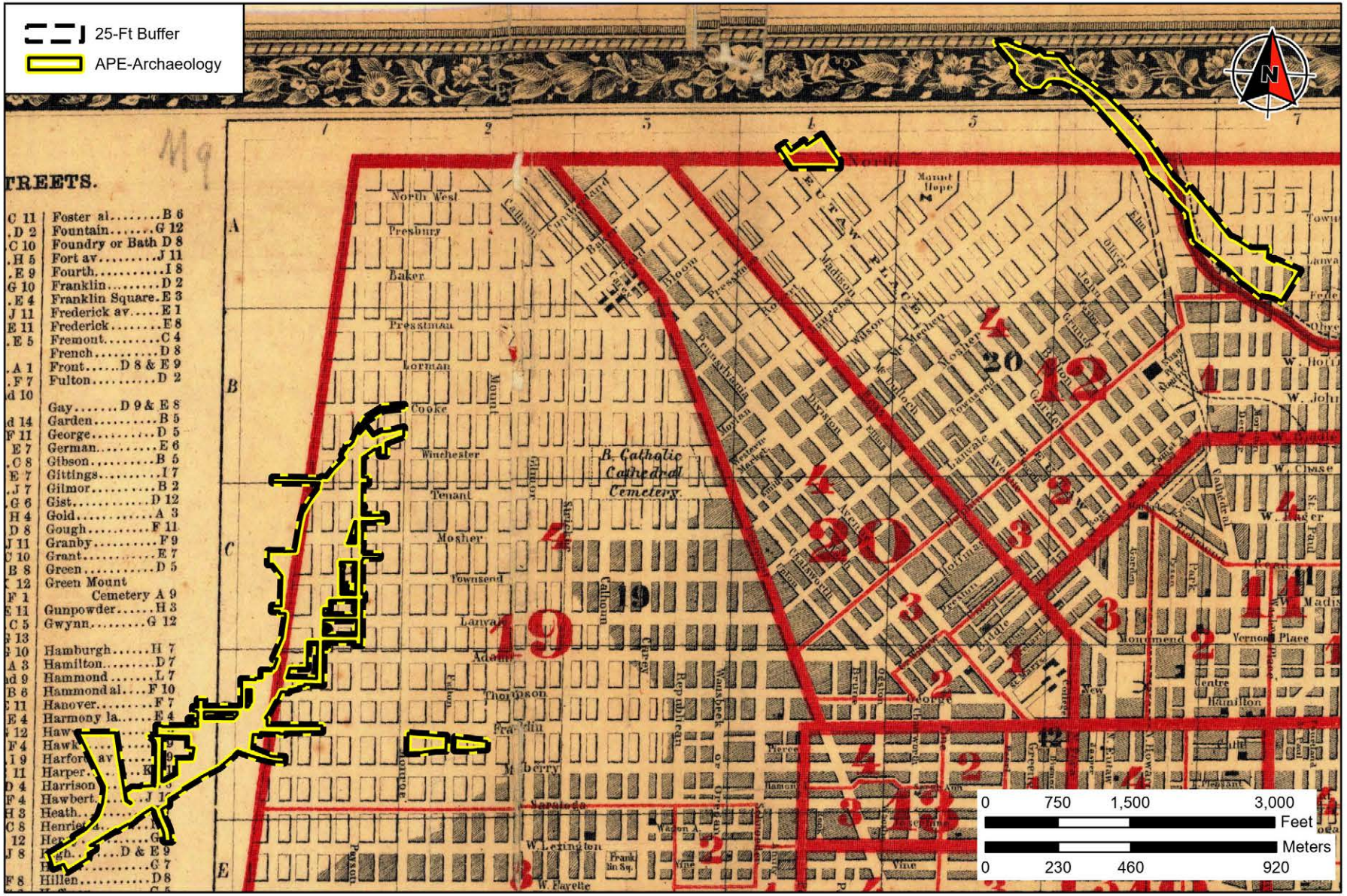

FIGURE 10: Project Vicinity in 1865 (Bache 1865)

Construction of the B&P Tunnel commenced in June 1871. Construction concluded nearly two years later, and the first locomotive passed through it on June 26, 1873. The opening of the B&P Tunnel was seen as an immense achievement for the time: "The construction of the Baltimore and Potomac tunnel has solved the question of rapid transit in the city of Baltimore for a century at least, if not for all time" (Scharf 1881).

Baltimore City became the Baltimore County seat in 1768. As early as 1835, parts of the county population outside the city began to lobby for complete separation of the city and the county. The main argument for separation was discontent with the combined functions of city and county government, which non-city residents saw as heavily biased in favor of city residents. The first referendum for separation was held in October 1837. Separation lost in a vote of 2,270 to 388. The towns near Baltimore City, where many of the city's leading merchants had homes, returned the highest percentage of no separation votes. Over the next decade non-city residents mounted a campaign in favor of separation. In 1851 the State of Maryland called a constitutional convention. The outcome of the convention included the separation of Baltimore City and County. On November 16, 1853, Baltimore County voters went to the polls to choose a new county seat. Three locations were selected by the voters, none with a clear majority. These included Clover Hill, the Alms House Property, and Towson (in that order). Voters returned to the polls on January 4, 1854; this time Towson took the lead. The cornerstone of the new county courthouse was laid on October 19, 1854. The first sessions of the courts were held in the building in January 1857 (Brooks and Rockel 1979; Greene 1980; Olson 1980).

Maryland entered a period of economic depression during the 1850s. Industry in the area suffered a decline in output and profit. The textile mills were especially hard hit in the early part of the decade. However, despite the slowdown in growth, immigrants continued to pour into Baltimore City. By 1860 "Baltimore [had] doubled its population, its work force, the number of houses, its built-up area, and its street mileage" (Olson 1980:103). The rapid growth of Baltimore City during the mid-nineteenth century pushed the city inland from its original core along the harbor. Between 1820 and 1870, the population of Baltimore increased from 63,000 to almost 269,000. Immigration was fairly heavy throughout this period. The new arrivals were primarily German or Irish (Browne 1980). All this growth was slowed to some extent by the Civil War.

The mayor of Baltimore, a known Southern sympathizer, was jailed during the war, as were Baltimore County Delegates Robert M. Dennison and Leonard G. Quinlan, and Senator A.A. Lynch. The Baltimore County group was detained in September 1861 to prevent their casting votes in favor of Maryland secession. During the war Union troops were stationed in Cockeysville. They patrolled the rail lines running through northern Baltimore County as well as along the York Turnpike (Brooks and Rockel 1979; Brugger 1988; McClellan 1994). Union troops were stationed in Baltimore City on Federal Hill in the Baltimore Harbor. Lookouts were also placed in the towers of Westminster Presbyterian Church and the Basilica of the Assumption of the Blessed Virgin Mary (the seat of the Archbishop of Baltimore). Military arms were stacked in the burial vaults in Westminster Cemetery, and burials were permitted only with permission of the military (Read 2000). The Union Army commandeered the estates of known Southern sympathizers. One of the homes seized was Mount Clare (now in Carroll Park), which was the home of James Carroll, a wealthy slave owner. The Union Army set up a military camp on the Mount Clare property (Read 1997).

The only incursion by Confederate troops into Baltimore County occurred in July 1864 during Gen. Jubal A. Early's campaign against Washington, DC. Maj. Harry Gilmor of the Glen Ellen Estate near the Gunpowder River was attached to Gen. Bradley R. Johnson's unit. Gilmor's column arrived in the Glyndon area of northern Baltimore County on the evening of July 9. The following day, Gilmor and Johnson pushed into Cockeysville and burned several rail bridges. Johnson then moved through the Green Spring Valley and was in Painter's Mill on July 11. He and his troops entered Howard County on July 12. Gilmor moved east to burn guarded bridges on the PW&B Railroad. During his raid on one of the bridges, he was able to capture a passenger train, which included Union Gen. William Buel Franklin as one of its passengers. Gilmor took Franklin prisoner and burned the bridge. Through the night of July 11, Union troops searched for Gilmor as he moved west to join Johnson and Early. Near Towson, Union troops skirmished with Gilmor's men without casualties on either side. Gilmor's men drove the Union troops down the York Turnpike toward Baltimore. Gilmor then moved west across Green Spring Valley, during which time General Franklin managed to escape his captors. On July 12 Gilmor and his men reached Pikesville and threatened to burn the U.S. Arsenal. They continued on through Randallstown and left the area by the day's end, rejoining Johnson and Early near Poolesville in Montgomery County, Maryland.

Maryland rewrote its constitution in 1864. The new constitution outlawed slavery and was put to a popular vote on October 13, 1864. It barely passed into law, with 30,174 in favor of the change and 29,799 opposed. On November 1, 1864, all slaves in Maryland were emancipated (Brooks and Rockel 1979; Brugger 1988; Maryland Constitutional Convention 1864). Five months later, in April 1865, the war ended with Lee's surrender at Appomattox Courthouse.

4. Industrial/Urban Dominance (1870 to 1930)

Post-Civil War industry and commerce in Baltimore City continued to grow rapidly (Figure 11). Industries in this period included clothing, canning, metal work, and shipping. Numerous economic depressions throughout the nineteenth century caused a continuous flux in Baltimore City business and industry. Despite the economic turmoil, immigrants poured into Baltimore City, including Greeks, Russians, Czechs, Poles, Lithuanians, Italians, and Finns (Zeidman 1991).

The closing years of the 1860s were a boom period in the economic cycle of the United States; however, the Panic of 1873 temporarily ended economic prosperity and ushered in a long period of recession (Brogan 1985). Until ca. 1880 the majority of immigrants arriving in Baltimore City were Irish or German. They found work on the docks and in the rapidly expanding factory system along the Jones Falls. These industries included garment factories, canning, and metal work (Olson 1980). By 1880 the makeup of the immigrant population had changed. Many of these immigrants were Germans who were escaping revolutions and wars sweeping through the various German principalities throughout the period. Between 1880 and 1920, changing social patterns in Eastern Europe and pogroms in Russia provided incentive for 2,000,000 Jews to immigrate to the United States (Dimont 1962:355, 361). Many of these immigrants were unskilled laborers who quickly entered the American factory system.

Between immigration and annexation of new land for the City, the population of the city increased from 332,000 in 1880 to 800,000 in 1930 (Arnold 1978; Olson 1980). This area of the county adjacent to the west, north, and east sides of the city was known as "The Belt." Intensive development had begun after the 1818 annexation. Between 1860 and 1880, settlement increased on the city's undeveloped periphery (Figure 12) as wealthy families began to leave the center city

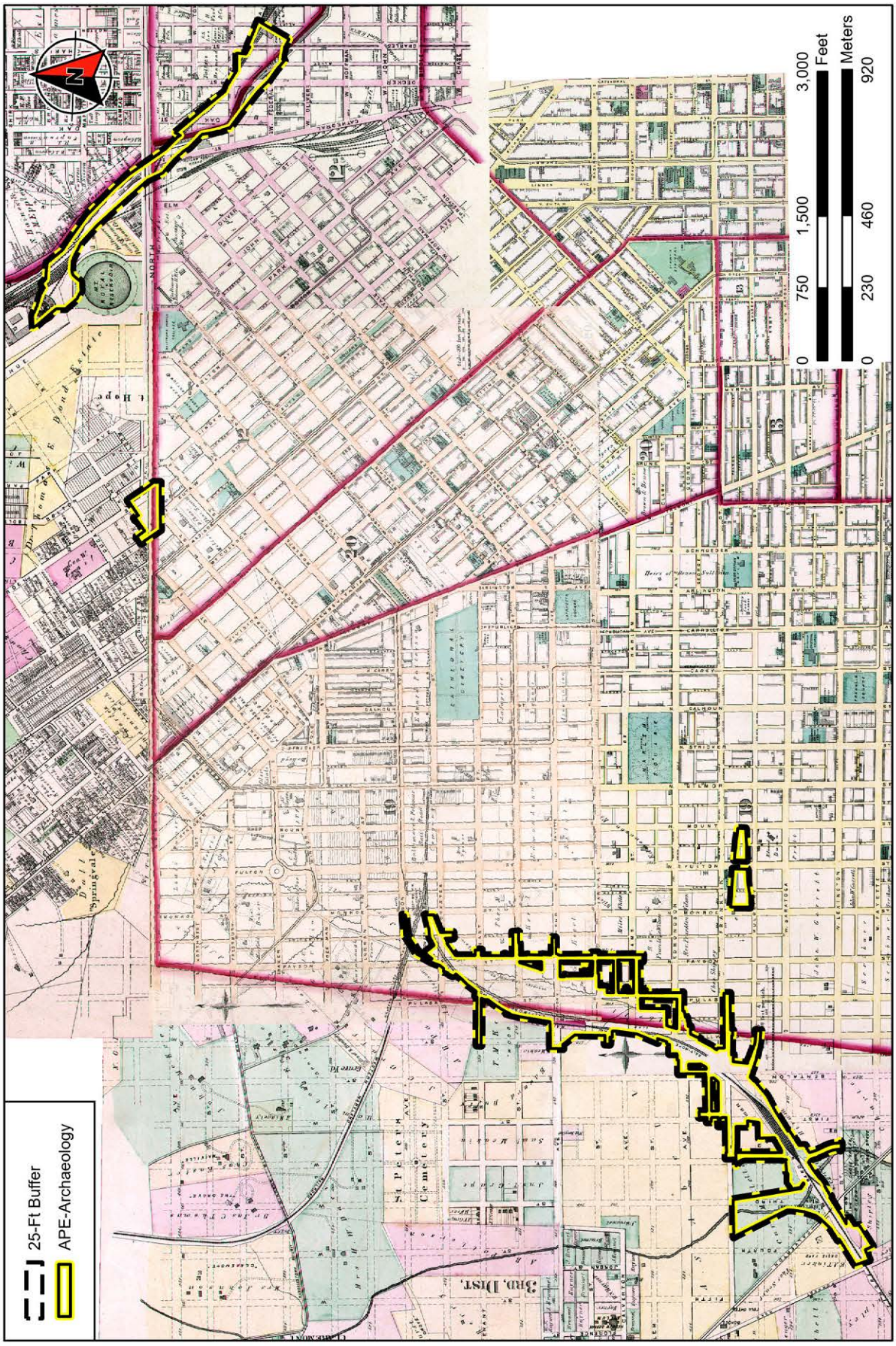

FIGURE 11: Project Vicinity in 1876 (Hopkins 1876)

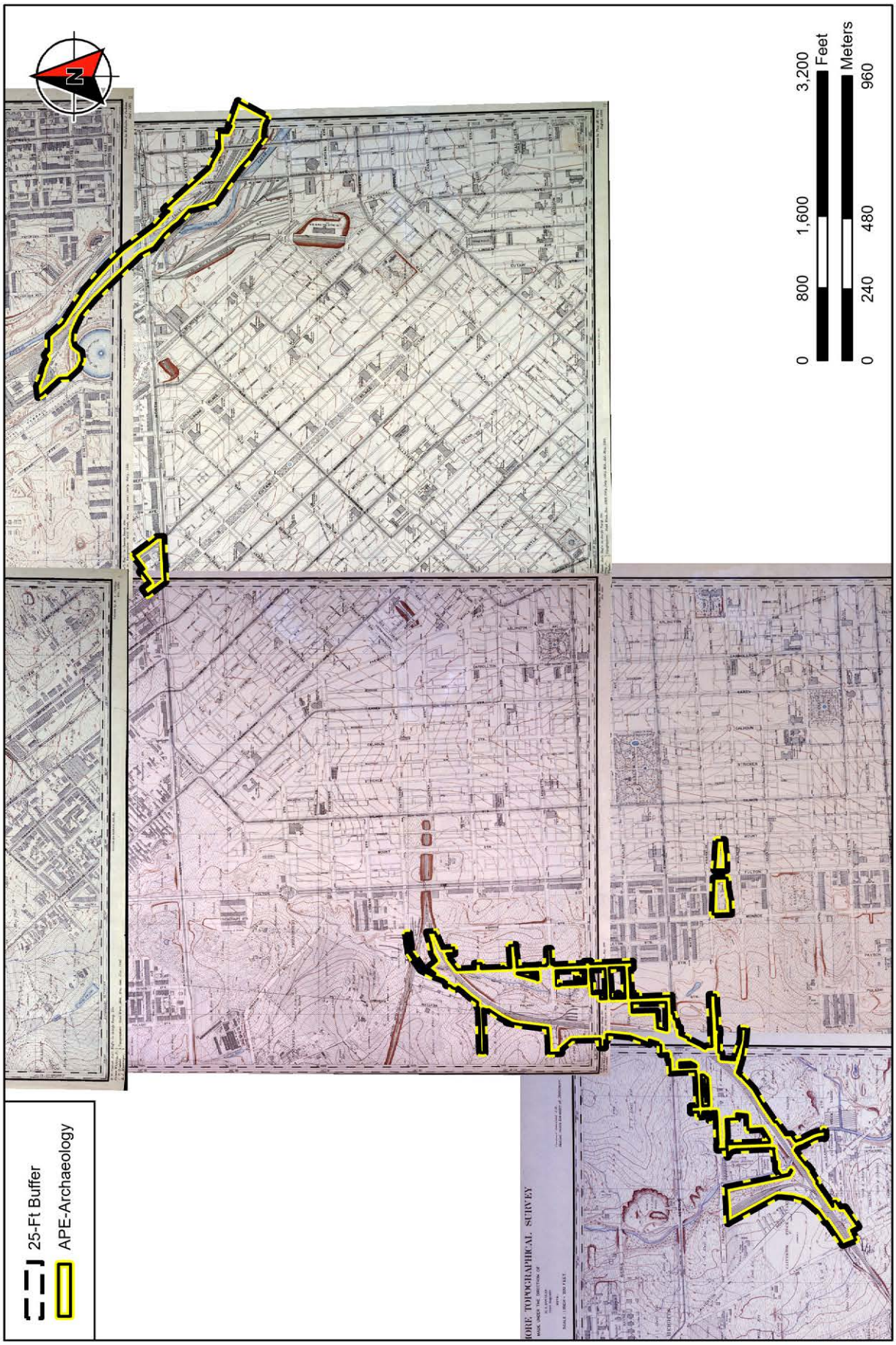

FIGURE 12: Project Vicinity in 1897 (Duncan 1897)

area for new suburbs that were connected to the city by horse-drawn streetcars. In addition to the residential development, new mill towns, such as Woodberry and Hampden, were developed outside the city along the Jones Falls. The population in "The Belt" area stood at 20,000 in 1874 and had almost doubled by 1884. In 1888 Baltimore County residents living on the west and north sides of the "The Belt" voted in favor of annexation to Baltimore City. This brought an additional 7.5 square miles into the city and an additional 38,000 people. It included two-thirds of the area around the city that had been developed since 1865 as a direct result of the extension of horse-drawn cars into the county (Arnold 1978).

During the first half of the nineteenth century, the African American population of Baltimore was centered in the Fells Point area. After the Civil War there was an influx of southern Blacks into the city. As the African American population in Baltimore increased, so too did the Euro-American population, largely as a result of the waves of European immigration. Tens of thousands of European workers were drawn to the city as new industries, expanding shipyards, and new merchandising houses were established in downtown, Fells Point, and Canton. These new European immigrants largely settled in the eastern and southern sections of the city, close to the factories and shipyards. Many of the established African American families that resided in these neighborhoods were displaced as most major Baltimore employers largely reserved industrial work for the recent white immigrants. Shut out of neighborhoods close to industry, new and established African American families alike found themselves settling in a horseshoe pattern around the central city with "Old West Baltimore" forming the west side of this horseshoe. Segregation restricted the areas where they could settle to the blocks south of North Avenue, west of Pennsylvania Avenue, and east of Fulton Avenue.

This portion of the city remained a patchwork of urban development and rural countryside until the end of the nineteenth century. While growth of the city expanded quickly in some parts north and west of the downtown during the late nineteenth century, many of the original grand homes and spacious estates remained part of the landscape of west Baltimore until the end of the nineteenth century. The homes and lands of Thomas Edmondson, Jr., Edward Patterson, Dr. Thomas Bond, and many others appear in several maps from the period.

East of Pennsylvania Avenue, many Euro-American residents from Baltimore's business and professional classes built large stately three-story townhouses along Madison Avenue, McCulloh Street, and Druid Hill Avenue, as well as farther east and north in what is today known as the Bolton Hill and Reservoir Hill neighborhoods. The opening of a streetcar line along Madison Avenue connected this area to the center of the city, which allowed people to commute easily to the expanding business district. At the same time Druid Hill Park, opened in the fall of 1860, was located just to the north and added to the attractiveness of living in the area. The institutions attracted to this portion of Old West Baltimore Reservoir Hill and Bolton Hill corresponded to the social status of its residents. Three private schools, including the fashionable Boy's Latin School, were located nearby, as well as Lafayette Market, at Laurens Street and Pennsylvania Avenue.

By the end of the nineteenth century, all of the major German Jewish synagogues had moved from their original locations in downtown and east Baltimore to Reservoir Hill, bound by Lanvale Street and McCulloh Street and Park Avenue and North Avenue (Shoken 2004b). The Jewish residents who moved into Reservoir Hill at the turn of the twentieth century were part of Baltimore's established German Jewish community that was originally located in parts of east Baltimore and

downtown. As a result the neighborhood became one of Baltimore's largest and affluent predominantly Jewish neighborhoods of the late nineteenth and early twentieth centuries. Many of the new Jewish immigrants during the same period came to Baltimore from Eastern Europe, many times settling in the former neighborhoods the existing German Jewish community had recently abandoned. Over time, much of the eastern European Jewish community also began to prosper.

During the same period, construction began on more modest two-story homes west of Pennsylvania Avenue. By the 1870s intense development in the neighborhood was centralized in the northern portion of Old West Baltimore, extending between Fulton Street to the west, Pennsylvania Avenue to the east, North Avenue to the north, and Patterson Avenue (present-day Laurens Street) to the south. Unlike the homes east of Pennsylvania Avenue, these were intended for the expanding white working class as well as for Baltimore's growing population of European immigrants (Shoken 2004a).

German immigrants were initially the largest ethnic group in this growing community. A growing African American population also settled in this area, living close to their white neighbors. Whereas the white residences were located off the main streets, African Americans and poorer immigrant families resided in alley housing behind their Euro-American neighbors. As Baltimore's African American population continued to expand during the 1880s and 1890s, a substantial African American community began to develop and spread along these alley streets. Over time, numerous African American residents of the neighborhood established local businesses, founded churches, and enrolled their children in schools.

As the neighborhood prospered, some community members could afford the larger main street homes. At the same time, many of the original white residents on these main streets left "Old West Baltimore" for other neighborhoods or left the city altogether for newly developing suburbs, thus providing an opportunity for African American residents to take their place. By the first decade of the twentieth century, the majority of what once was an ethnically mixed population in Old West Baltimore had become a predominantly African American neighborhood.

In 1904 much of the business and financial district of Baltimore City burned to the ground. An aftereffect of this disaster was vast changes to and improvement of the city's water quality and flow. Before the fire was completely under control, the mayor created the Burn District Commission to rebuild the city. Their stated duty was to rebuild the area of Baltimore that had been destroyed by the fire, but their recommendations had a direct impact on parts of the city that had not been burned (Petersen 2004). A sewage commission was set up to revamp the city's waste and stormwater control. By 1906 they had built a pilot sewage plant in Walbrook. In 1909 the Back River plant was up and running. "By the end of 1914 there were twenty-one thousand homes connected, and about that many drop privies were abandoned" (Olson 1980:250). The new sewers were gravity flow systems. A pumping station on Pratt Street forced the low-lying areas around the harbor to drain. Only those areas on the edges of the city and in low-lying elevations did not receive sewers.

This capital improvement project also benefited Baltimore County. The Maryland legislature approved the creation of the Metropolitan District, which served both the city and county's water and sewage needs. The county tied into the city's water and sewer lines and was able to extend service to many of its suburban residents. The Loch Raven Reservoir was constructed during this

period and was completed in 1923. Later reservoir projects included Prettyboy Reservoir on the upper Gunpowder Falls (1933) and Liberty Reservoir on the Patapsco (1954). Figure 13 shows the APE-Archaeology in 1914.

In 1918 Baltimore City made its last annexation of county property, despite the protests of many of the people living in these areas. Unlike the 1888 annexation, the people living in the proposed annexation area did not vote to join the city. Instead, the Maryland legislature passed an annexation bill that set the city's boundaries where they are today. The total area incorporated by the city included 46.5 square miles taken from Baltimore County, and 5.4 square miles taken from Anne Arundel County (Arnold 1978). This final annexation included roughly all the areas of the current city west of the Gwynns Falls, north of 28th Street, and east of Canton (from Baltimore County), as well as an area south of the Gwynns Falls and the Patapsco River (which was primarily from Anne Arundel County).

5. Modern Period (1930 to present)

The beginning of the modern period roughly coincides with the start of the Great Depression on October 29, 1929. Although segments of the American economy were already in a slow downturn before the market crash, the Baltimore region's economy had been affected only to a minor degree. After the market crashed in 1929, the region's diversified economy resulted, at least temporarily, in a city unemployment rate that was slightly lower than the national average. Nevertheless, by 1931 there were 42,000 unemployed Baltimoreans, roughly one-eighth of the city's work force (Olson 1980). In Baltimore County the County Children's Aid Society listed 242 families on their relief rolls in December 1931; by March 1932 the number of families had increased to 606 (Brooks and Rockel 1979). The region's high unemployment rate continued into the late 1930s. By 1937 increasing tensions in Europe were translating into a build-up of the defense industry in Baltimore County. Companies like Glen L. Martin and Bethlehem Steel began to expand production as orders arrived from Europe. During World War II workers moved into Baltimore City from the rural South and West Virginia. Many of these laborers found jobs in the defense plants in eastern Baltimore County. Others worked for the rail yards in Baltimore City, settling in the area around Carroll Park known as "Pig Town."

By August 1941, 50,000 Baltimoreans were employed by the defense industry. Approximately half of these jobs were in aircraft manufacture at the Martin Company. However, this build-up in wartime industries did not come without risks to the region's economy. After the war ended in 1945, 45,000 defense workers lost their jobs at the same time that 35,000 veterans were returning home. With approximately 80,000 people looking for work simultaneously, the region's economy needed to turn quickly from a wartime to a peacetime economy. Companies such as Bethlehem Steel, Westinghouse, and Western Electric successfully converted their production to peacetime commodities by the early 1950s. Baltimore's postwar economy continued to grow into the 1970s (Olson 1980).

During the last two decades of the nineteenth century, as African American laborers began to concentrate in housing in the alleys of Baltimore, demographic profiles show an influx of rural native Maryland African Americans into Baltimore from southern Maryland. Baltimore's African American population nearly tripled from a population of 28,000 in 1860 to 79,000 in 1900 (Garonzik 1976; Hall 1912). This development in housing concentrated the city's poor into a

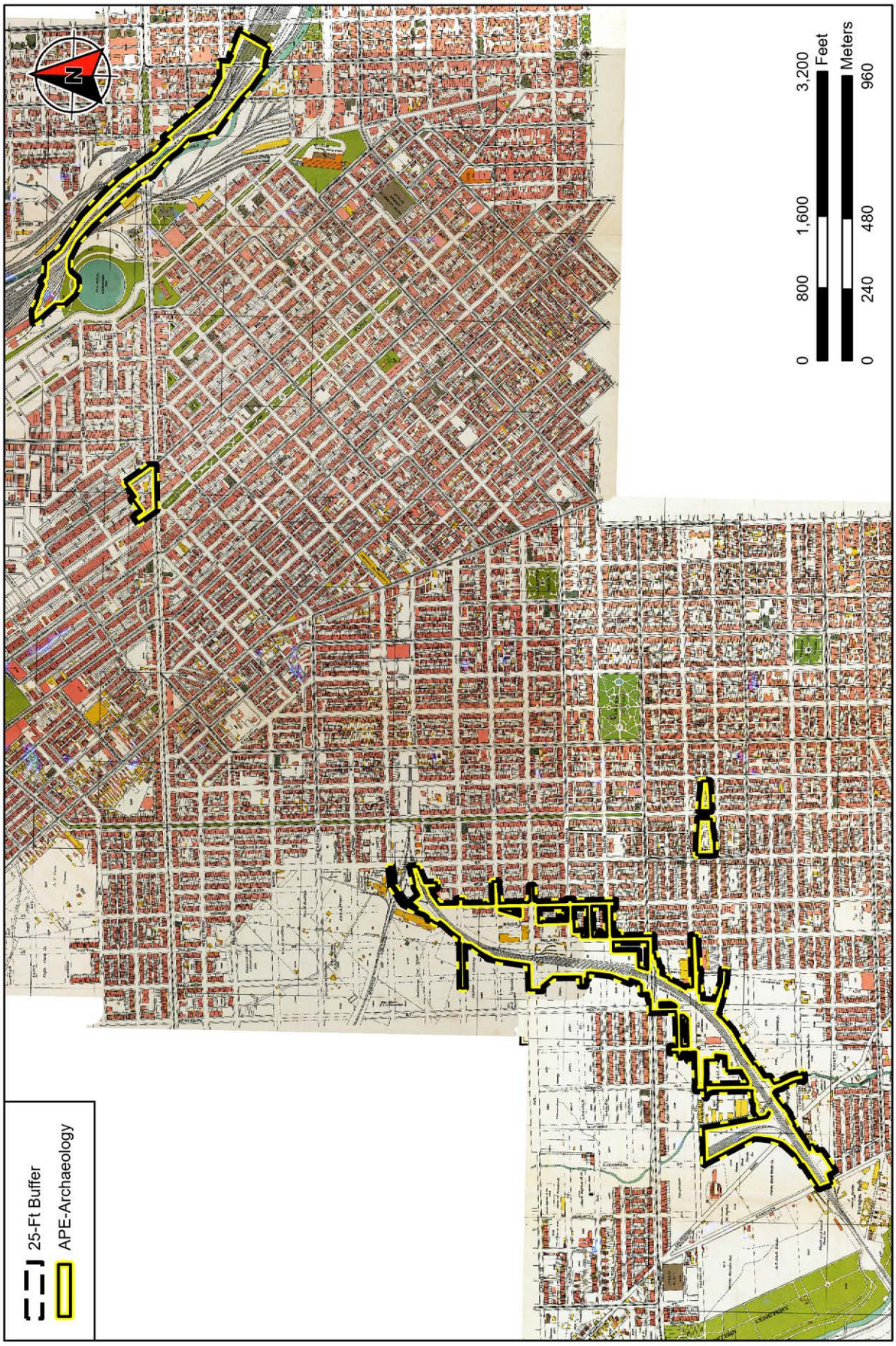

FIGURE 13: Project Vicinity in 1914 (Topographic Survey Commission 1914)

classic "alley life" pattern, and also occurred in Annapolis, Philadelphia, and Washington, DC (q.v. Aiello and Seidel 1994; Borchert 1980; Cheek 1986; Cheek and Friedlander 1990; Cheek and Seifert 1994; Greenberg 1981; Hayward 2008; Warner and Mullins 1993).

During the early twentieth century the demographics of the neighborhoods of Old West Baltimore, Bolton Hill, Harlem Park, and Reservoir Hill began to change. Racial discrimination and the high unemployment rate of the Depression era kept many of the area inhabitants in low-paying jobs. Real estate values in the area had been in decline since the depression of 1893. In the 1920s property values in the area had decreased in general. During that decade movement of the white population out of West Baltimore changed the racial composition of these neighborhoods. Vacant housing in the eastern portion of the city was rapidly filled by African American tenants moving into the city from rural areas of Maryland and the South. This migration of African Americans from rural to urban areas was part of a national trend that had begun early in the century. In 1910, 2,500 African Americans and 7,500 Euro-Americans lived in Old West Baltimore. By 1930 African Americans were the largest population living in the same neighborhoods. To the south, Harlem Park remained predominantly white until the end of World War II (McDougall 1993). After World War II, Harlem Park became and remains predominantly African American.

In 1950 a survey of the city's 250,000 houses placed 90,000 within "blighted" areas of the city. Within the blighted areas, 45,000 houses were classified as substandard. Another 18,000 structures were classified as dilapidated. One-third of the city's population lived in these homes. To stimulate growth in the city, the city government embarked on a plan of urban renewal. In 1951 a 27-block area of East Baltimore was selected as a pilot area. Many of the buildings in the pilot area were condemned and razed. In their place subsidized housing projects for the poor were built (Greene 1980; Olson 1980).

The end of the war was also a period of rising housing construction in the suburban Baltimore County communities ringing Baltimore City, such as Lutherville, Pikesville, Randallstown, Woodlawn, and Catonsville. During the 1950s, 1960s, and 1970s, there was a huge exodus of middle-class white families from the city to the suburbs (Orser 1991, 1994). The shops and department stores frequented by the white middle class also slowly left the city and were re-established in new suburban malls. The results of this 20-year trend were the loss of business in the city's central core, particularly along Howard Street, and a diminished tax base. The population of Baltimore County grew by more than 40 percent between 1940 and 1950, and by another 45 percent between 1950 and 1960 (Forstall 1996). Road development in the area also spurred population growth.

By the beginning of the mid-1960s, residential development covered much of the former agricultural landscape in the portion of Baltimore County along the northern border of Baltimore City. By the end of the twentieth century, large-scale shopping complexes and highway facilities dominated the former farming communities. The Baltimore Beltway (I-695) was built through the county, with construction starting in the Towson area in 1955 (MD Roads n.d.). In 1966 plans to construct six rapid transit lines, from Baltimore to the surrounding suburb, were developed. This plan was not put into action until the mid-1980s, and only one of the six lines was built. In 1983 a line between Charles Center in downtown Baltimore and Reisterstown Plaza was opened. Four years later, the line was extended north to Owings Mills. At about the same time the Baltimore Metro System was under construction, I-795 was built between the Baltimore Beltway and Owings

Mills. The final extension north to Reisterstown and the Westminster Pike was completed in 1987. The Metro and the interstate opened the Owings Mills area to suburban development in the 1990s. Some of this development extended across the reservoir into the Sykesville area of Carroll County.

Baltimore has undergone a period of rebuilding since the late 1970s. The city government and private developers both have made attempts to revitalize the city. Among the numerous projects initiated, two of the more notable are the revitalization of the Inner Harbor area and homesteading. Baltimore's Inner Harbor area has been developed successfully into a tourist and shopping mecca that draws dollars back downtown. Homesteading created a market to restore homes within the city through the sale of dilapidated and abandoned properties at low cost to middle-class buyers, both white and African American. Homesteading produced a viable environment in a once hostile landscape and brought tax dollars back into the city. The most recent round of revitalization has included the Howard Street corridor. Plans for this area include the creation of cultural centers for dance, music, and the arts. Another project includes the current construction of low-cost housing and rental units in the Jonestown area of East Baltimore. In addition, the Reginald F. Lewis Museum of Maryland African American History and Culture opened on June 25, 2005. The museum is in Jonestown on the edge of the Baltimore Inner Harbor near the new housing units.

D. PREVIOUS STUDIES AND KNOWN SITES

1. Previous Archaeological Studies

A review of cultural resources survey data maintained by MHT on Medusa revealed that 12 previous archaeological studies have been conducted within a 1.6-kilometer (1-mile) radius of the APE-Archaeology (Figure 14; Table 1). Of those, four studies extend within portions of the APE-Archaeology.

The first study including the APE-Archaeology was conducted by the Maryland Geological Survey in 1982 and consisted of a Phase I reconnaissance survey to identify archaeological resources in the proposed I-595 corridor between I-95 and I-170 (Dinnel 1982). A portion of the reconnaissance survey extended along the north side of the NEC between North Warwick Avenue and West Franklin Street; however, no subsurface testing occurred within the APE-Archaeology.

In 2013 stage 1 of the Phase IB archaeological investigation for the Red Line Corridor Transit Study included portions of the APE-Archaeology along West Franklin Street and West Mulberry Street (Ward et al. 2013). Stage 1 of the Phase IB investigation included testing of accessible surface alignment segments of the project. Part of the current APE-Archaeology was situated within Archaeological Study Area 3 for the Red Line study. Limited shovel testing and geotechnical borings occurred within Archaeological Study Area 3 on lots south of Edmondson Avenue and West Franklin Street; however, no subsurface testing occurred in the APE-Archaeology as part of the 2013 investigation.

In 2015 a second part of stage 1 of the Phase IB archaeological investigation for the Red Line Corridor Transit Study was concluded and included the survey of below-ground impacts anticipated as part of the Red Line project, such as tunnel portals, stations, and vertical features (Ward et al. 2015). Portions of the APE-Archaeology included as part of the stage 2 Phase IB investigation consisted of the MARC parking lots between West Franklin Street and West

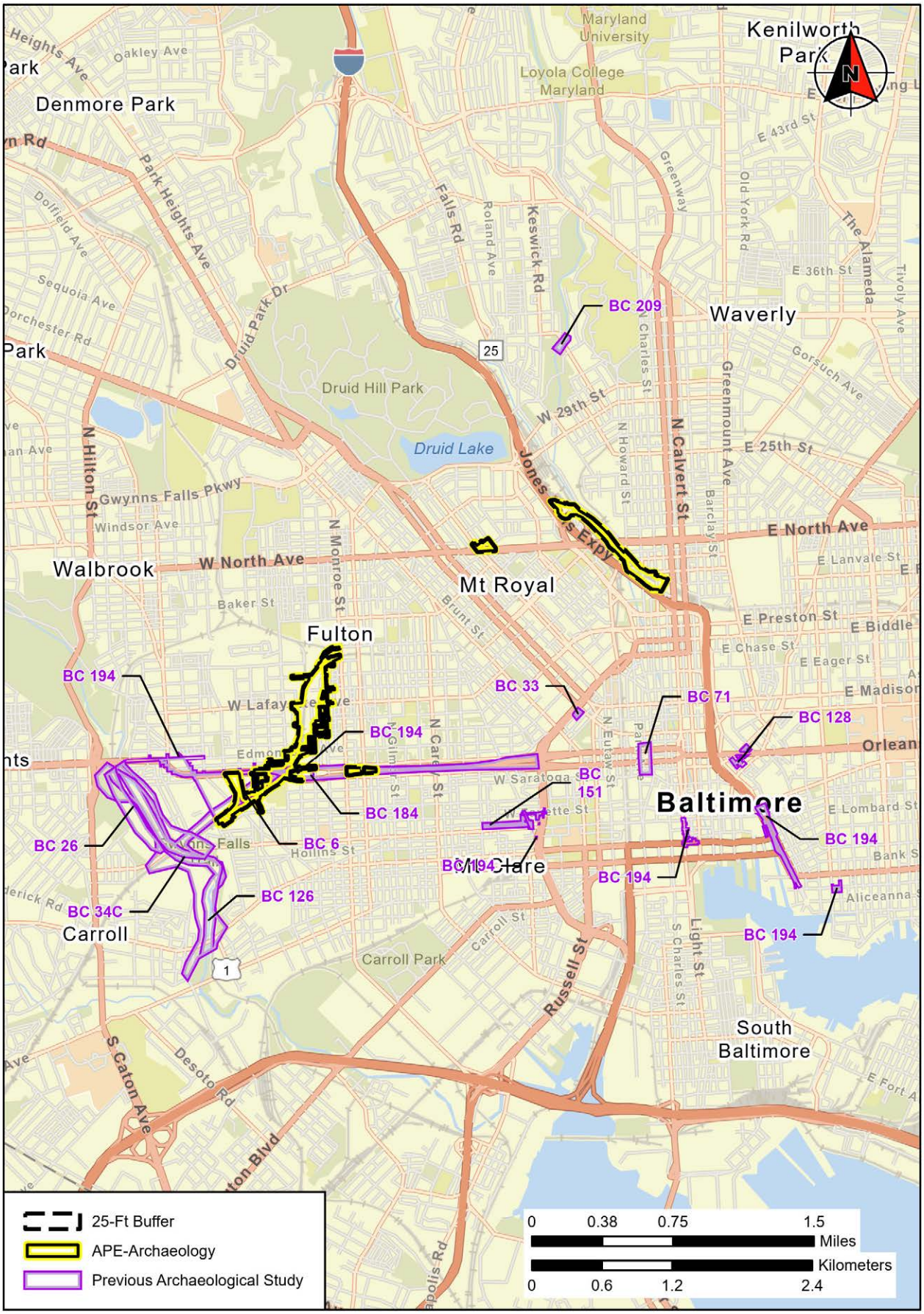

FIGURE 14: Previous Archaeological Studies Within 1-Mile Radius of APE-Archaeology (ESRI World Street Map 2021)

TABLE 1: PREVIOUS ARCHAEOLOGICAL INVESTIGATIONS
WITHIN A 1-MILE RADIUS OF APE-ARCHAEOLOGY

STUDY	No.	REFERENCE
Phase I Reconnaissance Survey of the Archeological Resources in the Proposed I-595 Corridor Between I-95 and I-170, Baltimore City, Maryland	BC 6	Dinnel 1982*
Orchard Street Church Archeological Monitoring	BC 33	Weber 1984a
Phase I/Phase II Archeological Reconnaissance Survey for the Gwynns Falls Sewer Interceptor, Baltimore, Maryland	BC 34C	Weber 1984b
Phase IA Historical Background Study and Phase IB Archeological Investigation of the Maryland Library for the Blind and Physically Handicapped, Baltimore, Maryland	BC 71	Goodwin 1991
Preliminary reconnaissance survey of the archeological resources in the proposed I-70 alignment through Leakin and Gwynns Falls Park	BC 26	Harrison 1977
Archeological Investigations at the Juvenile Justice Center, Baltimore, Maryland	BC 128	Williams et al. 2000
Phase I Archeological Survey of the Proposed 3.03-mile Phase 2 Gwynns Falls Pathway	BC 126	Hill 2000
Phase I Archeological Investigations of the proposed UMAB† Health Sciences Research Park, 800-900 West Baltimore Street, Baltimore, Maryland	BC 151	Williams 2005
Stage 1 Phase IB Archeology Technical Report, Red Line Light Rail Transit Project, City of Baltimore and Baltimore County, Maryland.	BC 184	Ward et al. 2013*
Stage 1 Phase IB Archeology Interim Technical Report, Red Line Light Rail Transit Project, City of Baltimore and Baltimore County, Maryland.	BC 194	Ward et al. 2015*
Phase IA Archeological Study, B&P Tunnel Project, Baltimore, Maryland [no location data available on Medusa]	BC 195	Shellenhamer and Kodlick 2015*
Phase I Archaeological Survey for the Remington Avenue Bridge Replacement Project, City of Baltimore, Maryland.	BC 209	Hatch et al. 2018

* Study includes portions of the APE-Archaeology †University of Maryland, Baltimore

Mulberry Street, east of the NEC and the grass-covered median west of the railroad. Two geoprobes were excavated east of the APE-Archaeology, which resulted in the identification of 4 to 8 feet of redeposited soil overlying deep alluvium composed of moist and sandy soil. Although no borings were conducted within the boundaries of the current APE-Archaeology, this location was interpreted as a historic swamp or wetlands that was infilled as urban development expanded west toward Gwynns Run.

Also in 2015, an initial Phase IA archaeological study for the B&P Tunnel Program was completed in support of the DEIS. At that time several alignment alternatives were under consideration. Since designs had not been sufficiently developed at the time of the Phase IA study, the APE at that time was limited to the centerline of the alignments of each of the design alternatives. Given their cumulative linear extent and the stage of the Program at the time of the survey, it was deemed prudent to conduct an archaeological assessment study to acquire a comprehensive understanding of the archaeological sensitivity of all the proposed alternatives. The high-level survey was also performed with the intent to provide information that could assist with planning activities. The primary purposes of the Phase IA Archaeological Survey were to (1) develop a comprehensive overview of the archaeological context and sensitivity of the alternatives that can be applied toward planning activities, and (2) construct an archaeological foundation for any additional archaeological studies that may be warranted once a Selected Alternative was determined. The

Phase IA study concluded that although large portions of the alignment alternatives have been disturbed, there remains the potential for the presence of both precontact and historic archaeological sites within the alignments of each of the build alternatives. The study recommended that a supplemental Phase IA archaeological study be conducted once the Preferred Alternative was determined and the extent of anticipated ground-disturbing activities ascertained.

The investigations conducted outside the APE-Archaeology but within 1.6 kilometers (1 mile) (see Table 1) range from assessments of archaeological potential and preliminary reconnaissance surveys that involved the examination and identification of both historic architectural and archaeological resources to archaeological monitoring and intensive data recovery investigations of individual archaeological sites.

2. Previously Identified Archaeological Sites

According to the archaeological site files maintained by the MHT, no previously recorded archaeological sites are situated within the APE-Archaeology, and no archaeological sites have been previously recorded within 500 feet of the APE-Archaeology. Nine sites are present within a 1.6-kilometer (1-mile) radius (Table 2). Five of the recorded archaeological represent domestic or commercial structures dating from the eighteenth through twentieth centuries. Three historic sites consist of an early to mid-twentieth-century wine cellar, a nineteenth-century African American church, and archaeological deposits associated with [redacted]. The final site in the vicinity of the APE-Archaeology is [redacted], which is a multi-component resource consisting of a precontact lithic scatter of unknown temporal affiliation and an eighteenth-century artifact scatter that may be associated with a Revolutionary War camp as well as artifacts associated with an early nineteenth-century church. Of the nine sites, two have been evaluated for the National Register of Historic Places (NRHP) and were determined not eligible. The remaining seven sites have not been evaluated or received an NRHP determination from the MHT.

TABLE 2: ARCHAEOLOGICAL SITES WITHIN A
1.6-KILOMETER (1-MILE) RADIUS OF APE-ARCHAEOLOGY

SITE NO.	NAME	PERIOD	DESCRIPTION	NRHP STATUS
18BC16	[redacted]	19th century	Artifact concentration, possible dump site; no subsurface integrity	Unevaluated
18BC26	[redacted]	18th to 19th century	Frame houses, brick commercial building.	Unevaluated
18BC45	[redacted]	19th to 20th century	Brick rowhouses and commercial structures; no subsurface integrity	Unevaluated
18BC54	[redacted]	19th century	African American church; contains subsurface integrity	Unevaluated
18BC91	[redacted]	19th century	Brick townhouse	Not Eligible (MHT Determination 1991)
18BC92	[redacted]	Early 19th century	Brick townhouse	Not Eligible (MHT Determination 1991)
18BC93	[redacted]	Early to mid-20th century	Wine cellar; contains subsurface integrity	Unevaluated
18BC94	[redacted]	19th to 20th century	Jail	Unevaluated
18BC142	[redacted]	Precontact/18th to 19th century	Precontact lithic scatter/18th-century artifact scatter/early 19th-century church	Unevaluated

3. Previously Identified Historic Architectural Resources

A review of the Maryland Inventory of Historic Properties (MIHP) forms on file at the MHT indicates that portions of five historic districts lie within the APE-Archaeology (Figure 15; Table 3). Both the Reservoir Hill Historic District (B-1379) and the Edmondson Avenue Historic District (B-5187) are listed in the NRHP. The Greater Rosemont Historic District (B-5112) and the Midtown Edmondson Historic District (B-5118) have been determined eligible for listing in the NRHP. The Industrial Warehouse District (B-5116) was recorded but determined not eligible for listing in the NRHP. All four of the eligible or listed historic districts consist primarily of a combination of rowhouses, detached houses, duplexes, and apartment buildings constructed from the late nineteenth to the early to mid-twentieth centuries.

Records indicate an additional 16 individual or contributing resources lie within portions of the APE-Archaeology (see Table 3). They consist of a variety of resource types that were constructed from the late nineteenth through the first half of the twentieth century and include railroads, bridges, commercial and industrial buildings, a firehouse, and a reservoir pipe vault. Of the 16 resources, five are listed as eligible for the NRHP as contributing resources, four resources have been determined not eligible, and the remaining seven are eligible for listing in the NRHP.

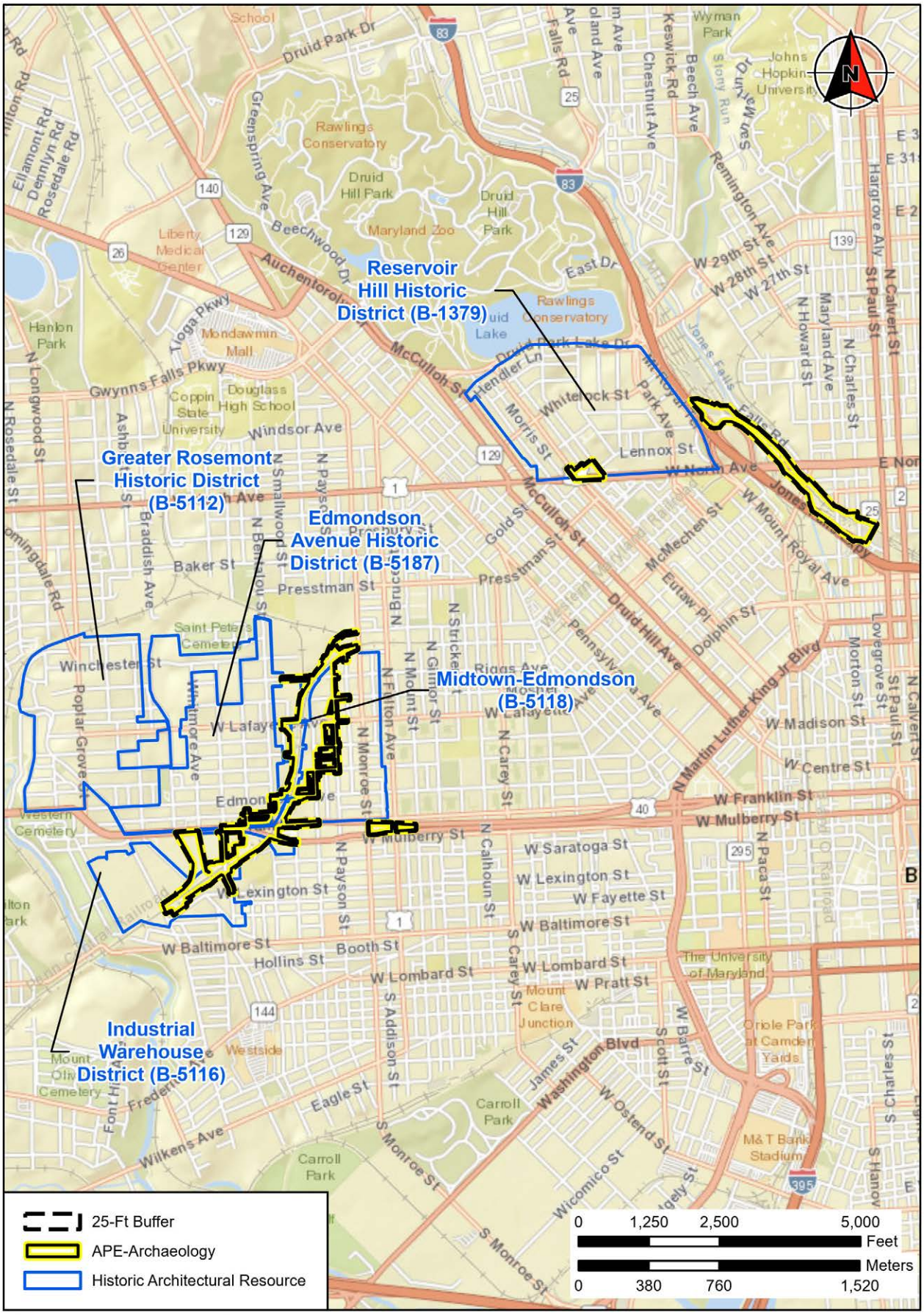

FIGURE 15: Historic Architectural Resources in APE-Archaeology (ESRI World Street Map 2021)

TABLE 3: HISTORIC ARCHITECTURAL RESOURCES IN APE-ARCHAEOLOGY

MIHP NO.	RESOURCE NAME	NRHP STATUS	DESCRIPTION
B-1040	American Ice Company	Eligible	Late 19th-century industrial building. Damaged by 2004 fire, rear additions have been removed.
B-1379	Reservoir Hill Historic District	Listed	Mostly late 19th- to early 20th-century rowhouses. Also includes mansions, apartment buildings, religious and commercial buildings.
B1379-6	Madison Park Medical Center	Eligible	Mid-20th- century, one-story concrete commercial building, does not contribute to the Reservoir Hill Historic District.
B-4521	North Avenue Bridge (BC1208)	Eligible	North Avenue Bridge over Falls Road.
B-4529	Howard Street Bridge (BC1405)	Eligible	Howard Street Bridge over I-83, Amtrak, and Jones Falls.
B-4544	Charles Street Bridge (BC1210)	Not Eligible	Charles Street Bridge over Amtrak.
B-5112	Greater Rosemont Historic District	Eligible	Mostly late 19th- to early 20th-century rowhouses, duplexes and suburban-style homes.
B-5112-2	Ward Baking Company	Eligible	Early 20th-century three-story Ward Baking Company building and one-story auto repair shop.
B-5112-3	Edmondson Avenue Station	Eligible	Early 20th-century one-story, embanked Spanish Mission style railroad passenger station.
B-5112-4	Fire Department Engine House Number 36	Eligible	Early 20th-century Tudor Revival style, Fire Department Engine House.
B-5116	Industrial Warehouse District	Not Eligible	Industrial warehouse buildings dating from ca. 1920-1960.
B-5118	Midtown Edmondson Historic District	Eligible	Late 19th- to early 20th-century rowhouses and commercial district.
B-5118-2	Atlas Safe Deposit and Storage Company Warehouse Complex	Eligible	Early 20th-century four-story warehouse with first-floor offices.
B-5163	Union Railroad	Eligible	NCRR, Pennsylvania Railroad, Canton Railroad, Northern Suffolk Railroad.
B-5164	B&P Railroad	Eligible	Completed in 1873. Includes associate tunnel and bridges; most other structures and buildings date to early 20th century.
B-5164-1	West Mulberry Street Bridge	Eligible	West Mulberry Street Bridge, south of the West Baltimore MARC Station.
B-5187	Edmondson Avenue Historic District	Listed	Mostly late 19th- to mid-20th-century residences, some commercial and light industrial buildings.
B-5233	Bentalou Elementary School	Not Eligible	Mid-20th-century one-, two-, and three-story elementary school.
B-5287	B&O Railroad Baltimore Belt Line	Eligible	Freight line constructed between 1891 and 1895.
B-5295	Mount Royal Reservoir Pipe Vault	Not Eligible	Mid-19th-century masonry pipe vault building constructed into the embankment of the reservoir.
B-5296	Warehouse	Eligible	Mid-20th-century one-story warehouse.

V. ASSESSMENT OF PRIOR DISTURBANCE

A. CARTOGRAPHIC REVIEW

A series of historical maps of the Baltimore City from the nineteenth and twentieth centuries was consulted to help assess the potential for historic archaeological resources in the APE-Archaeology. To meet the program objectives of developing a comprehensive overview, it was deemed prudent to select maps that would provide a chronological representation of the project location. Rather than concentrating the initial efforts on a single time frame, a sample of maps spanning the nineteenth and early twentieth centuries was selected. For the purposes of this study, the selected historical maps were imported and georeferenced into GIS. The location of buildings, roads, and other improvements are an approximation because historical maps are imprecise relative to modern coordinate systems; however, the historical information presented on the maps is useful in identifying the likelihood that historic archaeological resources may be present in the APE-Archaeology.

Maps consulted include those listed below, selected based on their levels of detail, their estimated level of accuracy, their compatibility with one another and modern landmarks, and relevance to the developmental history in the APE-Archaeology.

- *Plan of the City and Environs of Baltimore* (Warner and Hanna 1801)
- *Approaches to Baltimore, Maryland* (Bache 1849/1865)
- *City Atlas of Baltimore, Maryland and Environs* (Hopkins 1876)
- *Atlas of the City of Baltimore, MD* (Duncan 1897)
- *Atlas of the City of Baltimore, Maryland* (Topographical Survey Commission 1914)

The cartographic review indicates that the APE-Archaeology was situated in undeveloped or dispersed agrarian settlements surrounding the City of Baltimore until the mid-nineteenth century. The Warner and Hanna (1801) map does not extend to the location of the south portal and approach; however, the map shows several large estates in the vicinity of the north portal and approach as well as at the Intermediate Ventilation Facility (see Figure 7). Two estates are depicted at the north portal and approach. The eastern terminus intersects the approximate location of a house identified as belonging to a Mr. Rutter. Another house, belonging to Dr. Birkhead, was situated south of the proposed location of the north portal. In addition, two mills are depicted along the Jones Falls in the vicinity of the APE-Archaeology. No buildings are depicted within the Intermediate Ventilation Facility in the 1801 map; however, a meandering cart road extends along the eastern boundary.

The Bache (1849/1865) map was published in 1865 by the U.S. Coast Survey, later the U.S. Coast and Geodetic Survey, both predecessors of the National Oceanic and Atmospheric Administration. The map was published in the 1860s, but the title block indicates that the location of improvements depicted on the map was based on a survey completed in 1849 by J.B. Glick, Assistant Coast Surveyor, and updated with several Civil War earthworks and other recent improvements in 1865 and 1866. Unlike earlier maps of the City of Baltimore, the 1849/1865 map extends sufficiently west to include the portion of the APE-Archaeology containing the south portal and approach. By 1849 the APE-Archaeology was still largely rural, although the large estates depicted in the Warner and

Hanna (1801) map had been supplanted by smaller farms, and several new roads leading out of the city core had been established (see Figure 10). Ross Street (present-day Druid Hill Avenue) and Madison Avenue extend northwest out of the city core, parallel to Pennsylvania Avenue. West of the city, both Franklin Street and Lexington Street had been constructed by that time, and agricultural fields and farmhouses lined many of these new streets and avenues. In addition, the North Central Railway (formerly the B&S Railroad) was established into the City of Baltimore, along the Jones Falls.

According to the 1849/1865 map, the portion of the APE-Archaeology that includes the south portal and approach was situated along a mix of cleared terraces and wooded floodplains bordering the north branch of Gwynns Run. Both West Lafayette Street and West Franklin Street were established by that time and extended east to west through the APE-Archaeology. Other than roads, other improvements mapped in this portion of the APE-Archaeology during the period include a house located within the western terminus, on the west side of a portion of Calverton Road that was razed during the original construction of the B&P railroad. The map also depicts another house and fence line within the boundaries of one of the two staging areas in the median of U.S. Route 40. Otherwise, the remainder of the APE-Archaeology containing the south portal and approach consisted of undeveloped farmland.

The eastern portion of the APE-Archaeology containing the north portal and approach was significantly more developed by the mid-nineteenth century. According to the 1849/1865 map, Falls Road was formally established along the east bank of the Jones Falls. Portions of the road and the Jones Falls extend through the APE-Archaeology. Several buildings are also depicted within the APE-Archaeology, including mill buildings and an associated mill race at the eastern terminus where Baltimore Pennsylvania Station (B-3727) is currently located. The map also shows the Mount Royal Reservoir, constructed in 1862, in the vicinity of the north portal, as well as two houses within the alignment of the current railroad tracks leading to the station.

The 1849/1865 map also shows three buildings at the proposed location of the Intermediate Ventilation Facility. By 1849 the cart road (present-day Bloom Street) depicted in 1801 had been straightened and partially bisects that portion of the APE-Archaeology. Two houses are shown on either side of the road, and a third, on the south side of the road, partially extends into the APE-Archaeology.

The rapid population growth of Baltimore City during the mid-nineteenth century continued to push the development within the city beyond its original core along the harbor. Between 1860 and 1880, settlement increased on the city's undeveloped periphery as wealthy families began to leave the center city area for the new suburbs that were connected to the city by horse-drawn streetcars (see Figure 12). In addition to the residential development, new mill towns, such as Woodberry and Hampden, were along the Jones Falls. The Hopkins (1876) atlas reflects the increased development north and west of the city's original core during this period (see Figure 11). The map depicts the proposed gridded street pattern that is similar to the present-day street pattern, although the presence of houses and other buildings depicted within roads suggests that not all of the proposed roadways depicted on the map had been constructed by 1876, particularly in the western portion of the city. The western portion of the APE-Archaeology remained slower to develop than other portions of the city during that time. Areas that were formerly large farm estates on the outskirts of Baltimore were starting to be supplanted by parceled city lots containing rowhouses

and commercial buildings. As discussed in Chapter IV.C, construction of these new neighborhoods was driven by the African American migration into the city in the years following the Civil War. Many of these newly arrived residents settled in Old West Baltimore, north and west of Franklin Street and Dolphin Street. At the same time both established German Jewish families and more recently arrived Eastern European Jewish immigrants began to settle north of Old West Baltimore in what became known as Reservoir Hill (see Chapter IV.C.4).

The B&P Tunnel was completed in 1873 (see Chapter IV.C.3). The newly constructed tunnel extended from Gilmor Street to Cathedral Street (present-day Mt. Royal Avenue) and passed underneath the growing Baltimore City neighborhoods of Old West Baltimore and Bolton Hill. The Hopkins (1876) atlas shows the B&P Railroad extending through the western portion of the APE-Archaeology parallel to the north branch of Gwynns Run and extending through several large parcels owned by the Patterson, Keerl, Shipley, and Abell families. Although the 1876 map depicts the various large parcels as containing proposed gridded streets and blocks, the map depicts few houses or other improvements in the western portion of the APE-Archaeology at that time. Those depicted on the map are situated in the vicinity of Calverton Road and farther east near the intersection of West Franklin and North Fulton Streets (see Figure 11). The buildings depicted near Calverton Road are centered near the B&P Railroad. They include the Calverton Road Station, a drove shed, and other buildings likely associated with the operation of the railroad. Three buildings are illustrated at the site of the proposed staging area at West Franklin and North Fulton Streets. Two houses are located on the east side of North Fulton Street, and a large house identified as the "Home for the Aged Methodist Episcopal Church" lies on the east side of the road.

The vicinity of the proposed location of the Intermediate Ventilation Facility was part of the Reservoir Hill neighborhood by 1876. The part of Bloom Street that previously bisected this portion of the APE-Archaeology is shown as replaced by a city block owned by E. Whitman. The Hopkins (1876) map depicts a single wood-frame building in the APE-Archaeology near the corner of Eutaw Street (present-day Eutaw Place) and North Avenue with several other buildings located to the north. By the late nineteenth century the eastern portion of the APE-Archaeology continued to be dominated by the construction of railroad infrastructure. The 1876 map depicts numerous tracks owned by the Northern Central and B&P railroads and a round house in the vicinity of the proposed north portal. Other improvements depicted on the map include a line of rowhouses between the NCR tracks and the Jones Falls.

At the turn of the twentieth century, neighborhoods in the vicinity of the APE-Archaeology continued to grow and new residential blocks were established. According to the Duncan (1897) atlas, the city continued to expand west of Gilmor Street as the neighborhoods of Poppleton, Franklin Square, Harlem Park and Sandtown-Winchester were established (see Figure 12). Most residential development in those neighborhoods did not extend as far as the western portion of the APE-Archaeology by that time, as the majority of houses depicted on the 1897 map are east of Payson Street. The majority of the western portion of the APE-Archaeology remained largely undeveloped in 1897 with the exception of the western terminus near Calverton Road. The Duncan (1897) atlas shows additional sheds and warehouses close to the rail station and a spur line extending from the main alignment through the Calverton Stock Yards to Franklin Street. Farther east of West Franklin Street, the 1897 map depicts five residences in the APE-Archaeology at the former intersection with North Wheeler Avenue. The two residences that were located at on the east side of North Fulton Street at West Franklin Street were gone by 1897; however, the Methodist

Episcopal Church home for the aged was still present along with additional residences on the west side of North Fulton Street. The only other development in the APE-Archaeology for the south portal and approach was an area designated as a city dump south of Lanvale Street, between Payson Street and Pulaski Street. The remainder of the land bordering the B&P Railroad remained cleared as undeveloped terraces overlooking the north branch of Gwynns Run. However, development west of Payson Street occurred soon after 1897. Rowhouses stood between Riggs Avenue and Lanvale Street and became part of the Monroe-Riggs neighborhood.

In 1897 the proposed location of the Intermediate Ventilation Facility was occupied by a series of rowhouses extending along North Avenue and along Eutaw Street (present-day Eutaw Place) and Linden Avenue. The map depicts approximately 17 rowhouses and the North Avenue Baptist Church on the corner of North and Linden avenues within the APE-Archaeology.

The development in the eastern portion of the APE-Archaeology remained relatively unchanged at the turn of the twentieth century. In 1897 the majority of the APE-Archaeology in the vicinity of the proposed north portal and approach consisted of the Jones Falls and the tracks for the B&P Railroad and NCR as they approach Union Station. Several buildings were also present on either side of the Jones Falls and were likely associated with the operation of the railroad.

By the early twentieth century the neighborhoods in the vicinity of the APE-Archaeology were fully developed, populated in large part as a result of the migration of African Americans from the South and Eastern European immigrants. Many of the last farms/estates present on the former western boundary of the city had been sold to developers as the neighborhoods continued to expand west of the B&P Tunnel and Railroad. According to the Topographical Survey Commission (1914) atlas, the only undeveloped portions of the city within the APE-Archaeology at that time were lots located immediately adjacent to the B&P Railroad between Riggs Avenue and Edmondson Avenue (see Figure 13).

The buildings and railroad infrastructure associated with Calverton Station remained largely unchanged between 1897 and 1914. New development during that period in the western portion of the APE-Archaeology included the construction of several blocks of rowhouses along Payson Street, Brice Street, and Pulaski Street between Harlem Street and Riggs Street. Several houses and commercial buildings constructed prior to 1914 lie within the western part of the APE-Archaeology, east of the existing railroad. Additional buildings, representing rowhouses and warehouses, are depicted on the west side of the railroad on the south side of Franklin Street. The slow progress of development in the western portion of the APE-Archaeology into the twentieth century was likely, in part, because of the unsuitable topography in the vicinity of the B&P Railroad. Until the twentieth century, the north branch of Gwynns Run and its associated floodplain extended along the east side of the railroad. By 1914 the stream was channelized and buried with imported soil. This allowed the construction of additional houses and businesses closer to the railroad beginning in the first decades of the twentieth century, which continued to increase in the decades that followed.

The Topographical Survey Commission (1914) maps shows the location for the proposed Intermediate Ventilation Facility as unchanged from its depiction in the 1897 map (see Figure 13). The North Avenue Baptist Church still occupied the corner of Linden and North avenues, and the remainder of this portion of the APE-Archaeology contained brick rowhouses until the mid-

twentieth century. By that time all the rowhouses had been razed. The North Avenue Baptist Church was torn down and replaced with commercial retail buildings, which remain today, and the Madison Park Medical Center was constructed on the corner of Eutaw Place and West North Avenue along with a parking lot on Linden Avenue.

The eastern portion of the APE-Archaeology has remained relatively unchanged since 1897. The area primarily consisted of the Jones Falls and railroad tracks. The 1914 map also depicts three buildings associated with the railroad in the APE-Archaeology near the proposed location of the north portal. The map also shows another railroad-related building near the Jones Falls, south of West North Avenue.

B. GIS TOPOGRAPHIC ANALYSIS

Those areas of the APE-Archaeology subjected to the topographic analysis include the vicinity of the south portal and approach, the Intermediate Ventilation Facility, and the eastern portion of the approach to the north portal. The portion of the APE-Archaeology above West 20th Street was not included as part of the topographic analysis because the map for that quadrant presented inconsistent topographic data that could not be rectified with the data presented in the adjoining quadrants. The modern elevations used in the analysis were an elevation dataset from the Baltimore City Department of Planning (Open Baltimore), published in 2021. The 2021 dataset was derived using light detection and ranging (LiDAR) to support 2-foot contours and has an accuracy less than 1 foot.

Figures 16-18 show the results of the analysis. The model shows that the modern elevation in the portions of the APE-Archaeology at the south portal and approach is substantially higher than the elevation in 1897 (see Figure 16). In 1897 the majority of the APE-Archaeology closest to the current railroad alignment consisted of a stream valley and adjacent terraces overlooking the north branch of Gwynns Run (Duncan 1897). Later maps indicate that the stream was buried and the stream valley between the B&P Railroad and Monroe Street was infilled with imported soil. According to the model, it is likely that approximately 6 to over 20 feet of imported soil were deposited in the stream valley to raise the ground surface to correspond to the elevation of the developed portions of the city east of Monroe Street. The model also indicates that other areas in this portion of the APE-Archaeology were graded and primarily correspond to roadway improvements at West Franklin Street and West Mulberry Street and other development south of West Mulberry Street.

At the Intermediate Ventilation Facility, the model shows the modern elevation in the majority of this portion of the APE-Archaeology as slightly lower than it was in 1897 (see Figure 17). In addition, several isolated areas representing a slight increase in the modern elevation are present along the northern and eastern portions of the APE-Archaeology. However, given the margin of error in any analysis of this type, the modern elevation in this portion of the APE-Archaeology could be unchanged.

The model at the north portal and approach suggests a varying elevation change in portions of the APE-Archaeology after 1897 (see Figure 18). Below West Trenton Street, the model suggests that the modern elevation is between 3 and 16 feet lower than in 1897. Above West Trenton Street, the model also suggests that grading occurred on the east side of the APE-Archaeology and that filling occurred west of the Jones Falls after 1897.

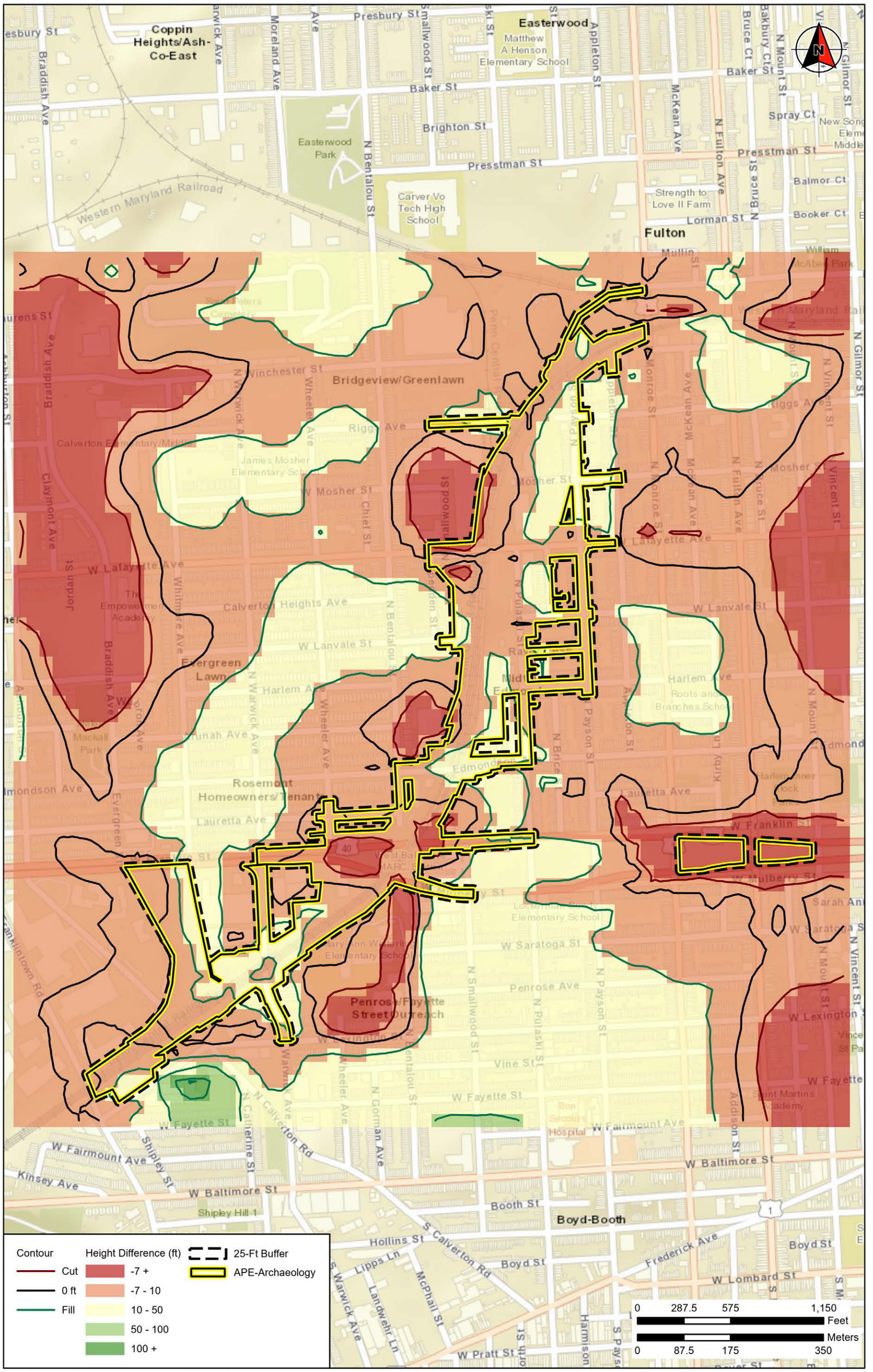

FIGURE 16: Projected Depth of Fill at South Portal and Approach (ESRI World Street Map 2021)

FIGURE 17: Projected Depth of Grading at Intermediate Ventilation Facility (ESRI World Street Map 2021)

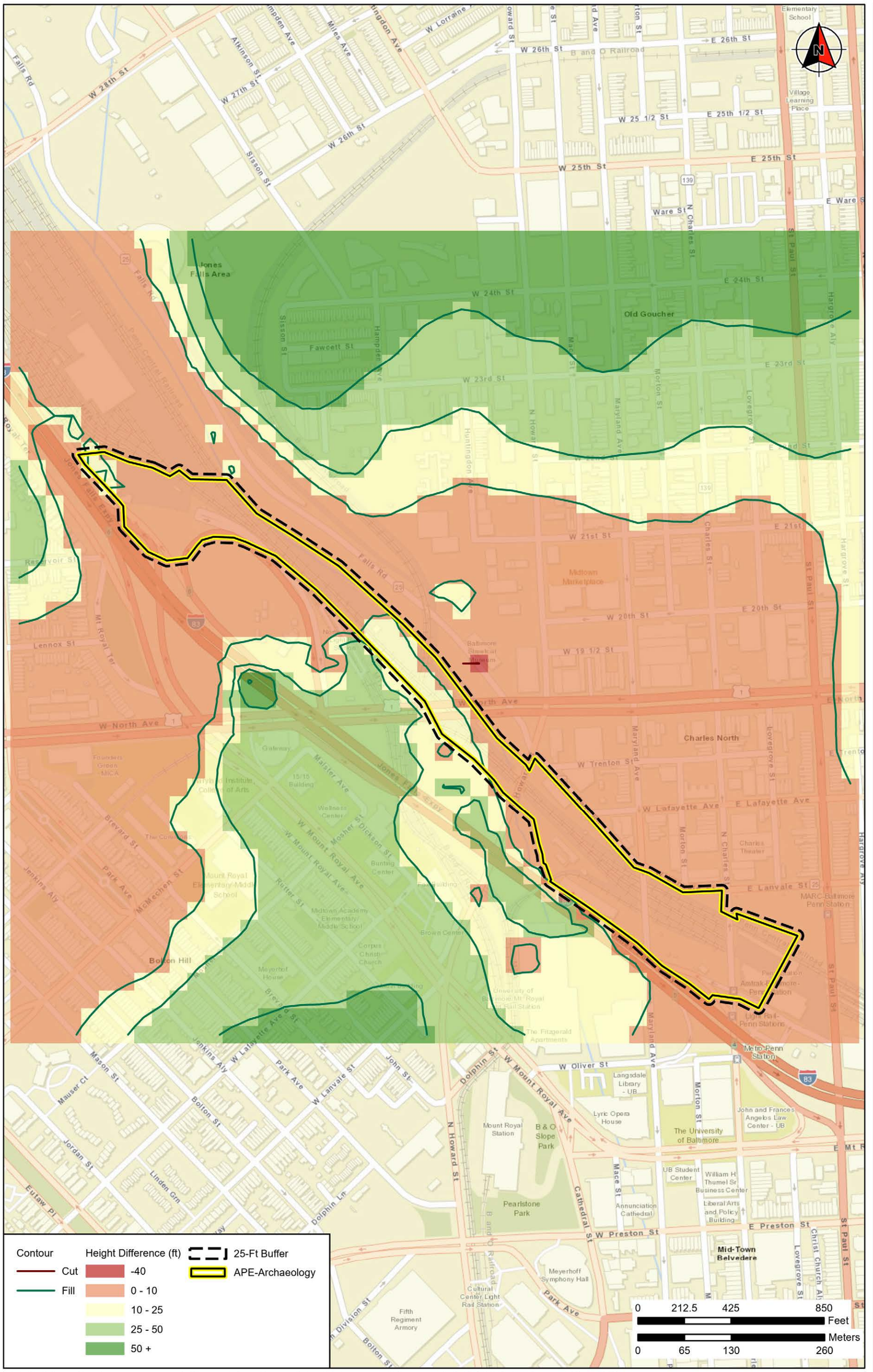

FIGURE 18: Projected Depth of Fill and Grading at North Portal and Approach (ESRI World Street Map 2021)

C. REVIEW OF GEOTECHNICAL DATA

1. South Portal and Approach

The logs for 24 geotechnical borings completed between North Warwick Avenue and North Riggs Avenue were reviewed to assess the depth of fill from the existing ground surface documented in the APE-Archaeology for the south portal and approach (Figure 19; Table 4). With the exception of Boring Number S-P4-05A, varying depths of redeposited soil were observed in this portion of the APE-Archaeology. Between North Warwick Avenue and the Franklin Mulberry Expressway, fill deposits were observed to extend between 3 and 6 feet below ground surface (bgs) with overlying strata consisting of moist sand and clayey silt.

The depth of fill gradually increased as the APE-Archaeology extended north toward North Riggs Avenue. Between Edmondson Avenue and Mosher Street, multiple overlying strata composed of mixed fills were observed extending to between 10 and 14 feet bgs. The strata underlying the fill deposits were generally characterized as moist sand and clayey silt or silty clay.

TABLE 4: BORINGS AT SOUTH PORTAL AND APPROACH

BORING NO.	APPROXIMATE BORING LOCATION	DEPTH OF FILL*
S-P3-B12	N. Warwick Ave – South of Tracks	3.0
S-P4-07	Franklin Mulberry Expressway, East Bound	4.0
S-P4-08 OW	Franklin Mulberry Expressway, East Bound	4.0
S-P4-06	Franklin Mulberry Expressway, West Bound	4.0
S-P2-B8	Franklin Mulberry Expressway, West Bound	6.0
S-P4-05A	Franklin Mulberry Expressway, West Bound	0.0
S-P2-B6A OW	Edmondson Ave	13.5
S-P2-B6	Edmondson Ave	8.0
S-P4-04	Edmondson Ave	34
S-P4-03	Edmondson Ave	34
S-P2-B5	Harlem Ave and N Pulaski St	11
UT-02	Between Harlem Ave and W Lanvale St	14
S-P2-B4	N Pulaski St and W Lanvale St	10
S-P4-01	Lafayette Ave	8.0
S-P2-B3A	Lafayette Ave and Brice St	10
SA-P2-1 OW	Mosher St	10
SA-P4-01	Mosher St	6.0
SA-P3-1	Mosher St	16.5
TA-P3-1	West of N Payson St	19.2
UT-05	N Payson St	14
SA-P4-02	West of N Payson St	19
SA-P3-3	N Payson St	23
SP-1	Riggs Ave	17
T-P3-1	North of Riggs Ave	23

* Approximate feet bgs

FIGURE 19: Geotechnical Boring Locations at South Portal and Approach (ESRI World Street Map 2021)

Two borings (S-P4-03 and S-P4-04), at 2124 Edmondson Avenue, encountered mixed fills extending to 34 feet bgs and may represent a filled cellar or another historic feature. The boring log for S-P4-04 indicates the presence of trace amounts of brick appearing in samples taken between 19 to 21 feet bgs and trace amounts of "burnt fragments" in samples taken between 24 to 26 feet and 29 to 31 feet bgs. The boring log for S-P4-03 also indicates that "burnt fragments" were observed in samples taken between 29 and 31 feet bgs.

Farther north, a boring (S-P2-B5) completed in the parking lot at 630 North Pulaski Street was documented as containing fill deposits extending to approximately 11.7 feet bgs. Shell fragments were encountered starting with samples taken at 2.5 feet bgs. The boring log indicates that the frequency of shell fragments increased at approximately 8 feet bgs and also included brick, metal, and rubber in samples taken at 11 to 11.7 feet bgs. The shell and other historic material may suggest the presence of an artifact scatter associated with a buried historic ground surface or buried cellar or another cultural feature. It is also possible the presence of the material occurred as the result of a secondary deposition when the area was filled sometime in the twentieth century.

Fill deposits were observed extending between to approximately 16.5 to 23 feet bgs in the borings conducted at the site of the proposed south portal, between Mosher Street and North Riggs Avenue. The southernmost boring (SA-P3-1) in this location was situated in the vicinity of 932 N Payson Street. Seven overlying layers of redeposited soil were observed extending to 16.5 feet bgs. The boring log indicates trace cinders, wood fragments, and plastic in samples taken between 8 and 12 feet bgs. The logs for the other borings conducted in this area also document the presence of trace amounts of similar material as well as coal, brick fragments, glass, and gravel in multiple overlying layers of mixed soil. The strata underlying the fill deposits in this area are characterized as a range of moist to wet sand, silt, or clayey silt.

2. Intermediate Ventilation Facility

The logs for six geotechnical borings at the site of the proposed Intermediate Ventilation Facility (Figure 20; Table 5) were reviewed. Three borings were located in the parking lot along Linden Avenue. Boring logs for IVF-P5-8A and IVF-P5-8B documented the presence of redeposited soil extending to 4.5 feet bgs. Samples taken at 2.0 to 2.5 and 4.0 and 4.5 feet bgs indicated the presence of mixed sand and silty clay soils containing gravel and trace brick fragments. A third boring (IVF-P5-6), excavated in the southwest corner of the parking lot, documented multiple layers of mixed redeposited sand and silt extending to 18 feet bgs. No brick fragments or trace amounts of any other cultural material were documented in the boring log.

TABLE 5: BORINGS AT INTERMEDIATE VENTILATION FACILITY

BORING NO.	APPROXIMATE BORING LOCATION	DEPTH OF FILL*
IVF-P2-7A	Linden Ave	16.8
IVF-P3-4	West of Jordan St	9.0
IVF-P5-6	Parking lot East of Jordan St	18
IVF-P5-8A	Parking lot East of Jordan St	4.5
IVF-P5-8B	Parking lot East of Jordan St	4.5
IVF-P5-9	West of Jordan St	10

* Approximate feet bgs

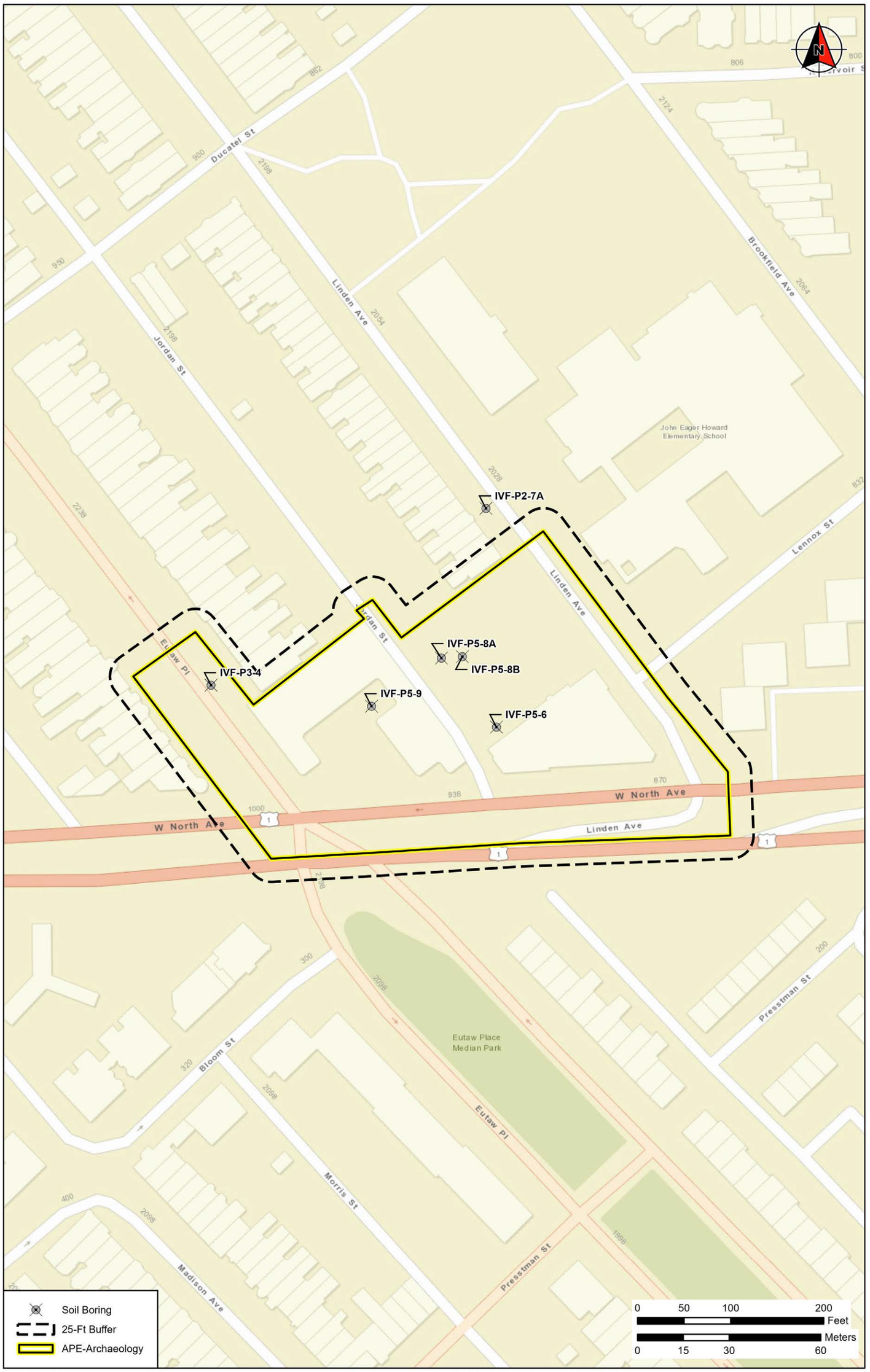

FIGURE 20: Geotechnical Boring Locations at Intermediate Ventilation Facility (ESRI World Street Map 2021)

Two borings (IVF-P3-4 and IVF-P5-9) were located west of Jordan Street. The boring log for IVF-P3-4 indicated the presence of brown silty clay extending to 4.5 feet bgs, followed by brown sand and silty clay extending to 9 feet bgs. No brick or other cultural material was recovered from the samples. Unlike the other boring at this location, the soils documented in IVF-P3-4 were uniform and appear to represent an intact landform as opposed to the mixed redeposited soils observed in other borings. The boring log for IVF-P5-9 indicated two layers of red-brown clayey silt extending to approximately 4.5 feet bgs and contained trace amounts of asphalt, gravel, and stone. Additional layers of mixed sand and gravel fill extended to 10 feet bgs.

The sixth boring was located north of the parking lot, in the approximate location of 2018 Linden Avenue. Multiple layers of redeposited soil composed of mixed silty clay and sand extended to approximately 16.8 feet bgs. A utility line was encountered at 3.6 feet bgs, and asphalt fragments were observed in samples collected at 10.5 to 12.5 feet bgs.

3. North Portal and Approach

The logs for 12 geotechnical borings for the portion of the APE-Archaeology that consists of the location of the north portal and approach were reviewed (Figure 21; Table 6). The geotechnical borings were conducted from the site of the proposed north portal and extended south to the Howard Street Bridge. Two borings (TA-P3-3 and NP-1) in the vicinity of the proposed north portal documented the presence of fill extending to varying depths. The boring log for TA-P3-3 documented three layers of redeposited soil consisting of mixed sand and fine gravel extending to 6.5 feet bgs with decomposing bedrock underlying the fill deposits. The log for NP-1 documented a layer of clay fill extending to 2.5 feet bgs containing gravel, brick, and stone fragments. The logs further indicate the presence of "possible fill" extending to 11.5 feet bgs consisting of sand and gravel, similar to the fill deposits identified in boring TA-P3-3.

TABLE 6: BORINGS AT NORTH PORTAL AND APPROACH

BORING NO.	APPROXIMATE BORING LOCATION	DEPTH OF FILL*
TA-P3-3	North of I-83 Ramp	6.8
NP-1	I-83 Ramp	11.5
NP-P2-1 OW	McMechen Street	9.5
JFW-1	Service Road along Jones Falls	27.5
JFW-2	Service Road along Jones Falls	10
NP-2	West of McMechen St	7.3
NP-3 OW	West of McMechen St	3.4
NA-P2-1 OW	1800 Falls Road, Charles Interlocking	5.8
CSX-P	Between CSX and North Ave Bridges	10.3
CSX-A	Under CSX Bridge	10.5
JFW-3	North of W North Ave Bridge	16.5
JFW-4	South of W North Ave Bridge	11.5

* Approximate feet bgs

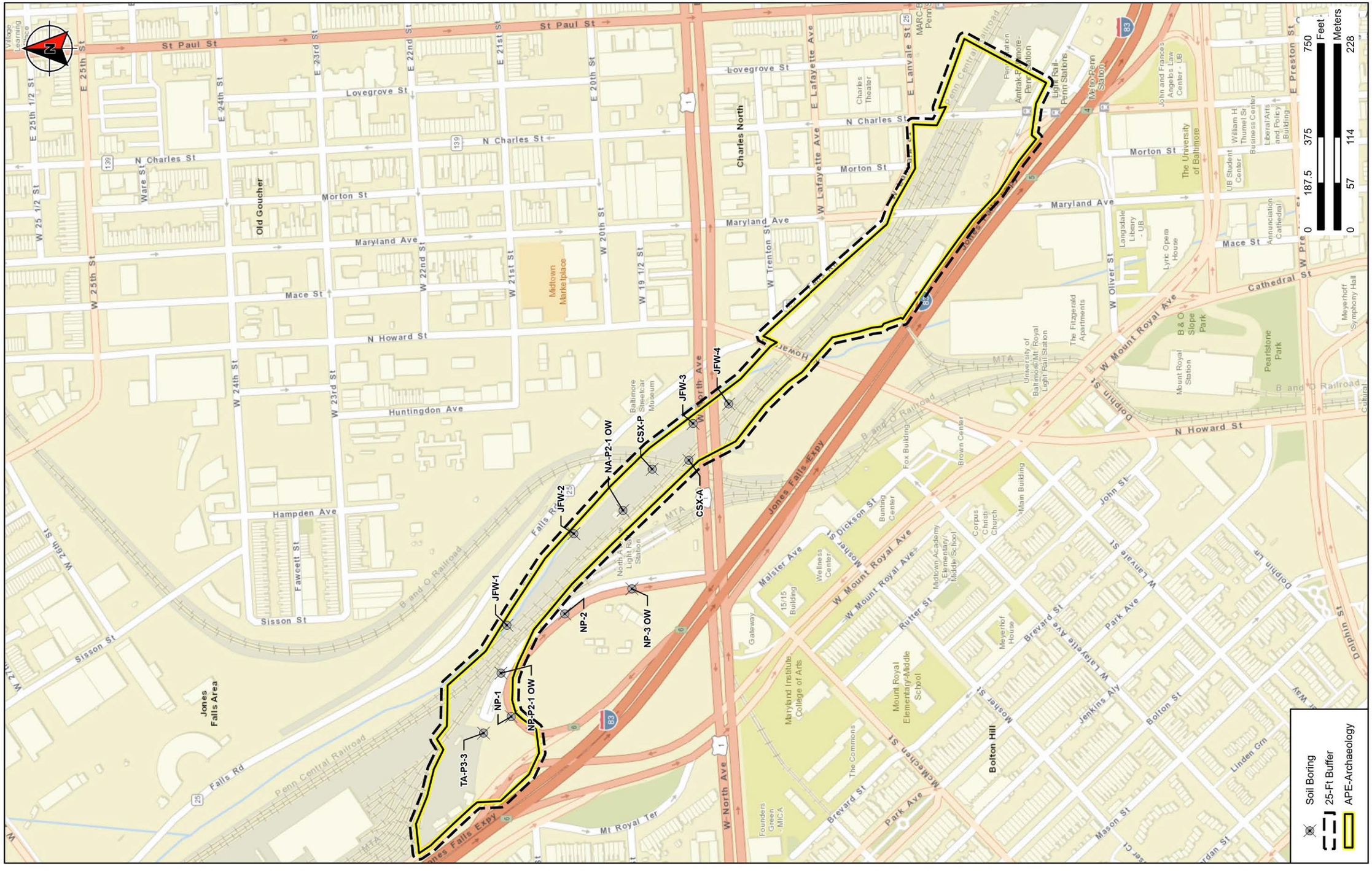

FIGURE 21: Geotechnical Boring Locations at North Portal and Approach (ESRI World Street Map 2021)

The logs of three geotechnical borings were reviewed for the area between the I-83 ramp and the light rail. Boring NP-P2-1 OW was east of the proposed location of the north portal and documented that mixed gravel, sand, and silty clay extended to 9.5 feet bgs. Farther east, two additional geotechnical borings (NP-2 and NP-3) documented the presence of redeposited soil composed of sand, silt, and gravel. The fill deposits observed in NP-2 consisted of two discrete layers of fill extending to 7.3 feet bgs. Boring NP-3 contained one layer of sand extending to 3.4 feet bgs.

Fill deposits were observed ranging between approximately 5.8 and 27.5 feet bgs in the area between the light rail and the Jones Falls. Boring JFW-1 documented a series of overlapping sand and gravel deposits extending to approximately 27.5 feet bgs. Similar sand and gravel deposits were documented to extend 10 feet bgs in boring JFW-2. The log for JFW-2 also described the presence of a stratum of silty clay from a sample taken at 4.0 to 4.5 feet bgs overlying additional layers of sand. Closer to the CSX bridge, boring NA-P2-1 documented a layer course to fine gravel and cinder extending to approximately 2.5 feet bgs followed by a layer of light brown and gray sand extending to 5.8 feet bgs. The boring logs characterize both layers as fill.

The four remaining logs reviewed as part of the study were from geotechnical borings in the vicinity of the CSX and West North Avenue bridges. Boring CSX-P was west of the Jones Falls and north of the CSX bridge. The log documents a series of mixed sand and gravel deposits extending to approximately 10.3 feet bgs. Trace amounts of glass were observed in samples taken at 8.0 to 8.5 feet bgs. Additional pieces of glass and brick were observed in samples taken at 9.5 to 10 feet bgs, and more brick was observed in a sample taken between 10 and 10.25 feet bgs.

Boring CSX-A was west of the light rail, between the CSX and West North Avenue bridges. The boring log characterized a series of gravel, sand, and silty clay fill deposits extending to 10.5 feet bgs. Trace amounts of cinders were observed in samples taken at 2 and 4 feet bgs. Samples taken at 6 feet bgs contained shell and trace amounts of root, and those taken at 8 feet bgs were observed as having a slight organic odor. The final sample for boring CSX-A was taken at 10 feet bgs and contained trace organics and glass fragments.

Boring JFW-3 was east of the light rail and north of the West North Avenue Bridge. The boring log characterized a series of gravel, sand, and clay fill deposits extending to 16.5 feet bgs. Trace amounts of cinders were observed in samples taken at 2 feet bgs. The boring log also indicated a boulder encountered between 8 and 9 feet bgs followed by moist clay, sand, and gravel extending to 16.5 feet bgs.

Boring JFW-4 was east of the light rail and south of the West North Avenue Bridge. The boring log characterized a series of gravel and sand fill deposits extending to 11.5 feet bgs. The boring log indicated a boulder encountered between 4.5 and 6.0 feet bgs. Below 6 feet bgs, the logs indicate the presence of coarse to fine gravel and sand extending to 11.5 feet bgs.

VI. SENSITIVITY ASSESSMENT

Archaeological sensitivity is ranked as high, moderate, or low based on the correlation of a location with various favorable environmental characteristics and documented factors. From an environmental perspective, the factors contributing to precontact archaeological sensitivity often also apply to early historic archaeological sensitivity.

In general, analysis of precontact site sensitivity for the Program considers landscape characteristics in or near the APE-Archaeology that are associated with documented precontact sites in the region and locally. These variables can include topography, proximity to water and resource catchment areas over time, soil characteristics, proximity to documented Native American trails or other areas of local and regional communication and exchange (e.g., navigable waterways), presence of natural landscape features (e.g., prominent ridges or hilltops), and proximity to lithic or clay source areas.

High-sensitivity zones for precontact archaeological resources include level to gently sloping, well-drained, upland areas within 500 feet of surface water or wetlands and areas within 500 feet of previously recorded archaeological sites. Moderate-sensitivity zones for precontact archaeological resources are generally more than 500 feet from a freshwater source and characterized by moderately sloping topography and/or somewhat poorly drained soils. Poorly drained soils and steeply sloping topography are negatively correlated with precontact habitation and indicate low sensitivity for precontact archaeological resources. Previous ground disturbance, such as that related to construction, ground clearing, and grading, also lowers the sensitivity for archaeological resources.

Historic site sensitivity depends on the relationship of the APE-Archaeology to local community development over time; historic transportation routes (e.g., roads, railroads, canals, rivers, etc.); the documentary record of residential, commercial, and institutional buildings; and the proximity to target historic resource areas (e.g., fall lines on rivers and streams where mills were established, quarry locations).

Historic archaeological sensitivity is ranked as high in areas near the location of documented historic development and within 300 feet of early transportation routes and as low in areas with little record of historic land development. The presence of standing historic structures indicates a high probability for associated historic archaeological sites. Information obtained from cartographic evidence also contributes to assessments of historic archaeological sensitivity. Although early historical maps do not depict historic structures with accuracy, nineteenth-century maps often record accurate details of settlement pattern, ownership, and occupation. The likelihood for historic archaeological resources to exist within the APE-Archaeology is high in areas that are in proximity to historic houses and outbuildings or in areas near early roads.

A. SOUTH PORTAL AND APPROACH

The GIS topographic analysis and the previous geotechnical boring logs suggest that the landscape within the APE-Archaeology for the south portal and approach was significantly modified over the last 120 years. Prior to the twentieth century, the portion of the APE-Archaeology extending from North Monroe Street southwest to beyond North Warwick Avenue was primarily

undeveloped pastures and woodlots along the stream valley of the north branch of Gwynns Run. Some grading and filling west of the stream occurred in the 1870s during the construction of the B&P Railroad while the landscape in the remainder of this portion of the APE-Archaeology remained intact. Native Americans likely traversed the stream valley prior to European colonization, and sites associated with their activities may be present. Although no precontact resources have been previously identified close to the APE-Archaeology, resource procurement and habitation sites have been identified along other tributaries within Baltimore City, including the Gwynns Falls and Jones Falls.

Maps dating to the early and mid-nineteenth century depict several early roads extending through the APE-Archaeology. Although most do not show houses or other buildings along those roads, maps and atlases from that period do not provide a complete representation of all the homes and improvements that were present. The Sidney and Neff (1851) map depicts a house or other building located near the present-day intersection of Mosher Street and North Payson Street, prior to the establishment of the modern street grid. In addition, the Sidney (1857) map shows a house belonging to "H. Stewart" close to the proposed location of the south portal. The depiction of buildings on the historical maps indicate the possibility that additional development may have occurred in the stream valley prior to the 1870s.

In the early twentieth century, significant modifications were made to the landscape as the stream valley of the north branch of Gwynns Run was filled with large quantities of transported soil. These activities resulted in an increase of 3 to 6 feet in surface elevation near North Warwick Street and upward of 16 to 20 feet extending north from that point with the greatest degree of elevation change occurring in the area above Mosher Street.

Once the stream valley was filled, the area was open for residential and commercial development. Ground disturbance related to construction was likely confined to the transported soil layers, particularly where the prior alteration of the landscape was most extensive. Over the course of the twentieth century, development continued and extended further into this portion of the APE-Archaeology.

Several historic properties are located in the APE-Archaeology, including the NRHP-listed Edmondson Avenue Historic District (B-5187) and the NRHP-eligible Greater Rosemont Historic District (B-5112) and Midtown Edmondson Historic District (B-5118). Historical maps indicate that most of the development in the vicinity of the APE-Archaeology occurred in the first decades of the twentieth century, with the earliest construction occurring between Riggs Avenue and West Lanvale Street, west of North Payson Street. The houses in this location were primarily constructed prior to 1914, with several having been built in the late 1890s. Many of the lots that contained rowhouses within the APE-Archaeology have been razed and currently consist of paved lots and open green spaces. Where the rowhouses are extant, the rear yards largely remain undeveloped. As a result, there is the potential for the presence of structural features and other preserved cultural deposits associated with the early residents of the Monroe-Riggs neighborhood.

- Based on the documentary research, developmental history, and past environmental characteristics, portions of the APE-Archaeology in the south portal and approach are assessed as having a moderate to high sensitivity for the presence of precontact and historic archaeological resources. The portion of the APE-Archaeology extending from Edmondson

Avenue north to the intersection of North Payson Street and Riggs Avenue has the potential to contain deeply buried precontact to early nineteenth-century resources (Figure 22). Despite the extent of development, there remains a moderate to high sensitivity for the presence of intact archaeological resources. The filling activities that occurred during the early twentieth century likely served to bury the earlier ground surface, which may have potential to contain precontact and early historic archaeological resources. In addition to a sensitivity for deeply buried resources, the areas from Riggs Avenue to West Lanvale Street between North Payson Street and North Pulaski Street also have a moderate sensitivity for the presence of late nineteenth- and early twentieth-century resources associated with residents of the Monroe-Riggs neighborhood (see Figure 22).

The remainder of the APE-Archaeology at the south portal and approach is assessed as having low sensitivity for the presence of precontact or historic archaeological resources. The prior modification of the landscape in the remainder of the APE-Archaeology at the south portal and approach consisted of substantial ground disturbance associated with the construction of the B&P Railroad, U.S. Route 40, and a mix of twentieth-century commercial and industrial development. Owing to the extent of previous ground disturbance that occurred, the potential for the presence of intact archaeological resources is low in the remainder of the APE-Archaeology for the south portal and approach.

B. INTERMEDIATE VENTILATION FACILITY

According to maps from the eighteenth and early nineteenth centuries, the APE-Archaeology lay on relatively level topography close to the springhead of a tributary of the Jones Falls. Although this location would have been sensitive for precontact archaeological resources, late nineteenth-century urban development likely caused significant disturbance to any Native American resources that may have been present. The subsequent redevelopment across most of the APE-Archaeology would have further reduced the likelihood for the presence of intact precontact archaeological resources.

The GIS topographic analysis suggests the modern elevation at the site for the proposed Intermediate Ventilation Facility is comparable to its historic elevation; however, the previous geotechnical boring logs indicate the presence of varying depths of fill at the locations they inspected. This portion of the APE-Archaeology is located within the NRHP-listed Reservoir Hill Historic District (B-1379) and also contains the NRHP-eligible Madison Park Medical Center (B-1379-6). Development in the Reservoir Hill Historic District began in the 1870s with the earliest houses located along Madison Avenue. According to the Hopkins (1876) atlas, the APE-Archaeology was part of an estate owned by E. Whitman. The map indicates that the majority of the APE-Archaeology was undeveloped with the exception of a building near the present-day intersection of Eutaw Place and West North Avenue. By the 1890s the APE-Archaeology was primarily occupied by a series of brick rowhouses on Linden Avenue, Eutaw Place, and West North Avenue. The North Avenue Baptist Church had also been built in the APE-Archaeology during this time, on the corner of Linden Avenue and West North Avenue. By the mid-twentieth century the APE-Archaeology was extensively redeveloped. The North Avenue Baptist Church was torn down at that time and replaced with commercial retail buildings. All the rowhouses were razed, and the Madison Park Medical Center was built on the corner of Eutaw Place and West North Avenue along with a parking lot on Linden Avenue.

Consequently, the mid-twentieth-century redevelopment of the APE-Archaeology along West North Avenue and Eutaw Place likely caused significant ground disturbance that diminishes the potential

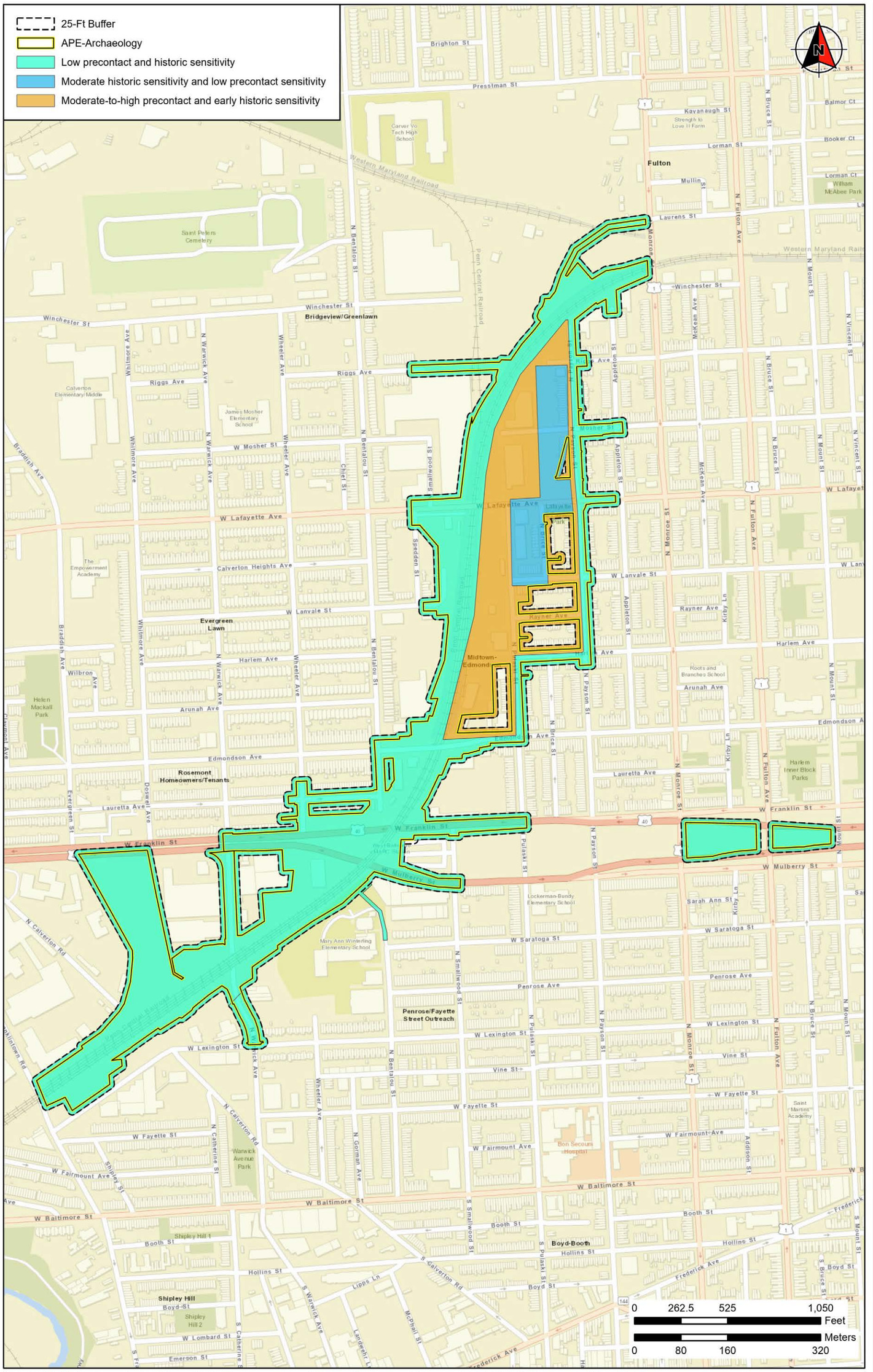

FIGURE 22: Archaeological Sensitivity Assessment of South Portal and Approach (ESRI World Street Map 2021)

to identify intact historic archaeological resources associated with either the late nineteenth-century occupation of Reservoir Hill or the early to mid-nineteenth-century estates that preceded them.

- Based on the documentary research, developmental history, and past environmental characteristics, the APE-Archaeology for the Intermediate Ventilation Facility is assessed as having a low sensitivity for the presence of precontact archaeological resources. The parking lot along Linden Avenue is assessed with a moderate to high sensitivity for the presence of historic archaeological resources dating from the late nineteenth century (Figure 23). The rest of the APE is assessed as having a low sensitivity for the presence of intact historic archaeological resources.

C. NORTH PORTAL AND APPROACH

This portion of the APE-Archaeology lies within the boundaries of three historic properties that are eligible for listing in the NRHP: the North Avenue Bridge (B-4521), the Union Railroad (B-5163), and the B&P Railroad (B-5164). The eastern terminus of the APE-Archaeology also extends within the boundaries of the NRHP-listed Baltimore Pennsylvania Station (B-3727).

The GIS topographic analysis and the previous geotechnical boring logs suggest that the landscape within the APE-Archaeology for the north portal and approach was significantly modified over the late nineteenth and twentieth centuries. In the early nineteenth century several mills were present in the APE-Archaeology along the Jones Falls. Water-powered mills were present along the Jones Falls since the eighteenth century, and their presence served to alter the course of the stream and the surrounding landscape through the construction of mill races, ponds, and dams. By the 1830s the first railroads were constructed along the west side of the Jones Falls, and in the decades that followed, additional tracks were constructed in this portion of the APE-Archaeology, which resulted in the further grading and filling of the natural topography. By 1876 the majority of the landscape in the APE-Archaeology along the Jones Falls was modified and contained rail tracks or other railroad infrastructure. Additional modifications were made to the landscape in 1862 with the construction of the Mount Royal Reservoir. Additional modifications to the landscape also occurred in the twentieth century, including the demolition of the Mount Royal Reservoir in 1924 and the construction of the Jones Falls Expressway in the 1960s. During the same time, the railroad infrastructure continued to expand along the Jones Falls, resulting in further ground disturbance.

Prior to European colonization, the uplands surrounding the Jones Falls would have been an attractive location for Native American groups to settle and procure resources. After the arrival of European colonists, numerous mills were established along the stream, some continuing to operate into the twentieth century. However, the documented modification of the landscape for the construction and continuous expansion of railroad infrastructure over the last two centuries likely resulted in the disturbance of any intact archaeological resources that may have been present along this portion of the Jones Falls. The construction and demolition of the Mount Royal Reservoir and the construction of the Jones Falls Expressway resulted in additional ground disturbance in the area.

- Based on the documentary research, developmental history, and past environmental characteristics, the APE-Archaeology for the south portal and approach is assessed as having a low sensitivity for the presence of intact precontact and historic archaeological resources (Figure 24).

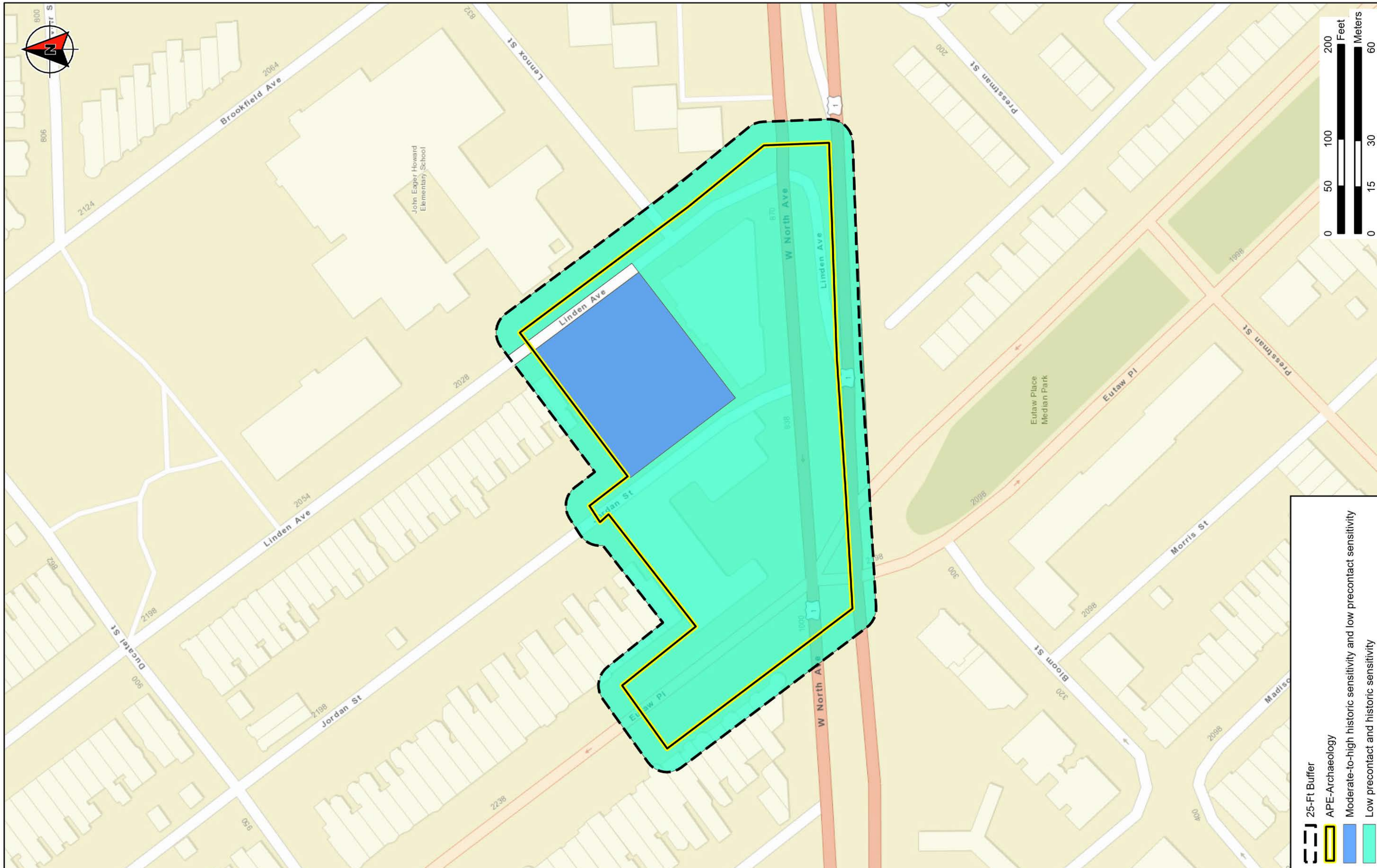

FIGURE 23: Archaeological Sensitivity Assessment of Intermediate Ventilation Facility (ESRI World Street Map 2021)

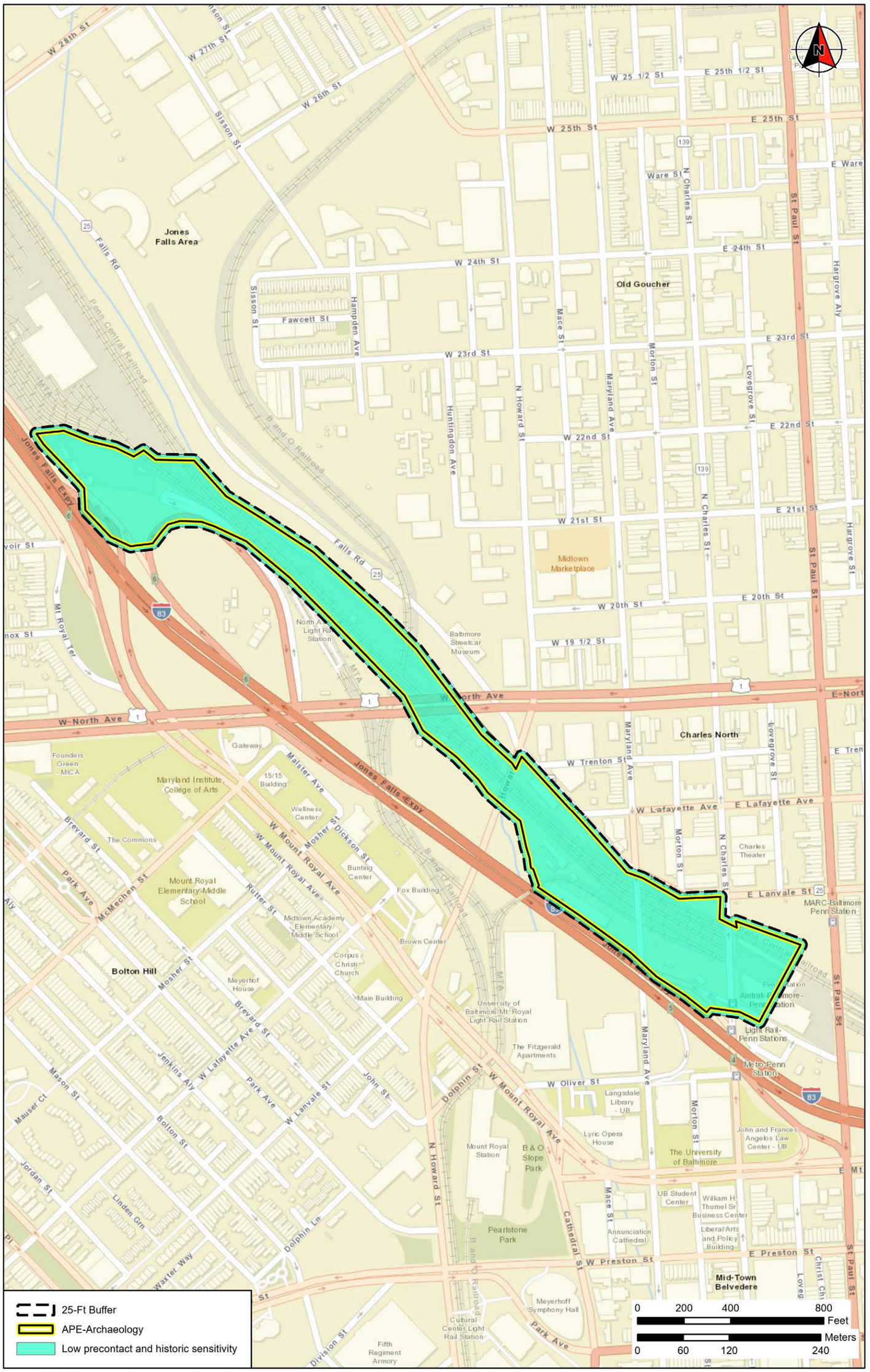

FIGURE 24: Archaeological Sensitivity Assessment at North Portal and Approach (ESRI World Street Map 2021)

VII. RECOMMENDATIONS

No further archaeological survey is recommended in those portions of the APE-Archaeology assessed with low archaeological sensitivity. Construction activities proposed in the areas of moderate to high archaeological sensitivity have the potential to impact intact archaeological sites that may be present, and in WSP's opinion further archaeological survey is needed in areas of moderate to high sensitivity to determine if significant archaeological historic properties are present and could be impacted by the Program. Furthermore, if, in the course of consultation and project planning, the LOD for the Program is modified to extend outside the currently defined APE-Archaeology, further evaluation will be required to determine whether the changes have the potential to impact archaeological historic properties.

A. GEOMORPHOLOGY SURVEY

WSP recommends a geomorphology survey in the portion of the APE-Archaeology extending from Edmondson Avenue to the intersection of North Payson Street and Riggs Avenue (Figure 25). The goal of the survey would be to determine whether intact buried surfaces are present under the overlying fill deposits that have the potential to contain archaeological resources. The geomorphology study should also include the portion of the APE-Archaeology between North Payson Street and North Pulaski Street from Riggs Avenue and West Lanvale Street to determine whether intact soil horizons are present with the potential to contain archaeological deposits associated with the late nineteenth- to early twentieth-century occupation of Monroe-Riggs neighborhood.

The study should be conducted by a geoarchaeologist and consist of mechanized direct push geotechnical sampling at select locations to determine the presence, depth, and age of potential precontact or historic artifact-bearing soil horizons in the area of sensitivity. If the survey identifies intact soil horizons, a systematic shovel test survey or the excavation of exploratory trenches may be required to identify archaeological resources that could be affected by the Program. In accordance with the Program PA, Appendix C provides a work plan for the geomorphology survey.

B. PHASE IB/II SURVEY

WSP recommends a Phase IB/II survey in the parking lot along Linden Avenue to determine whether intact yard deposits and features associated with the former late nineteenth-century houses are present underneath the parking lot (Figure 26). As the parking lot consists of an impervious surface, the survey should consist of the mechanical excavation of a series of backhoe trenches to sample the underlying soils. A total of eight trenches measuring 5x10 feet are recommended to determine if archaeological resources are present. In the event that intact topsoil layers or features are identified, test units should be manually excavated within the backhoe trenches.

All Phase IB/II archaeological surveys must be completed in accordance with the *Standards and Guidelines for Archeological Investigations* in Maryland (Shaffer and Cole 1994) with artifacts processed and curated according to state standards (Morehouse et al. 2018). In accordance with the Program PA, Appendix D provides a work plan for the Phase IB/II archaeological survey.

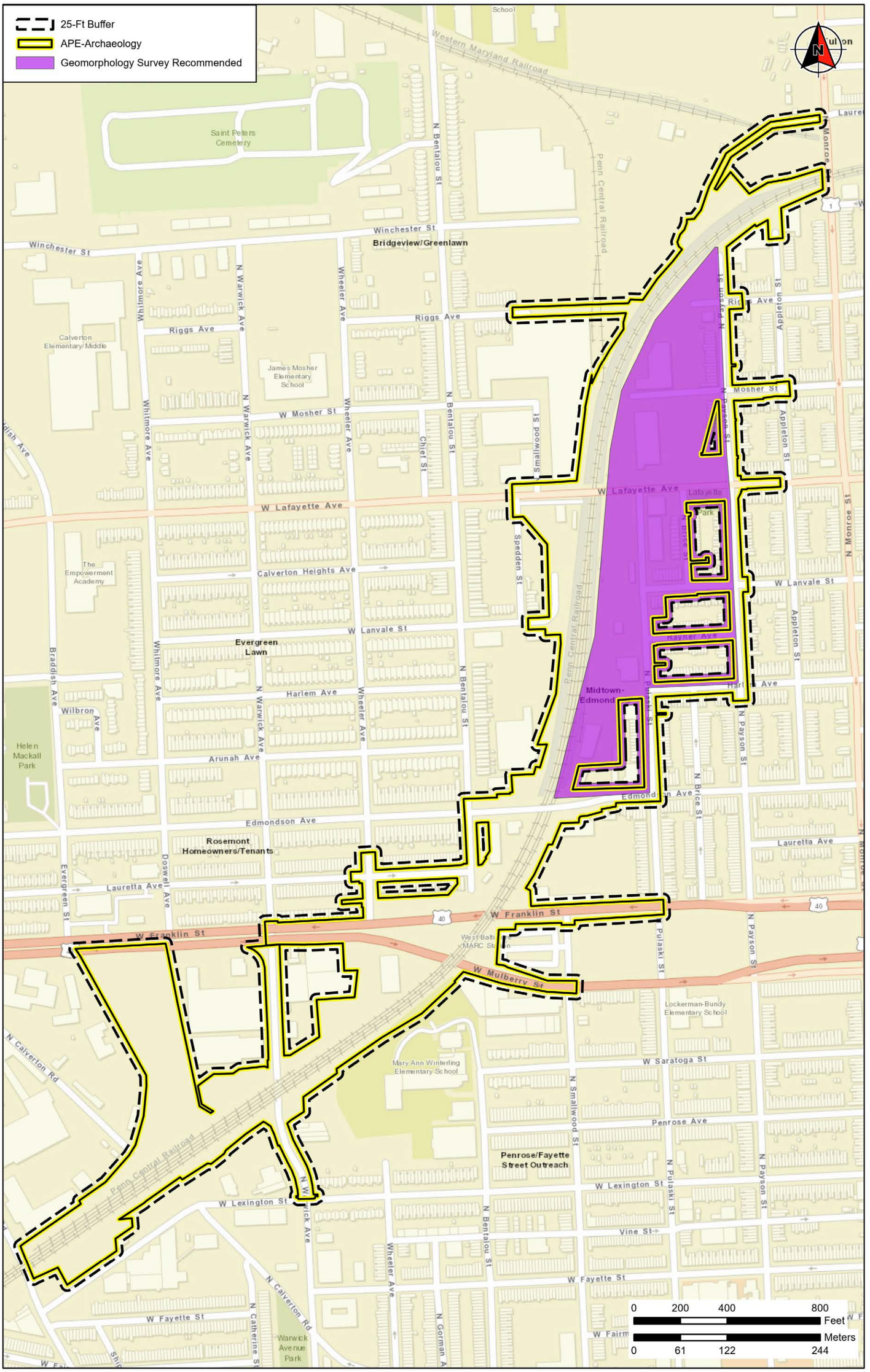

FIGURE 25: Area Recommended for Geomorphology Survey (ESRI World Street Map 2021)

FIGURE 26: Area Recommended for Phase IB Survey (ESRI World Street Map 2021)

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IX. LIST OF ABBREVIATIONS AND ACRONYMS

APE	Area of Potential Effects
APE-Archaeology	Archaeological Area of Potential Effects
B&O	Baltimore & Ohio
B&P	Baltimore & Potomac
B&S	Baltimore & Susquehanna
BP	Before present (present=AD 1950)
CFR	Code of Federal Regulations
DEIS	Draft Environmental Impact Statement
DEM	Digital Elevation Model
FEIS	Final Environmental Impact Statement
FRA	Federal Railroad Administration
GIS	Geographic information systems
LiDAR	Light Detection and Ranging
LOD	Limits of Disturbance
MARC	Maryland Area Rail Commuter
MDOT	Maryland Department of Transportation
MHT	Maryland Historical Trust
MIHP	Maryland Inventory of Historic Properties
MTA	Maryland Transit Administration
NCR	Northern Central Railroad
NEC	Northeast Corridor
NEPA	National Environmental Policy Act
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
PA	Programmatic Agreement
OD	Outside diameter
PB/P JV	Parsons Brinckerhoff/Parsons Joint Venture
Program	Tunnel Replacement Program
PW&B	Philadelphia, Wilmington, and Baltimore Railroad
RPA	Register of Professional Archaeologists
ROD	Record of decision
ROW	Right-of-way
Section 106	Section 106 of the National Historic Preservation Act, as amended
TIN	Triangulated Irregular Network
USDA	United States Department of Agriculture
WSP	WSP USA Inc.

APPENDIX A: QUALIFICATIONS OF THE INVESTIGATORS

QUALIFICATIONS OF THE INVESTIGATORS

JASON SHELLENHAMER

Master of Applied Archaeology, Historical Archaeology, University of Maryland, 2004
B.A., Anthropology, Minor in History, Franklin and Marshall College, 2001

Mr. Shellenhamer is a senior archaeologist with the Heritage Resource Practice in WSP's Southeast Region. His experience includes management of a wide range of cultural resource studies for federal, state, and municipal clients in the Middle Atlantic, Southeast and Northeast regions. His experience includes the design and direction of Phase I through Phase III studies, development of alternative mitigation strategies, consultation and agency coordination, National Register of Historic Places evaluations, historic property reviews, preservation easement property evaluations, and design and implementation of public outreach programs.

HENRY WARD

M.S.A., Graduate Fellowship, Department of Anthropology, University of Delaware, Newark, 1985
B.A., Department of Anthropology/Sociology, Ohio Wesleyan/Ohio State University, Delaware, Ohio, 1981

Mr. Ward is the cultural resources project manager and WSP archaeologist with over 42 years of experience as a professional archaeologist and cultural resources manager and he exceeds the Secretary of the Interior's Professional Qualification Standards for Archaeology. Mr. Ward possesses specific technical knowledge with the archaeological resources of the Chesapeake Region and has also had over a decade's general experience in overseeing comprehensive cultural resources programs that integrate the full range of archaeology and historic architectural disciplines.

APPENDIX B: 2017 B&P TUNNEL PRELIMINARY ENGINEERING GEOTECHNICAL DATA BORING LOGS

BORING LOG

BORING NUMBER: **NP-1**
SHEET NUMBER: **1** of **2**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**
CONTRACTOR: **E2CR, Inc.**
DRILLER: **S. Lyons**
INSPECTOR: **L. Sepulveda**
DRILLING METHOD: **HSA; Diamond Coring**
RIG TYPE: **CME-75, Truck Mounted**

LOCATION: **I-83 North Avenue Exit Ramp**
COORD.: **N: 599,868.3 E: 1,418,464.9**
SURFACE ELEV.: **112.8 feet**
DATUM: **Horizontal: NAD 83/91**
Vertical: NAVD 88
START DATE: **4/21/15** TIME: **10:15 pm**
FINISH DATE: **4/24/15** TIME: **12:15 am**

	Auger	Split Spoon	Casing	Dennison	Grab	Core Barrel
Type/Symbol	HSA	S ■	NW	D ▨	G ⊠	C ▤
I.D.	4.25"	1.375"	3.00"	n/a	3.25"	n/a
O.D.	8.25"	2"	3.50"	n/a	3.375"	n/a
Length	60"	24"	60"	n/a	6"	n/a
Hammer Wt.	n/a	140lbs	Drill Rod Size		AW (SPT sampling)	
Hammer Fall	n/a	30"	I.D. (O.D.)		1.219" (1.75")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Auger Depth (ft)	Hole Depth (ft)
4/22/15	8:20 pm	13.6	21.0	35.0
4/27/15	2:00 am	27.4	26.0	116.4
5/4/15	8:20 pm	40.0	26.0	116.4

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
						0.0 - 0.6											0.0' 2" Asphalt and 5" concrete slab 0.6'
																	112.2' Note: Hand excavated for utility clearance, depth 0.0'-7.2'
			G	1	⊠	2.0 - 2.5	G	R	A	B	6						Light brown CLAY, some coarse to fine Sand, some coarse to fine Gravel, bricks, stone fragments, dry (FILL)
			G	2	⊠	4.0 - 4.5	G	R	A	B	6						Light brown coarse to fine SAND, some Clay, little coarse to fine Gravel, dry (SC, possible FILL)
5			G	3	⊠	6.0 - 6.5	G	R	A	B	6						Light brown coarse to fine SAND, trace to little fine to medium Gravel (SC, possible FILL)
			S	1	■	8.0 - 10.0	11	11	12	18	15						Light brown fine GRAVEL, some Clay, some medium to fine Sand, medium dense, dry (GC, possible fill)
10																	11.5'
			S	2	■	13.0 - 15.0	12	14	17	19	7						101.3' Light brown CLAY, some medium to fine Sand, little coarse to fine Gravel, hard, dry (CL)
15																	16.0'
			S	3	■	18.0 - 19.9	17	26	38	50/5"	6						96.8' Light brown coarse to fine Gravel, some Clay, some medium to fine Sand, very dense, dry (GC)

B&P BORING LOG (FINAL) B&P TUNNEL PHASE1_160531 PH1.GPJ B&P TUNNEL - 150528 WITHOUT LOGO.PH1.GLB 1/19/17

Note:

BORING LOG
(continued)

BORING NUMBER: **NP-1**
SHEET NUMBER: **2** of **2**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **I-83 North Avenue Exit Ramp**
CLIENT: **AMTRAK**

CONTRACTOR: **E2CR, Inc.**
DRILLER: **S. Lyons**
INSPECTOR: **L. Sepulveda**

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
																	21.0'
																	91.8' (Auger refusal at 21 ft bgs, see Coring Log)
25																	
30																	
35																	
40																	

B&P BORING LOG (FINAL) B&P TUNNEL PHASE1_160531 PH1.GPJ B&P TUNNEL - 150528 WITHOUT LOGO.PH1.GLB 1/19/17

Note:

BORING LOG

BORING NUMBER: **NP-2**
SHEET NUMBER: **1** of **2**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**
CONTRACTOR: **E2CR, Inc.**
DRILLER: **S. Lyons**
INSPECTOR: **L. Sepulveda**
DRILLING METHOD: **HSA; Diamond Coring**
RIG TYPE: **CME-75, Truck Mounted**

LOCATION: **McMechen Street**
COORD.: **N: 599,652.6 E: 1,418,879.1**
SURFACE ELEV.: **97.5 feet**
DATUM: **Horizontal: NAD 83/91**
Vertical: NAVD 88
START DATE: **5/6/15** TIME: **1:15 am**
FINISH DATE: **5/7/15** TIME: **4:01 am**

	Auger	Split Spoon	Casing	Dennison	Grab	Core Barrel
Type/Symbol	HSA	S ■	NW	D ▨	G ▩	C ▤
I.D.	4.25"	1.375"	3.00"	n/a	3.25"	n/a
O.D.	8.25"	2"	3.50"	n/a	3.375"	n/a
Length	60"	24"	60"	n/a	6"	n/a
Hammer Wt.	n/a	140lbs	Drill Rod Size		AW (SPT sampling)	
Hammer Fall	n/a	30"	I.D. (O.D.)		1.219" (1.75")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Auger Depth (ft)	Hole Depth (ft)
5/7/15	9:05 pm	21.4	33.0	56.1

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
																	0.0' 6" Asphalt 0.5' 97.0' Note: Hand excavated for utility clearance, depth 0.0'-2.5'. Soil very dense, unable to progress beyond 2.5 ft bgs. Dark yellow-brown coarse to fine SAND, little coarse to fine Gravel, stone fragments, dry (FILL)
			G	1	▩	2.0 - 2.5	G	R	A	B	6						
			S	1	■	4.0 - 5.5	24	33	50/6"		18						Yellow-brown coarse to fine SAND and SILT, little coarse to fine Gravel, very dense, dry (SM, possible FILL)
5																	7.3'
																	90.2'
			S	2	■	9.0 - 11.0	5	13	13	13	24						Light yellow, yellow, brown and white SILT and medium to fine SAND, very stiff, dry (ML, Residual Soil)
10																	
			S	3	■	14.0 - 15.0	21	50/5.5"			11.5						Light yellow, yellow, brown and white SILT and medium to fine SAND, hard, dry (ML, Residual Soil)
15																	
			S	4	■	19.0 - 20.4	25	41	50/5"		17						Light yellow, yellow, brown and white SILT and medium to fine SAND, hard, dry (ML, Residual Soil)

B&P BORING LOG (FINAL) B&P TUNNEL PHASE1_160531 PH1.GPJ B&P TUNNEL - 150528 WITHOUT LOGO.PH1.GLB 1/19/17

Note:

BORING LOG
(continued)

BORING NUMBER: **NP-2**
SHEET NUMBER: **2** of **2**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **McMechen Street**
CLIENT: **AMTRAK**

CONTRACTOR: **E2CR, Inc.**
DRILLER: **S. Lyons**
INSPECTOR: **L. Sepulveda**

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
			S	5	■	22.5 - 22.6	50/1"				1						22.6' / 74.9 Light gray and gray fine GRAVEL and coarse to fine Sand sized bedrock fragments, very dense, dry (GP, Highly fractured bedrock) (Auger refusal at 22.6 ft bgs, see Coring Log)
25																	
30																	
35																	
40																	

B&P BORING LOG (FINAL) B&P TUNNEL PHASE1_160531 PH1.GPJ B&P TUNNEL - 150528 WITHOUT LOGO.PH1.GLB 1/19/17

Note:

BORING LOG

BORING NUMBER: **NP-3 OW**
SHEET NUMBER: **1** of **1**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**
CONTRACTOR: **E2CR, Inc.**
DRILLER: **S. Lyons**
INSPECTOR: **L. Sepulveda**
DRILLING METHOD: **HSA; Diamond Coring**
RIG TYPE: **CME-75, Truck Mounted**

LOCATION: **McMechen Street**
COORD.: **N: 599,382.2 E: 1,418,980.0**
SURFACE ELEV.: **101.5 feet**
DATUM: **Horizontal: NAD 83/91**
Vertical: NAVD 88
START DATE: **5/11/15** TIME: **11:30 pm**
FINISH DATE: **5/13/15** TIME: **4:25 am**

	Auger	Split Spoon	Casing	Dennison	Grab	Core Barrel
Type/Symbol	HSA	S	NW	D	G	C
I.D.	4.25"	1.375"	3.00"	n/a	3.25"	n/a
O.D.	8.25"	2"	3.50"	n/a	3.375"	n/a
Length	60"	24"	60"	n/a	6"	n/a
Hammer Wt.	n/a	140lbs	Drill Rod Size		AW (SPT sampling)	
Hammer Fall	n/a	30"	I.D. (O.D.)		1.219" (1.75")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Auger Depth (ft)	Hole Depth (ft)
5/13/15	1:40 am	11.8	12.0	84.3
5/14/15	9:00 pm	12.2	12.0	84.3

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
						0.0 - 0.8											0.0' 10" Asphalt slab 0.8'
			G	1		2.0 - 2.5 2.5 - 4.0	G	R	A	B							100.7' Yellow-brown coarse to fine SAND, some coarse to fine Gravel, some Clay (SC, possible FILL) Note: Hand excavated for utility clearance, depth 0.00'-2.75'. Soil very dense, unable to progress beyond 2.75 ft bgs. 3.4'
5			S	1		4.0 - 5.8	38	33	34	50/4"	22						98.1' S-1A: 4.0'-4.75': Light yellow-brown fine to medium SAND, trace Silt, very dense, dry (SP) 4.8' 96.8' S-1B: 4.75'-5.8': Light-yellow brown, white and brown medium to fine SAND and SILT, little coarse Gravel, dry, very dense (SM, Decomposed Rock) 7.0'
			S	2		8.0 - 9.3	26	43	50/3"		15						94.5' Light-yellow brown, white and brown SILT and coarse to fine SAND, trace to little coarse Gravel, hard, dry (ML, Decomposed Rock)
10			S	3		9.3 - 9.3	50/0				0						12.0'
																	89.5' (Auger refusal at 12 ft bgs, see Coring Log)
15																	

Note:

Boring No. **NP-3** Sheet **1** of **1**

BORING LOG

BORING NUMBER: **SP-1**
SHEET NUMBER: **1** of **2**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**
CONTRACTOR: **E2CR, Inc.**
DRILLER: **S. Lyons**
INSPECTOR: **L. Sepulveda**
DRILLING METHOD: **HSA: Diamond Coring**
RIG TYPE: **CME-75, Truck Mounted**

LOCATION: **1938 Riggs Avenue**
COORD.: **N: 595,370.7 E: 1,411,553.2**
SURFACE ELEV.: **162.1 feet**
DATUM: **Horizontal: NAD 83/91**
Vertical: NAVD 88
START DATE: **4/6/15** TIME: **9:50 am**
FINISH DATE: **4/9/15** TIME: **9:40 am**

	Auger	Split Spoon	Casing	Dennison	Grab	Core Barrel
Type/Symbol	HSA	S	NW	D	G	C
I.D.	4.25"	1.375"	3.00"	n/a	3.25"	n/a
O.D.	8.25"	2"	3.50"	n/a	3.375"	n/a
Length	60"	24"	60"	n/a	6"	n/a
Hammer Wt.	n/a	140lbs	Drill Rod Size		AW (SPT sampling)	
Hammer Fall	n/a	30"	I.D. (O.D.)		1.219" (1.75")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Auger Depth (ft)	Hole Depth (ft)
4/6/15	2:25 pm	10.0	10.0	10.0
4/9/15	9:10 am	9.2	33.0	91.0
4/10/15	9:00 am	9.0	33.0	96.2
4/13/15	10:00 am	10.1	33.0	96.2

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
						0.0 - 0.8											0.0' 0.8' 10" Layer of asphalt, brick and concrete
																	161.3'
			G	1		2.5 - 3.0	G	R	A	B	6						Light brown fine to coarse SAND, trace to little coarse Gravel, trace to little Silt, brick, coal, stone fragments, dry (SP-SM, FILL)
5			G	2		5.0 - 5.5	G	R	A	B	6						Light brown fine to coarse SAND, trace to little coarse Gravel, Silt, brick, coal, stone fragments dry (FILL)
			G	3		7.0 - 7.5	G	R	A	B	6						Light brown fine to coarse SAND, trace to little coarse Gravel, Silt, brick, coal, stone fragments dry (FILL)
10			S	1		10.0 - 12.0	1	1	WOH	1	0						Note: Probed with air knife to ~9 ft depth for utility clearance No recovery
			S	2		13.5 - 15.5	WOH	2	2	1	10						Light brown coarse to fine SAND, some Silt, some coarse Gravel, brick, coal, stone fragments, very loose to loose, moist (SM, FILL)
15																	17.0'
																	145.1'
			S	3		18.5 - 20.5	1	WOH	1	WOH	16						Dark gray Clayey SILT, some fine Sand, occasional plant fibers, micaceous, very soft, moist (OL)

B&P BORING LOG (FINAL) B&P TUNNEL PHASE1_160531 PH1.GPJ B&P TUNNEL - 150528 WITHOUT LOGO.PH1.GLB 1/19/17

Note:

BORING LOG
(continued)

BORING NUMBER: **SP-1**
SHEET NUMBER: **2** of **2**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **1938 Riggs Avenue**
CLIENT: **AMTRAK**

CONTRACTOR: **E2CR, Inc.**
DRILLER: **S. Lyons**
INSPECTOR: **L. Sepulveda**

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
																	22.0'
																	140.1'
25			S	4		23.5 - 25.5	6	11	23	16	14						S-4A (23.5'-25.0' and 25.3'-25.5'): Reddish brown fine to medium SAND, some Silt, trace decomposed medium to fine Gravel, micaceous, dense, moist (SM, Residual Soil)
																	S-4B (25.0'-25.3'): Light gray and black medium to fine SAND, some Silt, trace medium to fine Gravel, micaceous, dense, moist (SM, Decomposed Rock)
30			S	5		28.5 - 29.2	46	50/2"			8						Dark green-gray medium to fine SAND, some Silt, little medium to fine Gravel (bedrock fragments), very dense, moist (SM, Decomposed Rock)
																	33.0'
																	129.1' (Auger refusal at 33 ft bgs, see Coring Log)
35																	
40																	

B&P BORING LOG (FINAL) B&P TUNNEL PHASE1_160531 PH1.GPJ B&P TUNNEL - 150528 WITHOUT LOGO.PH1.GLB 1/19/17

Note:

BORING LOG

BORING NUMBER: **CSX-A**
SHEET NUMBER: **1** of **2**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**
CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **L. Sepulveda**
DRILLING METHOD: **Hollow Stem Augers; Diamond Coring.**
RIG TYPE: **CME-55, Rubber Track, Automatic Hammer**

LOCATION: **AMTRAK 1800 Falls Rd.; Charles Interlock; Under CSX bridge**
COORD.: **N: 599,153.0 E: 1,419,498.4**
SURFACE ELEV.: **64.3 feet**
DATUM: **Horizontal: NAD 83/91**
Vertical: NAVD 88
START DATE: **6/16/16** TIME: **10:20 am**
FINISH DATE: **6/16/16** TIME: **12:00 pm**

	Auger	Split Spoon	Casing	Pitcher	Grab	Core Barrel
Type/Symbol	n/a	S	NW	L	G	C
I.D.	n/a	1.375"	3.00"	n/a	3.25"	1.875"
O.D.	n/a	2"	3.50"	n/a	3.375"	2.980"
Length	n/a	24"	60"	n/a	6"	60"
Hammer Wt.	n/a	140lbs	Drill Rod Size		A	
Hammer Fall	n/a	30"	I.D. (O.D.)		1.219" (1.75")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
																	0.0' Note: Hand excavated for utility clearance, depth 0.0'-10.5'
			G	1		2.0 - 2.5	G	R	A	B	6						Dark gray and yellowish brown coarse to fine GRAVEL (up to 2") and coarse to fine Sand, trace Clayey Silt, trace cinders, moist (GP, Fill)
			G	2		4.0 - 4.5	G	R	A	B	6						Gray and yellowish brown coarse to fine SAND, little coarse to fine Gravel, trace Clayey Silt, trace cinders, moist (SP, Fill)
5			G	3		6.0 - 6.5	G	R	A	B	6						Light brown coarse to fine SAND, some coarse to fine Gravel, trace Silt, trace mica, trace shell, trace roots, moist (SP, Fill)
			G	4		8.0 - 8.5	G	R	A	B	6						Brown, black and orange CLAY & SILT, little coarse to fine Sand, trace mica, moist, slight organic odor (ML, Fill)
10			G	5		10.0 - 10.5	G	R	A	B	6						
			S	1		10.5 - 12.5	6	4	3	3	11.5						10.5' / 53.8' Black coarse to fine SAND, trace medium to fine Gravel, trace Silty Clay (in pockets), trace organics, trace glass fragments, moist, slight organic odor (CL, Fill)
																	Brown, dark green-gray and white coarse to fine SAND, some Silt, trace to little coarse to fine Gravel, loose, moist (SM)

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 3/2/17

Note:

BORING LOG
(continued)

BORING NUMBER: **CSX-A**
SHEET NUMBER: **2** of **2**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **L. Sepulveda**

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
			S	2		15.5 - 17.5	4	2	1	2	4						Brown coarse to fine SAND and coarse to fine Gravel, some Silt, very loose, wet (SM)
			S	3		18.0 - 18.2	100/2"				2						17.8'
			C	1		18.2 - 19.2	12	12	100	5.0	42						18.2' 46.1 Dark green, gray medium to fine SAND, some coarse to fine Gravel (bedrock fragments), trace to little Silt, very dense, moist (SP-SM, Decomposed Rock)
		0.3															
			C	2		19.2 - 24.2	60	60	100	36.6	61						Dark, bluish gray with streaks of white AMPHIBOLITE; medium to fine grains of amphibole and feldspar; close to very close fracture spacing; except extremely close fracture spacing at 18.20'-18.45'; slightly weathered; medium strong to strong; foliation not discernable at core scale. Dark, bluish gray with streaks of white AMPHIBOLITE; medium to fine grains of amphibole and feldspar; close to very close fracture spacing; slightly weathered; strong to medium strong; foliation not discernable at core scale.
20		0.3															
		0.9															
		0.3															
		0.8															
		0.5															
			C	3		24.2 - 28.2	48	48	100	20.6	43						24.20'-25.00': Dark, bluish gray with streaks of white AMPHIBOLITE; medium to fine grains of amphibole and feldspar; close to very close fracture spacing; slightly weathered; strong to medium strong; foliation not discernable at core scale.
		0.5															25.0' 39.3
25		0.6															25.00'-28.20': Light gray with streaks of black GRANITIC GNEISS; medium to fine grains of feldspar quartz and amphibole; close to very close fracture spacing; except extremely close fracture spacing at 25.90'-26.10'; slightly weathered; medium strong to strong; gneissic banding dips ~40°-45°; quartz bands up to 4.5" thick.
		0.4															36.1'
		1.0															(End of boring at 28.2 ft bgs)
30																	

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 3/2/17

Note:

BORING LOG

BORING NUMBER: **CSX-P**
SHEET NUMBER: **1** of **2**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**
CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **L. Sepulveda**
DRILLING METHOD: **Hollow Stem Augers; Diamond Coring.**
RIG TYPE: **CME-55, Rubber Track, Automatic Hammer**

LOCATION: **AMTRAK 1800 Falls Rd.; Charles Interlock; Between CSX and North Avenue bridges**
COORD.: **N: 599,300.5 E: 1,419,462.3**
SURFACE ELEV.: **66.0 feet**
DATUM: **Horizontal: NAD 83/91**
Vertical: NAVD 88
START DATE: **6/16/16** TIME: **7:00 am**
FINISH DATE: **6/16/16** TIME: **9:20 am**

	Auger	Split Spoon	Casing	Pitcher	Grab	Core Barrel
Type/Symbol	n/a	S	NW	L	G	C
I.D.	n/a	1.375"	3.00"	n/a	3.25"	1.875"
O.D.	n/a	2"	3.50"	n/a	3.375"	2.980"
Length	n/a	24"	60"	n/a	6"	60"
Hammer Wt.	n/a	140lbs	Drill Rod Size		A	
Hammer Fall	n/a	30"	I.D. (O.D.)		1.219" (1.75")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
																	0.0' Note: Hand excavated for utility clearance, depth 0.0'-10.25'
			G	1		2.0 - 2.5	G	R	A	B	6						Black medium to fine GRAVEL (some gravel pieces are porous and lightweight) and coarse to fine Sand, trace Silt, trace cinders, moist (GP, Fill)
			G	2		4.0 - 4.5	G	R	A	B	6						Dark gray, light gray and orange coarse to fine SAND, little medium to fine Gravel, trace Silt, trace cinders, moist (SP, Fill)
5			G	3		6.0 - 6.5	G	R	A	B	6						Black, orangish brown and light gray coarse to fine SAND, little Silty Clay, trace medium to fine Gravel, trace cinders, moist (SM, Fill)
			G	4		8.0 - 8.5	G	R	A	B	6						Grayish brown, orange and black, coarse to fine SAND, trace coarse to fine Gravel, trace Silt, trace cinders, trace glass fragments (not in jar), moist (SP, Fill)
			G	5		9.5 - 10.0	G	R	A	B	6						
10			S	1		10.0 - 12.0	3	4	3	4	16						10.3' Grayish brown, orange and black, coarse to fine SAND, little coarse to fine Gravel, trace Silt, trace cinders, trace glass fragments, trace brick fragments (up to 1.5"), moist (SP, Fill) 55.7' S-1A: 10.00'-10.25': Brown coarse to fine SAND; some Silt, trace fine Gravel, trace brick fragments, loose, moist (Fill) S-1B: 10.25'-11.35': Light brown and brown SILT, trace to little medium to fine Gravel, trace medium to fine Sand, medium stiff, moist; PP = 1.0-2.5 tsf (ML)

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 3/2/17

Note:
PP = Pocket Penetrometer field test reading, in tons per square foot (tsf)

BORING LOG
(continued)

BORING NUMBER: **CSX-P**
SHEET NUMBER: **2** of **2**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **L. Sepulveda**

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
			S	2		15.0 - 17.0	6	11	11	12	24						Brown, light brown and light gray Clayey SILT, little to some medium to fine Sand, trace to little fine Gravel, very stiff, moist; PP = 3.75-4.00 tsf (ML)
																	18.5'
																	47.5'
20			S	3		20.0 - 22.0	13	15	13	29	14						Reddish brown and gray medium to fine SAND, some Silt, trace medium to fine Gravel, medium dense, wet (SM, Decomposed Rock)
			S	4		22.3 - 22.4	50/1"				1						22.4'
		0.5	C	1		22.4 - 25.4	36	32	89	4.0	11						43.6' Dark gray and reddish brown coarse to fine GRAVEL (bedrock fragments), very dense, moist (GP, Decomposed Rock)
		0.4															22.40'-22.75': Assumed recovery loss. Dark, bluish gray amphibole SCHIST; medium to fine grains of amphibole and feldspar; close to very close fractures spacing; except extremely close at 22.75'-22.95'; slightly weathered; medium strong; foliation dips ~50°; GRANITIC GNEISS band at 25.20'-25.40'.
25		0.7															25.4'
			C	2		25.4 - 30.4	60	52	87	20.0	33						40.6'
		0.1															28.55'-29.25': Assumed recovery loss. Dark, bluish gray amphibole SCHIST, interlayered with GRANITIC GNEISS; medium to fine grains of amphibole and feldspar; close to extremely close fracture spacing; moderately weathered; medium strong to strong; except weak at 25.75'-26.08'; foliation dips ~40°.
		0.1															
		0.1															
		0.1															
30		0.6															30.4'
			C	3		30.4 - 33.4	36	36	100	11.0	31						35.6' Dark, bluish gray amphibole SCHIST with quartz-feldspar and PEGMATITE bands up to 5" thick; coarse to fine grains of amphibole, feldspar, mica and minor garnet; close to extremely close fracture spacing; moderately weathered; medium strong to strong; foliation dips ~40°-45°.
		0.9															
		0.0															
		0.0															(End of boring at 33.4 ft bgs)

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 3/2/17

Note:
PP = Pocket Penetrometer field test reading, in tons per square foot (tsf)

BORING LOG

BORING NUMBER: **IVF-P2-7A**
SHEET NUMBER: **1** of **3**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**
CONTRACTOR: **E2CR, Inc.**
DRILLER: **S. Lyons**
INSPECTOR: **L. Sepulveda**
DRILLING METHOD: **Hollow Stem Augers; Diamond Coring.**
RIG TYPE: **CME-55, Truck Mounted, Automatic Hammer**

LOCATION: **2018 Linden Avenue**
COORD.: **N: 599,203.9 E: 1,416,101.4**
SURFACE ELEV.: **185.1 feet**
DATUM: **Horizontal: NAD 83/91**
Vertical: NAVD 88
START DATE: **11/14/16** TIME: **12:10 pm**
FINISH DATE: **11/17/16** TIME: **2:00 pm**

	Auger	Split Spoon	Casing	Pitcher	Grab	Core Barrel
Type/Symbol	HSA	S	NW	L	G	C
I.D.	4.25"	1.375"	n/a	n/a	3.25"	n/a
O.D.	8.25"	2"	n/a	n/a	3.375"	n/a
Length	60"	24"	n/a	n/a	6"	n/a
Hammer Wt.	n/a	140lbs	Drill Rod Size		A	
Hammer Fall	n/a	30"	I.D. (O.D.)		1.219" (1.75")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Auger Depth (ft)	Hole Depth (ft)
11/15/16	11:50 am	18.0	-	20.0
11/16/16	8:06 am	17.2	-	54.1
11/17/16	7:47 am	17.6	-	125.4

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
																	0.0'
																	3" Asphalt; 9" Subbase (Gravel) 1.0'
																	184.1' Note: Hand excavated for utility clearance, depth 0.0'-10.0' Light brown and reddish brown Silty CLAY, trace medium to fine Gravel, trace medium to fine Sand, moist (CL, Fill) Note: Cobbles at 2.5'-3.6' depth. Utility at 3.6' depth and 3.1' from curb. Offset hole 1' North and to 1.5' from the curb.
			G	1		2.0 - 2.5	G	R	A	B	6						
			G	2		4.0 - 4.5	G	R	A	B	6						Brown and tan coarse to fine SAND, trace medium to fine Gravel, trace Silt, wet (SP, Fill)
5			G	3		6.0 - 6.5	G	R	A	B	6						Brown and tan coarse to fine SAND, little medium to fine Gravel, trace Silt, wet (SP, Fill)
			G	4		8.0 - 8.5	G	R	A	B	6						Brown and tan coarse to fine SAND, trace coarse to fine Gravel, trace Silt, wet (SP, Fill) Note: Could not take a sample at 9.5'-10.0' due to high Gravel content. Probed to 10.0' depth with air knife. End of soft dig at 10.0'.
10			S	1		10.5 - 12.5	11	11	11	15	17						Light brown medium to fine SAND, trace to little medium Gravel, trace Silt, asphalt fragments, medium dense, dry (SP, Fill)
			S	2		13.5 - 15.5	8	11	12	14	17						Light brown coarse to fine SAND, some coarse to fine Gravel, little Silt, medium dense, dry (SM, possible Fill)
15																	Note: Encountered obstruction at 15.5' depth bgs. Hole abandoned. The samples below are from offset location IVF-P2-7A. 16.8'
			S	1		18.0 - 20.0	13	12	10	10	14						168.3' Light brown coarse to fine SAND and coarse to fine Gravel, little Silt, medium dense, wet (SM)

B&P BORING LOG (FINAL) B&P TUNNEL 8-16-16 PH2 E2CR.GPJ B&P TUNNEL - 8-16-16 AD E2CR.GLB 1/19/17

Note:

BORING LOG
(continued)

BORING NUMBER: **IVF-P2-7A**
SHEET NUMBER: **2** of **3**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **E2CR, Inc.**
DRILLER: **S. Lyons**
INSPECTOR: **L. Sepulveda**

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
25			S	2		23.0 - 25.0	8	13	11	8	16						Light brown coarse to fine SAND and coarse to fine Gravel, little Silt, medium dense, wet (SM)
																	26.5' / 158.6'
30			S	3		28.0 - 30.0	9	7	9	10	14						Light yellow, orange and brown Clayey SILT, little coarse to medium Sand, very stiff, moist (MH, Residual Soil)
																	31.5' / 153.6'
35			S	4		33.0 - 35.0	8	8	9	9	7						Light gray medium to fine SAND and Silty Clay trace coarse to fine Gravel, very stiff, moist (SC, Residual Soil)
																	36.5' / 148.6'
40			S	5		38.0 - 40.0	6	6	8	7	18						Light gray and gray Silty CLAY and medium to fine Sand, trace medium Gravel, stiff, moist (CL, Residual Soil)
																	41.5' / 143.6'
			S	6		43.0 - 45.0	6	8	10	10	24						Light gray-green and green Clayey SILT, little to some medium to fine Sand, very stiff, moist, subhorizontal relict fractures observed, no discernable relict foliation (MH, Decomposed Rock)

B&P BORING LOG (FINAL) B&P TUNNEL 8-16-16 PH2 E2CR.GPJ B&P TUNNEL - 8-16-16 AD E2CR.GLB 1/19/17

Note:

BORING LOG
(continued)

BORING NUMBER: **IVF-P2-7A**
SHEET NUMBER: **3** of **3**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **E2CR, Inc.**
DRILLER: **S. Lyons**
INSPECTOR: **L. Sepulveda**

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
50			S	7		48.0 - 50.0	13	25	23	20	24						46.5' 138.6' Light gray and light green with speckles of dark and white medium to fine SAND, some Clayey Silt, trace medium to fine Gravel (quartz), dense, moist, no discernable relict foliation (SM, Decomposed Rock) 52.5'
			S	8		53.0 - 53.1	50/1"				1						132.6' Light gray and light green with speckles of black and white medium to fine SAND, some Silt, trace fine Gravel, very dense, moist (SM, Decomposed Rock)
			S	9		54.0 - 54.0	50/0.5"				0.5						54.1' 131.0' White and light gray medium to fine SAND, little medium to fine Gravel, trace Silt, very dense, moist (SP, Decomposed Rock) (Spoon refusal at 54.1 ft bgs, see Coring Log)
55																	
60																	
65																	

B&P BORING LOG (FINAL) B&P TUNNEL 8-16-16 PH2 E2CR.GPJ B&P TUNNEL - 8-16-16 AD E2CR.GLB 1/19/17

Note:

BORING LOG

BORING NUMBER: **NA-P2-1 OW**
SHEET NUMBER: **1** of **3**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**
CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **L. Sepulveda**
DRILLING METHOD: **Rotary Wash; Diamond Coring.**
RIG TYPE: **CME-55, Rubber Track, Automatic Hammer**

LOCATION: **AMTRAK 1800 Falls Rd.; Charles Interlock; Next to equipment shed**
COORD.: **N: 599,418.2 E: 1,419,296.0**
SURFACE ELEV.: **68.8 feet**
DATUM: **Horizontal: NAD 83/91**
Vertical: NAVD 88
START DATE: **6/15/16** TIME: **7:30 am**
FINISH DATE: **6/15/16** TIME: **11:30 am**

	Auger	Split Spoon	Casing	Pitcher	Grab	Core Barrel
Type/Symbol	n/a	S	NW	L	G	C
I.D.	n/a	1.375"	3.00"	n/a	3.25"	1.875"
O.D.	n/a	2"	3.50"	n/a	3.375"	2.980"
Length	n/a	24"	60"	n/a	6"	60"
Hammer Wt.	n/a	140lbs	Drill Rod Size		A	
Hammer Fall	n/a	30"	I.D. (O.D.)		1.219" (1.75")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
																	0.0' Note: Hand excavated for utility clearance, depth 0.0'-10.0'
			G	1		2.0 - 2.5	G	R	A	B	6						Black coarse to fine GRAVEL and coarse to fine Sand, trace Silt, trace cinders, moist, some gravel pieces are porous and lightweight (GP, Fill)
5			G	2		5.0 - 5.5	G	R	A	B	6						
			G	3		6.0 - 6.5	G	R	A	B	6						5.8' Light brown and gray, medium to fine SAND, little Clayey Silt, trace coarse to fine Gravel, trace cinders, moist (SM, Fill) 63.0'
			G	4		8.0 - 8.5	G	R	A	B	6						Brown and gray coarse to fine SAND, little Silty Clay, trace fine Gravel, moist (SC) 8.0' 60.8' Brown and orangish brown Silty CLAY, little medium to fine Sand, trace medium to fine Gravel, moist (CL)
			G	5		9.5 - 10.0	G	R	A	B	6						9.5'
10			S	1		10.0 - 12.0	15	26	33	54	14						10.0' Brown coarse to fine GRAVEL, some coarse to fine Sand, trace Silty Clay, moist (GP) 58.8' S-1A: 10.0'-10.9': Dark brown, green and gray medium to fine SAND, some Silt, little coarse to fine Gravel, very dense, moist (SM, Decomposed Rock) S-1B: 10.9'-11.2': Light gray and gray medium to fine SAND, some Silt, trace coarse to fine Gravel, very dense, moist (SM, Decomposed Rock)

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 3/2/17

Note:

BORING LOG
(continued)

BORING NUMBER: **NA-P2-1 OW**
SHEET NUMBER: **2** of **3**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **L. Sepulveda**

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
			S	2		15.0 - 15.8	72	100/3.5"			9.5						Light gray, gray and yellow-brown coarse to fine SAND, some Silt, trace fine Gravel, very dense, moist (SM, Decomposed Rock)
			S	3		18.0 - 18.1	100/1"				1						18.1'
		2.3	C	1		18.1 - 20.1	24	24	100	15.0	63						50.7' Light gray, gray and yellow-brown coarse to fine SAND, some Silt, some coarse to fine Gravel, very dense, moist (SM, Decomposed Rock)
		2.1															18.10'-18.25': Rock fragments; possibly wash.
20		2.7	C	2		20.1 - 25.1	60	60	100	57.5	96						18.25'-20.10': Gray and yellow-brown SCHISTOSE GNEISS; medium to fine grains of feldspar, quartz, amphibole and mica; close fracture spacing; slightly weathered; medium strong; gneissic banding dips ~50°.
		1.4															20.1'-25.1': Gray and yellow-brown SCHISTOSE GNEISS; medium to fine grains of feldspar, quartz, amphibole and mica; moderate to close fracture spacing; slightly weathered; strong to medium strong; gneissic banding dips ~50°; quartz-feldspar rich band at 23.80'-24.60'.
		2.3															
		3.7															
		3.7															25.1'
25		3.0	C	3		25.1 - 30.1	60	60	100	60.0	100						43.7' Light gray and white with streaks of black GNEISS; medium to fine grains of feldspar, quartz and amphibole; moderate to close fracture spacing; unweathered; strong; gneissic banding, where visible, dips ~45°.
		4.0															27.5'
		2.1															41.4' PEGMATITE band at 27.45'-28.96'.
		0.2															29.0'
		0.8															39.8'
30		0.1	C	4		30.1 - 35.2	61.2	61	100	49.0	80						Light gray and white with streaks of black GNEISS; medium to fine grains of feldspar, quartz and amphibole; moderate to very close fracture spacing; except extremely close fracture spacing at 31.10'-31.30'; slightly weathered; strong to medium strong; gneissic banding, where visible, dips ~50°; PEGMATITE band at 31.45'-31.95'.
		0.8															
		0.8															
		0.5															

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 3/2/17

Note:

BORING LOG
(continued)

BORING NUMBER: **NA-P2-1 OW**
SHEET NUMBER: **3** of **3**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **L. Sepulveda**

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	FIELD CLASSIFICATION AND REMARKS
							CORING RUN (in.)	REC. (in.)	REC. %	L>4" (in.)	RQD %	
35		0.5 0.4 0.5 2.5 2.7	C	5		35.2 - 40.1	59	59	100	44.5	75	Light gray and white with streaks of black GNEISS; medium to fine grains of feldspar, quartz and amphibole; unweathered to slightly weathered; strong; gneissic banding dips ~45°; amphibole-rich band at 38.95'-40.10'.
40		3.0 2.0 1.9 2.9 3.0	C	6		40.1 - 45.1	60	60	100	44.5	74	Light gray and white with black streaks GRANITIC GNEISS; medium to fine grains of feldspar, quartz, amphibole and minor magnetite and garnet; moderate to close fracture spacing; unweathered; strong; except very close fracture spacing; slightly weathered; medium strong at 40.40'-41.10'; gneissic banding dips ~40°; amphibole-rich band at 40.10'-41.10'; quartz vein at 44.85'-45.10'.
45		3.7 3.3 4.2 2.6	C	7		45.1 - 48.2	37.2	37	99	27.0	73	Light gray and white with black streaks GRANITIC GNEISS; medium to fine grains of feldspar, quartz, amphibole and minor magnetite and garnet; moderate to close fracture spacing; except very close fracture spacing at 47.30'-47.65'; slightly weathered; strong to medium strong.
50												20.6' (End of boring at 48.2 ft bgs)

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 3/2/17

Note:

BORING LOG

BORING NUMBER: **SA-P2-1 OW**
SHEET NUMBER: **1** of **2**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**
CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **L. Sepulveda**
DRILLING METHOD: **Rotary Wash; Diamond Coring**
RIG TYPE: **CME-55, Truck Mounted Automatic Hammer**

LOCATION: **Mosher Street and N Payson Street**
COORD.: **N: 594,925.9 E: 1,411,165.6**
SURFACE ELEV.: **163.3 feet**
DATUM: **Horizontal: NAD 83/91**
Vertical: NAVD 88
START DATE: **2/17/16** TIME: **9:00 am**
FINISH DATE: **2/26/16** TIME: **12:00 pm**

	Auger	Split Spoon	Casing	Pitcher	Grab	Core Barrel
Type/Symbol	HSA	S	HW	L	G	C
I.D.	3.25"	1.375"	4.00"	n/a	3.25"	n/a
O.D.	7.25"	2"	4.50"	n/a	3.375"	n/a
Length	60"	24"	60"	n/a	6"	n/a
Hammer Wt.	n/a	140lbs	Drill Rod Size		A	
Hammer Fall	n/a	30"	I.D. (O.D.)		1.219" (1.75")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)
2/17/16	9:00 am	10.0	-	10.0
2/25/16	7:27 am	7.3	23.0	28.3
2/26/16	7:40 am	13.5	29.0	57.0

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	FIELD CLASSIFICATION AND REMARKS
							CORING RUN (in.)	REC. (in.)	REC. %	L>4" (in.)	RQD %	
						0.0 - 0.4						0.0' 0.4' Asphalt slab 5"
			G	1		2.0 - 2.5	G	R	A	B	6	162.9' Note: Hand excavated for utility clearance, depth 0.0'-10.0' White and green Clayey SILT, trace coarse to fine Sand, trace asphalt fragments, moist (Fill)
			G	2		4.0 - 4.5	G	R	A	B	6	Light brown coarse to fine SAND, some Clayey Silt, some coarse to fine Gravel, moist (SM, Fill)
5			G	3		6.0 - 6.5	G	R	A	B	6	Light brown coarse to fine SAND, some Clayey Silt, some coarse to fine Gravel, moist (SM, Fill)
			G	4		8.0 - 8.5	G	R	A	B	6	Light brown coarse to fine SAND, some Clayey Silt, some coarse to fine Gravel, moist (SM, Fill)
			G	5		9.5 - 10.0	G	R	A	B	6	
10			S	1		10.0 - 12.0	3	6	7	7	24	10.0' Light brown coarse to fine SAND, some Clayey Silt, some coarse to fine Gravel, moist (SM, Fill) 153.3' Reddish brown and light gray CLAY, trace lignite, stiff, moist (CH)
			S	2		13.0 - 15.0	4	7	9	8	24	S-2A: 13.0'-14.5': Reddish brown and light gray CLAY, stiff, moist (CH) 14.5'
15												148.8' S-2B: 14.5'-15.0': Light green CLAY & SILT, trace medium to fine Sand, very stiff, moist (CL, Residual Soil) 16.5'
			S	3A		18.0 - 20.0	10	7	5	8	20	146.8' 18.5' S-3A: 18.0'-18.5': Light brown and reddish brown SILT & CLAY, trace coarse to fine Sand, stiff, moist (MH, Residual Soil) 144.8' S-3B: 18.5'-20.0': Green to olive green Clayey SILT

B&P BORING LOG (FINAL) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 3/2/17

Note: * 3 inch spoon

BORING LOG
(continued)

BORING NUMBER: **SA-P2-1 OW**
SHEET NUMBER: **2** of **2**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **L. Sepulveda**

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
																	and medium to fine Sand, medium dense, moist (ML, Decomposed Rock)
																	21.5' / 141.8'
25			S	4*		23.0 - 25.0	37	54	74	91	0						Note: No recovery with 2" split spoon, sample recovered using 3" split spoon. Olive green, dark green and light green fine SAND, some Silt, trace fine Gravel, very dense, moist, relict gneissic banding dips ~30°-50° (SM, Decomposed Rock)
			S	5		27.7 - 28.0	100/3"				3						28.0' / 135.3' Black to dark green fine SAND and Clayey Silt, very dense, moist (SC-SM, Decomposed Rock) (Spoon refusal at 28 ft bgs, see Coring Log)
30																	
35																	
40																	

B&P BORING LOG (FINAL) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 3/2/17

Note: * 3 inch spoon

BORING LOG

BORING NUMBER: **S-P2-B3A**
SHEET NUMBER: **1** of **3**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**
CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **L. Sepulveda**
DRILLING METHOD: **Hollow Stem Augers; Rotary Wash; Diamond Coring.**
RIG TYPE: **CME-55, Truck Mounted, Automatic Hammer**

LOCATION: **Lafayette Avenue and Brince Street**
COORD.: **N: 594,509.4 E: 1,411,399.7**
SURFACE ELEV.: **150.2 feet**
DATUM: **Horizontal: NAD 83/91**
Vertical: NAVD 88
START DATE: **7/22/16** TIME: **7:45 am**
FINISH DATE: **7/22/16** TIME: **10:15 am**

	Auger	Split Spoon	Casing	Pitcher	Grab	Core Barrel
Type/Symbol	HSA	S	NW	L	G	C
I.D.	4.25"	1.375"	3.00"	n/a	3.25"	1.875"
O.D.	8.25"	2"	3.50"	n/a	3.375"	2.980"
Length	60"	24"	60"	n/a	6"	60"
Hammer Wt.	n/a	140lbs	Drill Rod Size		A	
Hammer Fall	n/a	30"	I.D. (O.D.)		1.219" (1.75")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
																	0.0' Concrete/Asphalt 11"
																	0.9' Note: Hand excavated for utility clearance, depth 0.0'-10.5'
			G	1		2.0 - 2.5	G	R	A	B	6						149.3' Brown, gray and light gray coarse to fine SAND, little medium to fine Gravel, trace Silty Clay, moist (SP, Fill)
			G	2		4.0 - 4.5	G	R	A	B	6						Brown coarse to fine SAND, trace Silty Clay, trace coarse to fine Gravel, moist (SP, Fill)
5			G	3		6.0 - 6.5	G	R	A	B	6						Note: utility encountered at depth 6.0'. Hole offset 12.7' WEST. Brown coarse to fine SAND, trace Silty Clay, trace coarse to fine Gravel, moist (SP, Fill)
			G	4		8.0 - 8.5	G	R	A	B	6						Note: groundwater encountered at depth 8.0'. Yellowish-brown coarse to fine SAND and Silty Clay, trace medium to fine Gravel, wet (SC, Fill)
10			G	5		10.0 - 10.5	G	R	A	B	6						
			S	1		10.5 - 12.5	4	3	3	4	1						10.5' Reddish-brown Silty CLAY, trace medium to fine Sand, wet (CL) 139.7' Light brown coarse to fine SAND, some Silt, trace coarse Gravel, loose, wet (SM)
			S	2		12.5 - 14.5	3	2	1	1	14						12.5' 137.7' Gray and light brown coarse to fine SAND, some Silty Clay, trace coarse to fine Gravel, very loose, wet (SC)

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:

BORING LOG
(continued)

BORING NUMBER: **S-P2-B3A**
SHEET NUMBER: **2** of **3**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **L. Sepulveda**

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
			S	3		15.5 - 17.5	4	8	8	6	15						Gray medium to fine SAND and Silty Clay, medium dense, wet (SC)
																	18.0' / 132.2'
20			S	4		20.5 - 22.5	10	22	18	74	15						S-4A: 20.5'-21.5': Reddish brown fine SAND, some Silt, trace medium to fine Gravel, dense, moist (SM) S-4B: 21.5'-21.75": Gray-green medium to fine SAND, some clayey Silt, thin reddish brown Silty Sand layers, dense, moist (SM)
			S	5		24.1 - 24.2	50/1"				1						24.2' / 126.0' Green-gray medium to fine SAND, little to some Silt, trace medium Gravel, very dense, moist (SM)
25		1.7	C	1		24.2 - 25.7	18	18	100	18.0	100						
		1.5	C	2		25.7 - 30.7	60	57	95	57.0	95						25.7' / 124.5' Gray and light gray SCHISTOSE GNEISS; medium to fine grains of feldspar, quartz and amphibole; very close to extremely close fracture spacing; slightly weathered; medium strong; except weak; moderately weathered at 24.20'-24.40'; gneissic banding dips ~20°-30°.
		1.5															25.70'-25.95': Assumed recovery loss.
		2.1															Gray and light gray-green GNEISS; medium to fine grains of feldspar, amphibole, quartz and pyrite; moderate to very close fracture spacing; except extremely close fracture spacing at 25.95'-26.15', 28.20'-28.30' and 30.50'-30.70'; slightly weathered; strong; gneissic banding dips ~30°-40°.
		1.9															
30		1.9															
		4.1	C	3		30.7 - 35.7	60	60	100	56.5	94						30.7' / 119.5' Gray and light gray-green GNEISS, interlayered with PEGMATITE; medium to fine grains of feldspar, amphibole, quartz and pyrite; moderate to close fracture spacing; unweathered; strong; except extremely close fracture spacing; moderately weathered; extremely weak at 30.92'-31.00'; gneissic banding dips ~35°-40°.
		2.3															
		2.8															

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:

BORING LOG
(continued)

BORING NUMBER: **S-P2-B3A**
SHEET NUMBER: **3** of **3**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **L. Sepulveda**

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
35		2.8 2.4															
																	114.5' (End of boring at 35.7 ft bgs)
40																	
45																	
50																	

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:

BORING LOG

BORING NUMBER: **S-P2-B4**
SHEET NUMBER: **1** of **3**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**
CONTRACTOR: **FSD, Inc.**
DRILLER: **R. Stidham**
INSPECTOR: **A. Daniyarov**
DRILLING METHOD: **Hollow Stem Augers; Rotary Wash; Diamond Coring.**
RIG TYPE: **CME-55, Rubber Track Mounted, Automatic Hammer**

LOCATION: **Pulaski Street and W Lanvale Street**
COORD.: **N: 594,120.6 E: 1,411,177.1**
SURFACE ELEV.: **148.6 feet**
DATUM: **Horizontal: NAD 83/91**
Vertical: NAVD 88
START DATE: **7/25/16** TIME: **7:30 am**
FINISH DATE: **7/25/16** TIME: **12:15 pm**

	Auger	Split Spoon	Casing	Pitcher	Grab	Core Barrel
Type/Symbol	HSA	S	NW	L	G	C
I.D.	4.25"	1.375"	3.00"	n/a	3.25"	1.875"
O.D.	8.25"	2"	3.50"	n/a	3.375"	2.980"
Length	60"	24"	60"	n/a	6"	60"
Hammer Wt.	n/a	140lbs	Drill Rod Size		A	
Hammer Fall	n/a	30"	I.D. (O.D.)		1.219" (1.75")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
																	0.0' Concrete/Asphalt 12"
																	1.0' Note: Hand excavated for utility clearance, depth 0.0'-10.5'
			G	1		2.0 - 2.5	G	R	A	B	6						147.6' Brown, black and gray coarse to fine SAND, little Clayey Silt, trace coarse to fine Gravel, moist (SM, Fill)
			G	2		4.0 - 4.5	G	R	A	B	6						Gray Silty CLAY, trace medium to fine Sand, moist (CL, Fill)
5			G	3		6.0 - 6.5	G	R	A	B	6						Dark gray coarse to fine GRAVEL (cinders) and coarse to fine Sand, trace Silt, wood fragments, bone fragments, moist (GP, Fill)
			G	4		8.0 - 8.5	G	R	A	B	6						Dark gray Silty CLAY, little coarse to fine Sand, trace Gravel (cinders), geotextile fragment, wet (CL, Fill)
																	Note: groundwater level at 10.0' depth.
10			G	5		10.0 - 10.5	G	R	A	B	6						10.5' Grayish-brown coarse to fine GRAVEL, some Clayey SILT, little coarse to fine Sand, wet (GM, Fill)
			S	1		10.5 - 12.5	4	5	4	7	18						138.1' Orangish-brown, Silty CLAY, little coarse to fine Sand, trace coarse to fine Gravel, stiff, wet (CL, Residual Soil); PP = 1.25 tsf
																	13.3'
			S	2		14.0 - 16.0	3	8	9	7	19						135.4' Orangish-brown and grayish-brown SILT, little coarse to fine Sand, little coarse to fine Gravel, very

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:
PP = Pocket Penetrometer field test reading, in tons per square foot (tsf)

BORING LOG
(continued)

BORING NUMBER: **S-P2-B4**
SHEET NUMBER: **2** of **3**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **R. Stidham**
INSPECTOR: **A. Daniyarov**

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
																	stiff, moist, slightly micaceous (ML, Residual Soil); PP = 2.0 tsf
																	17.5' 131.1'
20			S	3		19.0 - 21.0	7	10	14	22	24						S-3A: 19.0'-20.5': Light gray and light orangish-brown coarse to fine SAND, little Silt, medium dense, dry, relict foliation dips ~45° (SM, Decomposed Rock). 20.5'
																	128.1' S-3B: 20.5'-21.0': Gray, dark orangish brown and black coarse to fine SAND, trace Silt, medium dense, dry, relict foliation dips ~30° (SP, Decomposed Rock)
25			S	4		24.0 - 24.5	100/6"				6						Light yellowish-brown, brown and dark gray coarse to fine SAND, trace Silt, trace medium to fine Gravel, very dense, dry, slightly micaceous (SP, Decomposed Rock)
			S	5		26.7 - 26.7	100/0"				0						No recovery. Spoon refusal. 26.7'
		1.7	C	1		26.7 - 28.7	24	18	75	5.5	23						121.9' Light gray, dark gray and light yellow-brown, GRANITIC GNEISS; coarse to fine grains of quartz and feldspar; close to extremely close fracture spacing; slightly to moderately weathered; medium strong to weak; gneissic banding dips ~30°-40°; where visible. 28.20'-28.70': Assumed recovery loss. 28.70'-29.50': Assumed recovery loss. 29.50'-31.45': Light gray, dark gray and light yellow-brown, GRANITIC GNEISS; coarse to fine grains of quartz and feldspar; slightly to locally moderately weathered, medium strong to locally weak; amphibole-rich at 31.45'-33.70'; gneissic banding, where visible, dips ~30°-40°.
		2.3															
		2.1	C	2		28.7 - 33.7	60	52	87	11.0	18						
30		1.9															
		2.4															
		2.2															
		2.2															

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:
PP = Pocket Penetrometer field test reading, in tons per square foot (tsf)

BORING LOG
(continued)

BORING NUMBER: **S-P2-B4**
SHEET NUMBER: **3** of **3**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **R. Stidham**
INSPECTOR: **A. Daniyarov**

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
35		2.1	C	3		33.7 - 38.7						60	58	97	19.8	33	33.70'-33.90': Assumed recovery loss. Light gray, dark gray and light yellow-brown, GRANITIC GNEISS; coarse to fine grains of quartz and feldspar; slightly to locally moderately weathered, medium strong to locally weak; amphibole-rich at 33.90'-34.50'; gneissic banding, where visible, dips ~30°-40°.
		2.2															
		2.2															
		1.7															
		2.5															
		2.6	C	4		38.7 - 43.7						60	60	100	30.5	51	Light gray, dark gray and light yellow-brown, GRANITIC GNEISS; coarse to fine grains of quartz and feldspar; moderately close to very close fracture spacing; except extremely close fracture spacing at 39.67'-39.73'; slightly weathered; medium strong to locally weak; amphibole-rich at 38.70'-40.15' and 41.65'-42.30'; quartz-feldspar band, 2.5" thick, at 42.35'; gneissic banding, where visible, dips ~30°-40°.
40		1.9															
		1.9															
		2.4															
		2.4															
		2.1	C	5		43.7 - 48.9						62.4	62.4	100	37.0	60	Light gray, dark gray and light yellow-brown, GRANITIC GNEISS; coarse to fine grains of quartz and feldspar; moderately close to extremely close fracture spacing; slightly weathered; strong to locally weak; amphibole-rich at 44.95'-45.45'; PEGMATITE band, 4" thick, at 44.10'; gneissic banding dips ~30°.
45		1.9															
		2.3															
		2.5															
		2.1															
50																	99.7' (End of boring at 48.9 ft bgs)

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:
PP = Pocket Penetrometer field test reading, in tons per square foot (tsf)

BORING LOG

BORING NUMBER: **S-P2-B5**
SHEET NUMBER: **1** of **4**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**
CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **L. Sepulveda**
DRILLING METHOD: **Hollow Stem Augers; Rotary Wash; Diamond Coring.**
RIG TYPE: **CME-55, Truck Mounted, Automatic Hammer**

LOCATION: **Harlem Avenue and N Pulaski Street**
COORD.: **N: 593,676.8 E: 1,411,123.4**
SURFACE ELEV.: **146.2 feet**
DATUM: **Horizontal: NAD 83/91**
Vertical: NAVD 88
START DATE: **10/5/16** TIME: **7:00 am**
FINISH DATE: **10/5/16** TIME: **10:32 am**

	Auger	Split Spoon	Casing	Pitcher	Grab	Core Barrel
Type/Symbol	HSA	S	NW	L	G	C
I.D.	3.25"	1.375"	3.00"	n/a	3.25"	1.875"
O.D.	7.25"	2"	3.50"	n/a	3.375"	2.980"
Length	60"	24"	60"	n/a	6"	60"
Hammer Wt.	n/a	140lbs	Drill Rod Size		A	
Hammer Fall	n/a	30"	I.D. (O.D.)		1.219" (1.75")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
																	0.0' 13.5" Asphalt/Concrete
																	1.1' / 145.1' Note: Hand excavated for utility clearance, depth 0.0'-11.0'
			G	1		2.0 - 2.5	G	R	A	B	6						Black and gray coarse to fine SAND and medium to fine Gravel, trace Silt, wire and shell fragments, dry (SP, Fill)
			G	2		4.0 - 4.5	G	R	A	B	6						Light orangish brown and dark gray coarse to fine SAND, little coarse to fine Gravel (quartz), little Silty Clay, shell fragments, moist (SC, Fill)
5			G	3		6.0 - 6.5	G	R	A	B	6						Gray, light gray and white coarse to fine SAND, some coarse to fine Gravel, little Silt, shell and glass fragments, dry (SP, Fill) Note: Groundwater at depth ~8'.
			G	4		8.0 - 8.5	G	R	A	B	6						Gray, light gray and white coarse to fine SAND, some coarse to fine Gravel, little Silt, frequent shell fragments, wet (SM, Fill)
10			G	5		10.5 - 11.0	G	R	A	B	6						
			S	1		11.0 - 13.0	1	1	1	WOH	10						Gray, light gray and white coarse to fine SAND, some coarse to fine Gravel, little Silt, frequent shell fragments, wet (SM, Fill) S-1A: 11.0'-11.7': Black and light brown coarse to fine SAND, some Silt, some coarse to fine Gravel, rubber, metal, shell and brick fragments, very loose, wet (SM, Fill)
			S	2		13.0 - 15.0	2	1	3	4	17						11.7' / 134.5' / 12.4' / 133.8' S-1B: 11.7'-11.8'Light gray medium to fine SAND, some Silty Clay, very loose, wet (SC) Light gray-brown and brown Silty CLAY, trace to little fine Sand (brown partings), soft, moist (CL)

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:

BORING LOG
(continued)

BORING NUMBER: **S-P2-B5**
SHEET NUMBER: **2** of **4**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **L. Sepulveda**

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
20			S	3		18.0 - 20.0	3	4	7	5	11.5						Light reddish-brown and light gray Silty CLAY, trace to little fine Sand, trace fine Gravel (quartz nodules), stiff, moist (CL, Residual Soil)
																	21.5'
																	124.7'
25			S	4		23.0 - 25.0	17	14	16	22	21						Reddish-brown and dark greenish-gray medium to fine SAND, some Silt, trace medium to fine Gravel, medium to dense, moist, subhorizontal relict layering (SM, Decomposed Rock)
			S	5		28.0 - 29.4	32	51	73/5"		13						Dark greenish-gray and reddish-brown medium to fine SAND, some Silt, trace fine Gravel, very dense, moist; subhorizontal relict layering (SM, Decomposed Rock)
30			S	6		32.9 - 32.9	10/0"				0						32.9'
		2.0	C	1		32.9 - 35.9	36	27	75	0.0	0						113.3' Spoon refusal. No recovery 32.90'-33.78': Dark gray with white streaks

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:

BORING LOG
(continued)

BORING NUMBER: **S-P2-B5**
SHEET NUMBER: **3** of **4**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **L. Sepulveda**

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
35		1.2															amphibole GNEISS; coarse to fine grains of amphibole, feldspar and minor mica and quartz; close to very close fracture spacing; slightly weathered; medium strong; gneissic banding dips ~20°.
		1.2															
		1.7	C	2		35.9 - 40.9						60	59	98	17.5	29	35.9' 33.78'-35.90': Light gray, light green-gray and light reddish-brown GRANITIC GNEISS; coarse to fine grains of feldspar, quartz, mica and minor amphibole; close to extremely close fracture spacing; moderately weathered; weak to extremely weak; gneissic banding dips ~20°-25°. 34.15'-34.90': Assumed recovery loss. 110.3'
		1.8															
		1.3															
		1.2															
40		1.6															Light gray, light green-gray and light reddish-brown GRANITIC GNEISS with thin amphibole-rich bands; coarse to fine grains of feldspar, quartz, mica and minor amphibole; close to extremely close fracture spacing; slightly weathered; medium strong to weak; gneissic banding dips ~20°-25°. 36.65'-36.75': Assumed recovery loss.
		1.2	C	3		40.9 - 45.9						60	42.5	71	6.0	30	Light gray, light green-gray and light reddish-brown GRANITIC GNEISS interlayered with GNEISS; coarse to fine grains of feldspar, quartz, mica and minor amphibole; close to extremely close fracture spacing; moderately weathered; strong to extremely weak; gneissic banding dips ~20°-25°. 42.10'-43.50': Assumed recovery loss.
		1.5															
		1.3															
		1.4															
45		1.8															45.9'
		1.7	C	4		45.9 - 50.9						60	60	100	18.0	30	100.3' Dark greenish gray to black with few white streaks AMPHIBOLITE; medium to fine grains of amphibole, feldspar, and minor mica; close to extremely close fracture spacing; slightly weathered; strong to locally weak; faint foliation dips ~25°; quartz-feldspar band at 45.90'-46.10'.
		1.6															
		1.6															
		1.6															
50		1.6															50.9'
		2.3	C	5		50.9 - 56.0						61.2	61	100	52.0	85	95.3' Dark greenish gray to black with few white streaks AMPHIBOLITE interlayered with amphibole GNEISS; medium to fine grains of amphibole, feldspar, and minor mica; moderate to close fracture

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:

BORING LOG
(continued)

BORING NUMBER: **S-P2-B5**
SHEET NUMBER: **4** of **4**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **L. Sepulveda**

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
55		2.3 2.1 2.3 2.1															spacing; except very close fracture spacing at 51.10'-51.25'; unweathered; strong; faint foliation dips ~20°.
																	90.2' (End of boring at 56 ft bgs)
60																	
65																	
70																	

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:

BORING LOG

BORING NUMBER: **S-P2-B6**
SHEET NUMBER: **1** of **4**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**
CONTRACTOR: **FSD, Inc.**
DRILLER: **R. Stidham**
INSPECTOR: **L. Sepulveda**
DRILLING METHOD: **Hollow Stem Augers; Rotary Wash; Diamond Coring.**
RIG TYPE: **CME-55, Rubber Track Mounted, Automatic Hammer**

LOCATION: **2140 Edmondson Avenue**
COORD.: **N: 593,190.8 E: 1,410,708.3**
SURFACE ELEV.: **171.5 feet**
DATUM: **Horizontal: NAD 83/91**
Vertical: NAVD 88
START DATE: **7/26/16** TIME: **7:45 am**
FINISH DATE: **7/26/16** TIME: **12:15 pm**

	Auger	Split Spoon	Casing	Pitcher	Grab	Core Barrel
Type/Symbol	HSA	S	NW	L	G	C
I.D.	4.25"	1.375"	3.00"	n/a	3.25"	1.875"
O.D.	8.25"	2"	3.50"	n/a	3.375"	2.980"
Length	60"	24"	60"	n/a	6"	60"
Hammer Wt.	n/a	140lbs	Drill Rod Size		A	
Hammer Fall	n/a	30"	I.D. (O.D.)		1.219" (1.75")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
																	0.0' Concrete/Asphalt 10"
																	0.8' / 170.7' Note: Hand excavated for utility clearance, depth 0.0'-10.5'. Rock fragments at 1.0'-2.0' depth.
			G	1		2.0 - 2.5	G	R	A	B	6						Brown and dark gray coarse to fine SAND, little Silty Clay, little coarse to fine Gravel, dry (SC, Fill)
			G	2		4.0 - 4.5	G	R	A	B	6						Brown coarse to fine SAND, some coarse to fine Gravel, little Silty Clay, dry (SC, Fill)
5			G	3		6.0 - 6.5	G	R	A	B	6						Brown, coarse to fine GRAVEL and coarse to fine Sand, trace Silty Clay, moist (GP, Fill)
			G	4		8.0 - 8.5	G	R	A	B	6						8.0' / 163.5' Tan and yellowish-brown medium to fine SAND, trace Silt, moist (SP)
10			G	5		10.0 - 10.5	G	R	A	B	6						10.0' / 161.5' Light brown coarse to fine SAND, some Silty Clay, moist (SC)
			S	1		10.5 - 12.5	1	1	3	2	17						161.0' Reddish-brown to brown Silty CLAY, some medium to fine Sand, trace medium to fine Gravel, soft, moist (CL); PP = 1.75-3.0 tsf
																	13.3' / 158.3'
			S	2		14.0 - 16.0	2	2	1	2	19						Light brown and dark brown medium to fine SAND, some Silt, trace fine Gravel, very loose, wet (SM)

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:
PP = Pocket Penetrometer field test reading, in tons per square foot (tsf)

BORING LOG
(continued)

BORING NUMBER: **S-P2-B6**
SHEET NUMBER: **2** of **4**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **R. Stidham**
INSPECTOR: **L. Sepulveda**

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
																	17.5' / 154.0'
20			S	3		19.0 - 21.0	9	8	13	10	14						Light gray and light brown coarse to fine SAND and medium to fine Gravel, trace to little Silt, medium dense, wet (SP)
																	22.5' / 149.0'
25			S	4		24.0 - 26.0	2	2	3	3	16						Light yellow-brown and light gray with streaks of brown coarse to fine SAND, some Clayey Silt, loose, moist (SM, Residual Soil)
																	27.5' / 144.0'
30			S	5		29.0 - 31.0	3	4	5	6	24						Light yellow-brown with streaks of brown Clayey SILT and coarse to fine Sand, stiff, moist (ML, Residual Soil)
																	32.5' / 139.0'

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:
PP = Pocket Penetrometer field test reading, in tons per square foot (tsf)

BORING LOG
(continued)

BORING NUMBER: **S-P2-B6**
SHEET NUMBER: **3** of **4**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **R. Stidham**
INSPECTOR: **L. Sepulveda**

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	FIELD CLASSIFICATION AND REMARKS
							CORING RUN (in.)	REC. (in.)	REC. %	L>4" (in.)	RQD %	
35			S	6		34.0 - 36.0	8	9	11	14	24	Light gray and light yellow-brown coarse to fine SAND and Clayey Silt, medium dense, wet (SM, Residual Soil)
40			S	7		39.0 - 41.0	6	10	10	11	24	Brown and light gray coarse to fine SAND and Clayey Silt, medium dense, moist (SM, Residual Soil)
45			S	8		44.0 - 45.2	76	80	100/2"		14	Light green-gray and reddish-brown with gray bands medium to fine SAND, some Silt, very dense, moist, relict foliation dips subhorizontally (SM, Decomposed Rock)
50		1.2 2.3 3.3	S C	9 1		49.0 - 49.1 49.1 - 54.1	60/1.5" 60	58.5	98	40.5	1.5 98	49.1' 122.4' Green-gray with speckles of black and white medium to fine SAND, little Silt, very dense, moist (SM, Decomposed Rock) 49.10'-49.22': Assumed recovery loss. Light green and dark green with streaks of white AMPHIBOLE GNEISS; medium to fine grains of feldspar, amphibole, chlorite and quartz; moderate to very close fracture spacing; except extremely close fracture spacing at 51.60'-51.85'; slightly weathered;

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:
PP = Pocket Penetrometer field test reading, in tons per square foot (tsf)

BORING LOG
(continued)

BORING NUMBER: **S-P2-B6**
SHEET NUMBER: **4** of **4**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **R. Stidham**
INSPECTOR: **L. Sepulveda**

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
55		3.0 3.0 2.4 2.2 2.1 2.3 1.5	C	2		54.1 - 59.1	60	60	100	43.0	72						medium strong to strong; except moderately weathered; extremely weak at 49.22'-49.37'; gneissic banding dips ~35°. Light green and dark green with streaks of white AMPHIBOLE GNEISS; medium to fine grains of feldspar, amphibole, chlorite and quartz; moderate to very close fracture spacing; slightly weathered; strong to medium strong; except extremely close fracture spacing; moderately weathered; extremely weak at 56.14'-56.20' and 57.97'-58.10'; gneissic banding dips ~30°.
60																	112.4' (End of boring at 59.1 ft bgs)
65																	
70																	

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:
PP = Pocket Penetrometer field test reading, in tons per square foot (tsf)

BORING LOG

BORING NUMBER: **S-P2-B6A OW**
SHEET NUMBER: **1** of **4**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**
CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **A. Daniyarov**
DRILLING METHOD: **Hollow Stem Augers; Rotary Wash; Diamond Coring.**
RIG TYPE: **CME-55, Rubber Track Mounted, Automatic Hammer**

LOCATION: **2235 Edmondson Avenue**
COORD.: **N: 593,142.0 E: 1,410,676.2**
SURFACE ELEV.: **171.2 feet**
DATUM: **Horizontal: NAD 83/91**
Vertical: NAVD 88
START DATE: **7/26/16** TIME: **7:45 am**
FINISH DATE: **7/26/16** TIME: **12:30 pm**

	Auger	Split Spoon	Casing	Pitcher	Grab	Core Barrel
Type/Symbol	HSA	S	NW	L	G	C
I.D.	4.25"	1.375"	3.00"	n/a	3.25"	1.875"
O.D.	8.25"	2"	3.50"	n/a	3.375"	2.980"
Length	60"	24"	60"	n/a	6"	60"
Hammer Wt.	n/a	140lbs	Drill Rod Size		A	
Hammer Fall	n/a	30"	I.D. (O.D.)		1.219" (1.75")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
																	0.0' Concrete/Asphalt 11"
																	0.9' Note: Hand excavated for utility clearance, depth 0.0'-11.0'
			G	1		2.0 - 2.5	G	R	A	B	6						170.3' Dark brown and gray Silty CLAY, little medium to fine Sand, trace fine Gravel, dry (CL, Fill)
			G	2		4.0 - 4.5	G	R	A	B	6						Dark gray Clayey SILT and coarse to fine Sand, trace medium to fine Gravel, moist (ML, Fill)
5			G	3		6.0 - 6.5	G	R	A	B	6						Dark gray and light gray Clayey SILT, little coarse to fine Sand, trace coarse to fine Gravel, moist (ML, Fill)
			G	4		8.0 - 8.5	G	R	A	B	6						Brown coarse to fine SAND, little Silty Clay, trace medium to fine Gravel, moist (SC, Fill)
10			G	5		10.5 - 11.0	G	R	A	B	6						Brown coarse to fine SAND, little Silty Clay, little coarse to fine Gravel, moist (SC, Fill)
			S	1		11.0 - 13.0	3	4	2	2	23						S-1A: 11.0'-11.7': Brown, Silty CLAY, little coarse to fine Gravel, trace coarse to fine Sand, medium stiff, moist (CL, Fill) S-1B: 11.7'-12.9: Brown and dark gray Silty CLAY, some coarse to fine Sand, trace coarse to fine Gravel, medium stiff, moist, slight petrochemical odor (CL, Fill)
			S	2		13.5 - 15.5	3	4	5	5	24						13.5' 157.7' Gray and light gray SAND, little Silty Clay, trace medium to fine Gravel, loose, moist, slight petrochemical odor (SC); PID = 8.7 ppm

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:
PP = Pocket Penetrometer field test reading, in tons per square foot (tsf)
PID = Photoionization Detector test reading, in parts per million (ppm)

BORING LOG
(continued)

BORING NUMBER: **S-P2-B6A OW**
SHEET NUMBER: **2** of **4**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **A. Daniyarov**

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
																	17.0'
																	154.2'
20			S	3		18.5 - 20.5	6	8	10	10	17						Grayish brown and light gray coarse to fine SAND, trace coarse to fine Gravel (pure quartz), trace Silty Clay, medium dense, wet, slight petrochemical odor (SP); PID = 5.0 ppm
																	22.0'
																	149.2'
25			S	4		23.5 - 25.5	3	4	6	9	24						Light gray and light reddish brown, CLAY & SILT, trace medium to fine Sand, stiff, dry, slight petrochemical odor (CL); PID = 4.6 ppm
			S	5		28.5 - 30.5	6	6	7	8	24						Orangish-brown interlayered with white Silty, CLAY, little coarse to fine Sand, stiff, dry, no petrochemical odor (CL, Residual Soil)
30			S	6		33.5 - 35.5	3	4	6	9	24						

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:
PP = Pocket Penetrometer field test reading, in tons per square foot (tsf)
PID = Photoionization Detector test reading, in parts per million (ppm)

BORING LOG
(continued)

BORING NUMBER: **S-P2-B6A OW**
SHEET NUMBER: **3** of **4**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **A. Daniyarov**

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
35																	Orangish-brown interlayered with white, Silty CLAY, little coarse to fine Sand, stiff, dry (CL, Residual Soil)
			S	7		38.5 - 40.5	8	12	14	19	24						Orangish-brown interlayered with white, Silty CLAY, some coarse to fine Sand, very stiff, dry, relict foliation dips subhorizontally (CL, Decomposed Rock); PP = 3.5 tsf
40																	
																	42.0'
			S	8		43.5 - 45.5	22	30	36	47	24						129.2' Interlayered dark gray, orangish brown, black and white, coarse to fine SAND, trace fine Gravel, trace Silt (SP, Decomposed Rock)
45																	
			S	9		48.5 - 48.5	100/0"				0						48.5' Spoon refusal. No recovery
			C	1		49.2 - 50.2	12	12	100	0.0	0						122.7' Light greenish gray and light reddish brown GRANITE; medium to fine grains of quartz, feldspar and amphibole; very close fracture spacing; except extremely close fracture spacing at 49.40'-49.70'; slightly weathered; medium strong.
50		3.4	C	2		50.2 - 55.2	60	60	100	47.0	78						Light greenish-gray, light gray and dark gray GRANITE; medium to fine grains of quartz, feldspar, amphibole and minor mica and garnet; moderate to very close fracture spacing; slightly weathered;
		5.5															
		5.5															

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:
PP = Pocket Penetrometer field test reading, in tons per square foot (tsf)
PID = Photoionization Detector test reading, in parts per million (ppm)

BORING LOG
(continued)

BORING NUMBER: **S-P2-B6A OW**
SHEET NUMBER: **4** of **4**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **A. Daniyarov**

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	FIELD CLASSIFICATION AND REMARKS
							CORING RUN (in.)	REC. (in.)	REC. %	L>4" (in.)	RQD %	
		4.1										strong to locally medium strong; PEGMATITE band, 0.75" thick, at 53.35'; several healed fractures observed dipping at 0°-60°.
		4.6										
		3.6										
55			C	3		55.2 - 60.2	60	60	100	38.0	63	
		1.7										55.5' 55.20'-55.50': Light greenish-gray, light gray and dark gray GRANITE; medium to fine grains of quartz, feldspar, amphibole and minor mica and garnet; moderate to very close fracture spacing; slightly weathered; strong to locally medium strong;
		2.1										115.7' 55.50'-60.20': Light greenish gray, dark greenish gray and gray-light yellow AMPHIBOLE GNEISS; medium to fine grains of quartz, feldspar, amphibole and minor garnet; moderate to close fracture spacing; slightly weathered; strong to medium strong; except extremely close fracture spacing; moderately weathered; extremely weak at 57.40'-57.50', 58.65'-58.83' and 59.40'-59.53'; gneissic banding dips 30°; subvertical healed fractures at 59.40'-60.20'.
		2.6										
		1.8										
60		1.3										111.0' (End of boring at 60.2 ft bgs)
65												
70												

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:
PP = Pocket Penetrometer field test reading, in tons per square foot (tsf)
PID = Photoionization Detector test reading, in parts per million (ppm)

BORING LOG

BORING NUMBER: **S-P2-B8**
SHEET NUMBER: **1** of **2**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**
CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **A. Daniyarov**
DRILLING METHOD: **Hollow Stem Augers; Diamond Coring.**
RIG TYPE: **CME-55, Truck Mounted Automatic Hammer**

LOCATION: **MARC Station - West Baltimore; W Franklin Street**
COORD.: **N: 592,709.4 E: 1,410,433.1**
SURFACE ELEV.: **128.1 feet**
DATUM: **Horizontal: NAD 83/91**
Vertical: NAVD 88
START DATE: **10/11/16** TIME: **9:30 am**
FINISH DATE: **10/11/16** TIME: **12:15 pm**

	Auger	Split Spoon	Casing	Pitcher	Grab	Core Barrel
Type/Symbol	HSA	S	NW	L	G	C
I.D.	3.25"	1.375"	3.00"	n/a	3.25"	1.875"
O.D.	7.25"	2"	3.50"	n/a	3.375"	2.980"
Length	60"	24"	60"	n/a	6"	60"
Hammer Wt.	n/a	140lbs	Drill Rod Size		A	
Hammer Fall	n/a	30"	I.D. (O.D.)		1.219" (1.75")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
																	0.0' 13" Asphalt/Concrete
																	1.1' Note: Hand excavated for utility clearance, depth 0.0'- 9.5'. Soft dig terminated at 9.5' bgs, possible bedrock encountered.
																	127.0' Grayish brown and dark gray coarse to fine SAND, some Silty Clay, little coarse to fine Gravel, moist, faint petrochemical odor, cobbles around sample (Fill)
			G	1		2.0 - 2.5	G	R	A	B	6						
			G	2		4.0 - 4.5	G	R	A	B	6						Yellowish brown and light gray Silty CLAY, trace coarse to fine Sand, trace medium to fine Gravel, moist (Fill)
5																	Note: Groundwater at depth ~6'.
			G	3		6.0 - 6.5	G	R	A	B	6						6.0'
																	122.1' Brown SILT, little coarse to fine Gravel, little coarse to fine Sand, trace Clay, wet (ML)
			G	4		7.5 - 8.0	G	R	A	B	6						Brown and grayish brown SILT, little coarse to fine Sand, trace Clay, wet (ML)
																	9.0'
			S	1		9.7 - 9.9	50/2.5"				2.5						119.1'
10			C	1		10.0 - 11.0	12	12	100	0.0	0						10.0' Light gray, reddish brown and gray coarse to fine SAND, little Silt, very dense, moist (Decomposed Rock, SM)
		3.4															118.1' Note: Auger refusal at 10.0', possible bedrock encountered.
			C	2		11.0 - 16.0	60	60	100	40.0	67						Light gray, dark gray, reddish brown and white GRANITIC GNEISS; medium to fine grains of quartz, feldspar, biotite and minor garnet; close to very close fracture spacing; slightly weathered; medium strong.
		2.7															
		1.6															
		1.8															Light gray, dark gray, reddish brown and white GRANITIC GNEISS with few quartz-feldspar bands up to 1.25" thick; medium to fine grains of quartz, feldspar, biotite and minor garnet; moderate to close
		1.7															

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:

BORING LOG
(continued)

BORING NUMBER: **S-P2-B8**
SHEET NUMBER: **2** of **2**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **A. Daniyarov**

DEPTH (feet)	GRAPHIC LOG	CORING RATE (min/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	FIELD CLASSIFICATION AND REMARKS
							CORING RUN (in.)	REC. (in.)	REC. %	L>4" (in.)	RQD %	
20		1.7 1.7 2.2 1.5 2.5 2.5	C	3		16.0 - 21.0	60	54	90	34.0	57	fracture spacing; slightly weathered; strong to medium strong; except close to extremely close fracture spacing; moderately weathered; medium strong to weak at 11.00'-12.00' and 14.65'-14.90'. Light gray, dark gray, reddish brown and white GRANITIC GNEISS; medium to fine grains of quartz, feldspar, biotite and minor garnet; moderate to extremely close fracture spacing; slightly weathered; medium strong to weak; except completely weathered; extremely weak at 20.50'-20.60'. 20.10'-20.60': Assumed recovery loss.
25												107.1' (End of boring at 21 ft bgs)
30												

B&P BORING ONLY (SOIL AND ROCK COMB) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note:

BORING LOG

BORING NUMBER: **TA-P2-1 OW**
SHEET NUMBER: **1** of **2**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**
CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **L. Sepulveda**
DRILLING METHOD: **Hollow Stem Augers; Rotary Wash; Diamond Coring.**
RIG TYPE: **CME-55, Truck Mounted, Automatic Hammer**

LOCATION: **Prestman Street and N Monroe Street**
COORD.: **N: 596,862.9 E: 1,411,991.1**
SURFACE ELEV.: **172.1 feet**
DATUM: **Horizontal: NAD 83/91**
Vertical: NAVD 88
START DATE: **7/12/16** TIME: **9:40 am**
FINISH DATE: **7/14/16** TIME: **8:10 am**

	Auger	Split Spoon	Casing	Pitcher	Grab	Core Barrel
Type/Symbol	HSA	S	NW	L	G	C
I.D.	3.25"	1.375"	3.00"	n/a	3.25"	n/a
O.D.	7.25"	2"	3.50"	n/a	3.375"	n/a
Length	60"	24"	60"	n/a	6"	n/a
Hammer Wt.	n/a	140lbs	Drill Rod Size		A	
Hammer Fall	n/a	30"	I.D. (O.D.)		1.219" (1.75")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)
7/13/16	7:34 am	7.7	43.2	43.0
7/14/16	7:30 am	2.7	43.2	119.5
7/15/16	7:30 am	7.6	43.2	126.8

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
						0.0 - 0.3											0.0' 0.3' 4" Asphalt/Concrete
																	171.8' Note: Hand excavated for utility clearance, depth 0.0'-10.5'
			G	1		2.0 - 2.5	G	R	A	B	6						Light brown, gray and light gray medium to fine SAND, little Clayey Silt, trace medium to fine Gravel, moist (Fill)
			G	2		4.0 - 4.5	G	R	A	B	6						Light gray, gray, brown and black Silty CLAY, trace medium to fine Sand, trace Gravel (cinders), moist (Fill)
5			G	3		6.0 - 6.5	G	R	A	B	6						Yellow-brown, gray and brown SILT (mica grains), little coarse to fine Sand, trace coarse to fine Gravel, moist; coarse to fine sand and gravel size mica grains (Fill)
			G	4		8.0 - 8.5	G	R	A	B	6						Dark gray coarse to fine GRAVEL and coarse to fine Sand, trace Silt, moist; slightly micaceous (Fill)
10			G	5		10.0 - 10.5	G	R	A	B	6						
			S	1*		10.5 - 12.5	3	1	1	2	8						Dark gray, brown and black coarse to fine GRAVEL (pure quartz and feldspar), little coarse to fine Sand, trace Clayey Silt, moist (Fill) Dark gray, brown medium to fine SAND and Clayey Silt, little coarse to fine Gravel; brick and plastic fragments, very loose, wet (Fill)
			S	2*		14.0 - 16.0	4	2	2	1	20						Note: No recovery with 2" split spoon, sample recovered using 3" split spoon. Dark gray, brown and light brown medium to fine SAND and Clayey Silt, little coarse to fine Gravel, brick and plastic fragments, very loose, wet (Fill)
15																	Note: No recovery with 2" split spoon, sample recovered using 3" split spoon.
																	17.5' 154.6'
			S	3*		19.0 - 21.0	3	4	5	6	16						Olive-green coarse to fine SAND (mica grains), some Silt, trace Clay, trace coarse Gravel, loose, moist

B&P BORING LOG (FINAL) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note: * 3 inch spoon
PP = Pocket Penetrometer field test reading, in tons per square foot (tsf)

BORING LOG
(continued)

BORING NUMBER: **TA-P2-1 OW**
SHEET NUMBER: **2** of **2**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**

CONTRACTOR: **FSD, Inc.**
DRILLER: **J. Scribellito Jr.**
INSPECTOR: **L. Sepulveda**

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
																	(SM, Residual Soil) Note: 1" recovery with 2" split spoon, sample recovered using 3" split spoon.
25			S	4		24.0 - 26.0	7	8	8	13	14						Note: Switched from Augers to Rotary Wash at depth 24.0'. Dark gray, green-gray and reddish brown coarse to fine SAND (predominantly mica grains), little Clayey Silt, medium dense, moist (SM, Residual Soil)
			S	5		28.0 - 30.0	7	8	10	15	10						Bluish-green and brown coarse to fine SAND (mica rich) and Silt, trace Clay, trace fine Gravel, very dense, moist (SM, Residual Soil)
30																	
			S	6		33.0 - 35.0	10	19	49	84	17						Green-gray and yellow-white coarse to fine SAND (mica rich), some Silt, very dense, moist (SM, Residual Soil)
35																	
			S	7		38.0 - 38.3	100/3"				2.5						Gray with speckles of white, medium to fine SAND (feldspar, quartz and garnet grains), some Silt, trace Clay, very dense, moist, no apparent foliation (SM, Decomposed Rock)
40																	
			S	8		43.0 - 43.1	70/1"				1						43.1' 129.0' Black with speckles of white coarse to fine SAND (predominantly mica), little Silt, very dense, moist (SM, Decomposed Rock) (Spoon refusal at 43.1 ft bgs, see Coring Log)

B&P BORING LOG (FINAL) B&P TUNNEL 8-16-16 PH2.GPJ B&P TUNNEL - 8-16-16 AD.GLB 1/19/17

Note: * 3 inch spoon
PP = Pocket Penetrometer field test reading, in tons per square foot (tsf)

BORING LOG

BORING NUMBER: **IVF-P3-4**
SHEET NUMBER: **1** of **3**
PROJECT NUMBER: **185615A**

PROJECT: **B&P Tunnel Replacement Project**
LOCATION: **Baltimore, MD**
CLIENT: **AMTRAK**
CONTRACTOR: **E2CR, Inc.**
DRILLER: **S. Lyons**
INSPECTOR: **A. Daniyarov**
DRILLING METHOD: **Hollow Stem Augers; Rotary Wash; Diamond Coring.**
RIG TYPE: **CME-55, Truck Mounted, Automatic Hammer**

LOCATION: **2205 Eutaw Place**
COORD.: **N: 599,014.0 E: 1,415,806.1**
SURFACE ELEV.: **186.1 feet**
DATUM: **Horizontal: NAD 83/91**
Vertical: NAVD 88
START DATE: **1/16/18** TIME: **10:45 am**
FINISH DATE: **2/21/18** TIME: **8:15 am**

	Auger	Split Spoon	Casing	Pitcher	Grab	Core Barrel
Type/Symbol	HSA	S	NW	L	G	C
I.D.	4.25	1.375"	3.0"	2.86	3.25"	n/a
O.D.	7.625	2"	3.5"	3	3.375"	n/a
Length	60	24"	60"	24	6"	n/a
Hammer Wt.	n/a	140lbs	Drill Rod Size		A	
Hammer Fall	n/a	30"	I.D. (O.D.)		1.219" (1.75")	

GROUNDWATER DATA

Date	Time	Water Depth (ft)	Casing Depth (ft)	Hole Depth (ft)
2/14/18	7:52 am	17.0	39.0	39.0
2/15/18	7:49 am	16.5	49.0	80.0
2/20/18	9:45 am	17.5	49.0	125.0
2/21/18	7:50 am	16.0	49.0	160.2

DEPTH (feet)	GRAPHIC LOG	CASING (Blows/ft)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE SYMBOL	SAMPLE DEPTH (feet)	SOIL (Blows/6 in.) 0/6	6/12	12/18	18/24	REC. (in.)	CORING RUN (in.)	CORING REC. (in.)	CORING REC. %	CORING L>4" (in.)	CORING RQD %	FIELD CLASSIFICATION AND REMARKS
																	0.0'
																	0.4' 5" Asphalt; 8" Concrete
																	185.7'
																	185.0' Note: Hand excavated for utility clearance, depth 0.0'-8.0' Brown Silty CLAY, trace medium to fine Sand, moist (CL, Fill)
			G	1	☒	2.0 - 2.5	G	R	A	B	6						
			G	2	☒	4.0 - 4.5	G	R	A	B	6						Brown Silty CLAY, trace medium to fine Sand, moist (CL, Fill)
5			G	3	☒	6.0 - 6.5	G	R	A	B	6						Brown coarse to fine SAND, little Clayey Silt, moist (SM, Fill)
			G	4	☒	7.5 - 8.0	G	R	A	B	6						Brown coarse to fine SAND, little Clayey Silt, moist (SM, Fill)
			S	1	■	9.0 - 11.0	19	11	11	13	24						9.0'
10																	177.1' Orange-brown coarse to fine SAND, little Silt, medium dense, dry (SM)
			S	2	■	14.0 - 16.0	3	2	2	3	14						Orange-brown coarse to fine SAND, little Silt, trace coarse to fine Gravel, very loose, wet (SM)
15																	
			S	3	■	19.0 - 21.0	3	5	8	7	24						Orange-brown and tan coarse to fine SAND, little Silt, medium dense, wet (SM)

B&P BORING LOG (FINAL) B&P TUNNEL PH3.GPJ B&P TUNNEL - LIBRARY.GLB 3/16/22

Note: