Assessment of Effects Memorandum, Middlesex Canal Historic and Archaeological District

Iron Horse Park Superfund Site,
Operable Unit 3, Area of Concern 1

30 October 2020

Project No.: 0543195

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Iron Horse Park Superfund Site, Operable Unit 3, Area of Concern 1

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Acronyms and Abbreviations

Name	Description
ACHP	Advisory Council on Historic Preservation
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirements
B&M	Boston & Maine
CDM	Camper Dresser and McKee
CERCLA	Comprehensive Response, Compensation, and Liability Act
DOI	Department of the Interior
EPA	Environmental Protection Agency
ERM	Environmental Resources Management
ESD	Explanation of Significant Differences
IAA	Industrial Archaeological Associates
IHP	Iron Horse Park
LOW	Limit of Waste
MBTA	Massachusetts Bay Transportation Authority
MHC	Massachusetts Historical Commission
NPL	National Priorities List
NRHP	National Register of Historic Places
O&M	Operations and Maintenance
OU	Operable Unit
PAH	Polycyclic Aromatic Hydrocarbon
PAL	Public Archaeology Laboratory
PCB	Polychlorinated Biphenyl
RA	Remedial Actions
ROD	Record of Decision
VOC	Volatile Organic Compound

1. INTRODUCTION AND PURPOSE

Environmental Resources Management (ERM) is submitting this memorandum to the Environmental Protection Agency (EPA) to aid the agency in meeting Applicable or Relevant and Appropriate Requirements (ARARs) under the Comprehensive Response, Compensation, and Liability Act (CERCLA) as part of its remedial actions (RAs) at the Iron Horse Park (IHP) Site (the Site) in Billerica, Massachusetts. The Site was listed on the National Priorities List (NPL) in 1984. The memo assesses the effects of the proposed RAs for Area of Concern (AOC) 1 of the IHP on a portion of Middlesex Canal, a historic waterway constructed in the early nineteenth century between the Charles River in Boston and the Merrimack River in Lowell. The canal is listed on the National Register of Historic Places (NRHP) as part of the Middlesex Canal Historic and Archaeological District (the District). The Final Design Plan for the remediation at AOC 1 states that because the RAs at AOC 1 will impact the Middlesex Canal, consultation with the Advisory Council on Historic Preservation (ACHP), the Department of the Interior (DOI), and the Massachusetts Historical Commission (MHC) will be undertaken (ERM 2012). The current memo details the background Superfund information for IHP, the regulatory framework for the currently proposed RAs, background information on the Middlesex Canal, the currently proposed Final Design plans and construction activities, and the proposed final condition of the canal in the vicinity of AOC 1. Based on this information, the memo makes recommendations regarding the effect of the proposed RAs on the integrity of the canal and its continued eligibility for the NRHP.

2. SITE BACKGROUND

The Iron Horse Park site, located in Billerica, Massachusetts near the Tewksbury town line, is a 553-acre industrial complex that includes manufacturing and rail yard maintenance facilities, open storage areas, landfills, and former wastewater lagoons. A long history of activities at the site, beginning in 1913, has resulted in the contamination of soil, groundwater, sediment, and surface water. The Iron Horse Park site is bounded on the north by the Massachusetts Bay Transportation Authority (MBTA) railroad tracks, on the west by High Street and an auto auction facility, on the east by Gray Street, and on the south by a wetland, Pond Street, and the Middlesex Canal (Figure 1). The Middlesex Canal flows through the site to the east, where it joins Content Brook at the southeastern edge of the Shaffer Landfill. There are abundant wetlands at the site. Groundwater flows in both the overburden and bedrock at the Site and flow direction is generally from the southwest to the northeast. Investigation data indicate that overburden groundwater discharges to surface water at the Iron Horse Park site (EPA 2018).

The Iron Horse Park site was listed on the NPL in 1984. Following an initial site-wide Remedial Investigation (Camper Dresser and McKee [CDM] 1987), the site was divided into four operable units (OUs). Although part of the same NPL listing, each operable unit is essentially an independent site with separate usage and contamination histories. The Remedial Action (RA) work for OU-1 has been completed, while at OU-2, construction activities were completed in 2003 and operations and maintenance (O&M) is ongoing. OU-3 contains AOC 1, which is the subject of this memo (Figure 2). A Record of Decision (ROD) selecting the source control remedy at OU-3 was issued on September 30, 2004, which includes the capping of landfills and contaminated soil areas at six different areas of concern and maintenance of a landfill cap at a seventh area of concern. A settlement to implement the source control remedy at OU-3 was reached with responsible parties (OU-3 Settling Defendants) in the fall of 2007. OU-4 covers site-wide sediment and groundwater. The OU-4 ROD was issued on 25 July 2011 and outlines the remedy as groundwater monitoring, excavation of B&M Pond sediment, restoration of disturbed areas, monitored natural recovery for the Unnamed Brook and associated wetlands, institutional controls, and 5-year reviews. The OU4 remedial actions are ongoing, and the B&M Pond excavation activities will be completed during the AOC 1 remedial action.

AOC 1 is known as the Boston & Maine (B&M) Railroad Landfill. It is bounded on the south by the Middlesex Canal and on the north by an active commuter rail line. The B&M Railroad Yard (now Pan Am Railways) bounds the site on the west, while a wetland is located on the eastern boundary (Figure 3). AOC 1 is described as being 14 acres in the ROD, but based on the results of the pre-design investigations, the Limit of Waste (LOW) is estimated to encompass 12 acres. Historically a wetland area, AOC 1 was filled in by the B&M Railroad and used for disposal of various kinds of debris. Piles of debris and refuse, including drums and railroad ties, are spread over the AOC, extending to the interface with the wetland areas. Contaminants include volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), phthalates, petroleum hydrocarbons, pesticides, polychlorinated biphenyls (PCBs), and metals. These materials were found in surface and subsurface soils, with the highest concentrations generally detected in subsurface soils. The southeastern half of the landfill was contaminated with both organic compounds and metals (ERM 2012).

Remedial action under the 2004 ROD for AOC 1 requires measures that will protect environmental receptors from exposure to cadmium in soil and limit the migration of contaminants in the soil to groundwater. This will be accomplished by excavating landfill material from the edge of the wetland to minimize impacts of the cleanup action, capping landfill material, erecting a fence around the landfill, instituting land use restrictions, restoring wetlands impacted by the cleanup, inspecting and maintaining the landfill cap and fence, and sampling groundwater periodically to assess the effects of the source control action (capping) (EPA 2004). The details of the planned RA and its effect on the Middlesex Canal are discussed in the next section.

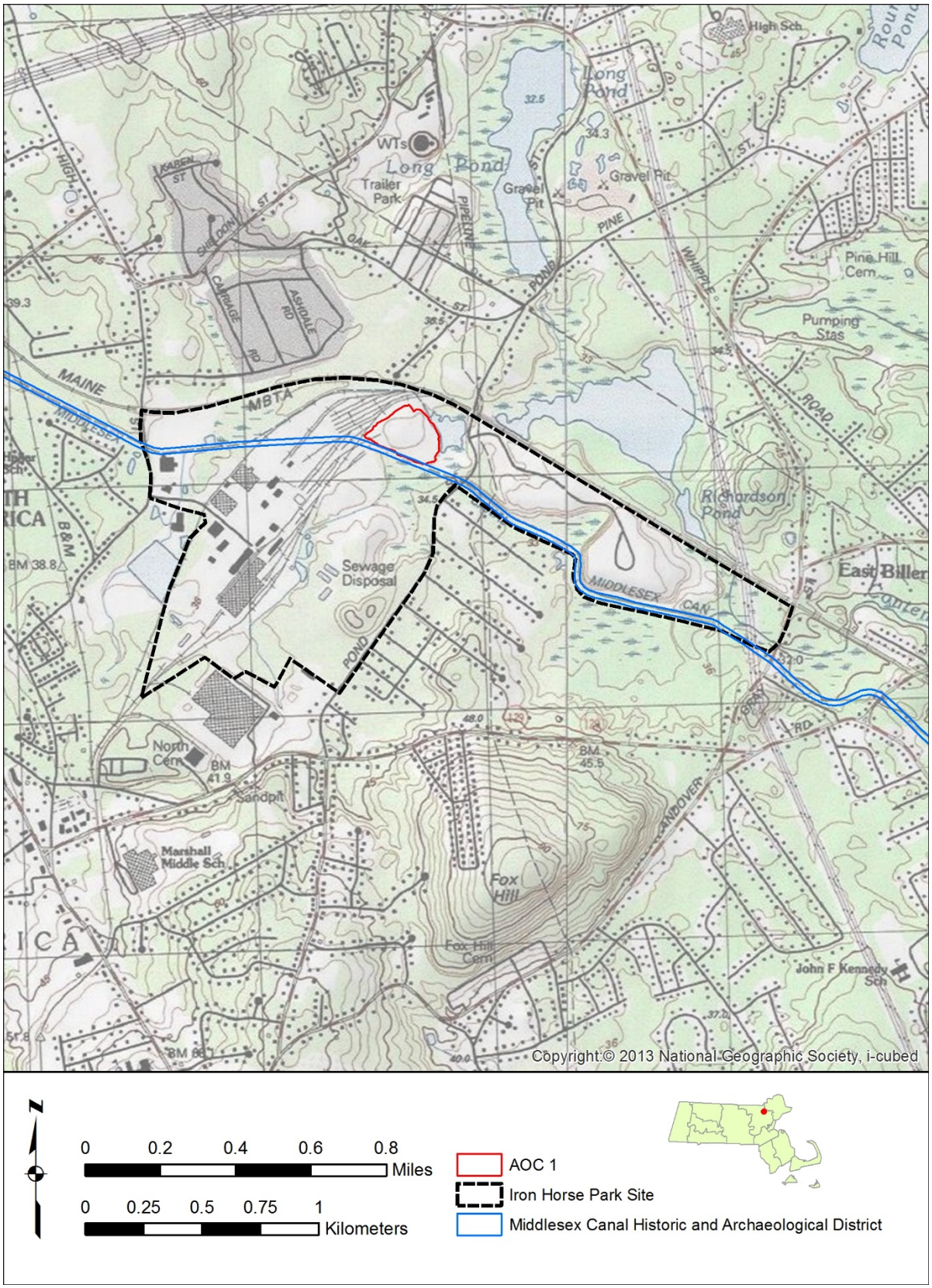


Figure 1: Location of Iron Horse Park Site

Figure 2: Iron Horse Park Site Showing AOCs in OU-3

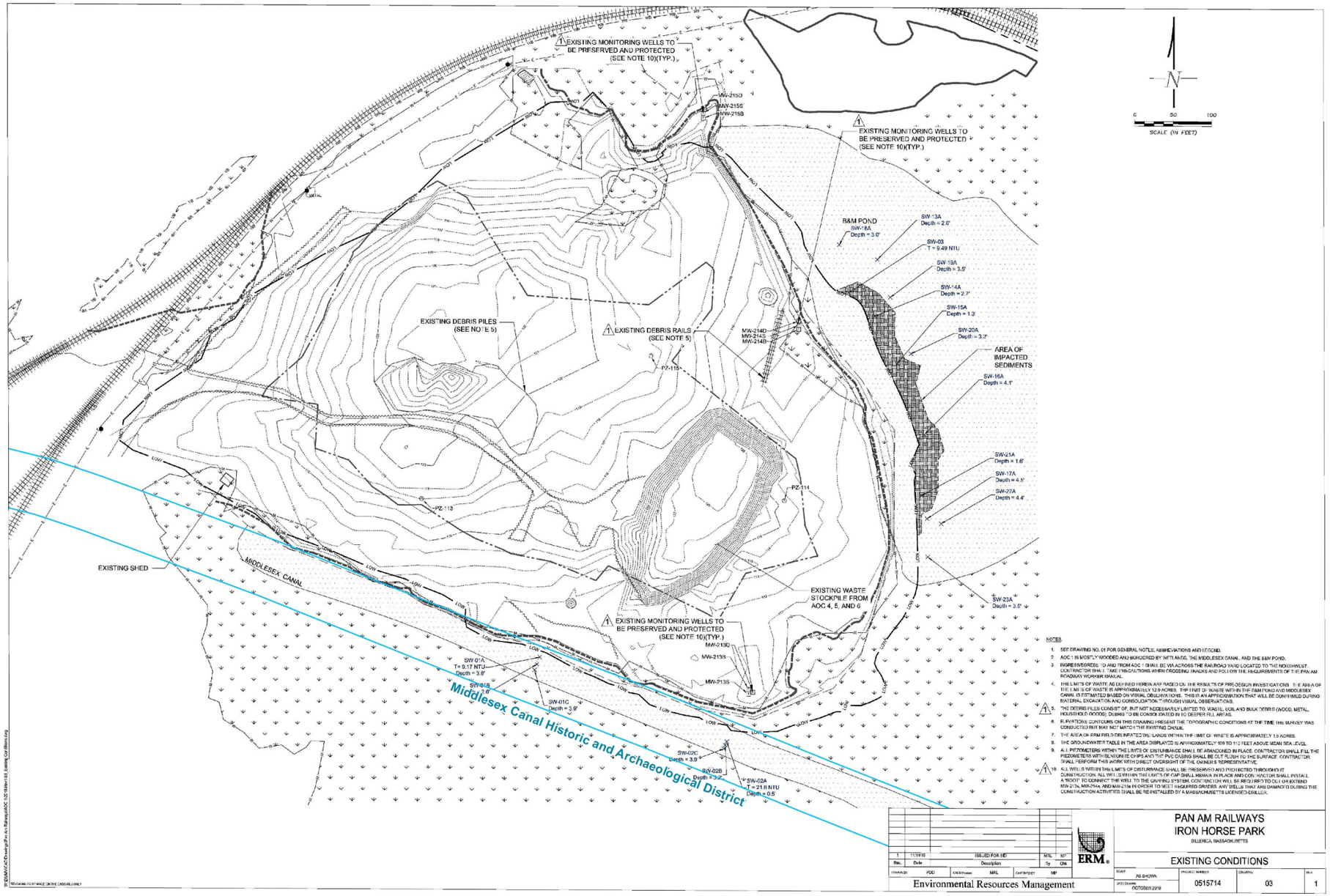


Figure 3: AOC 1, Existing Conditions Plan

2.1 Brief History of the Middlesex Canal

Construction on the Middlesex Canal began in 1793 and was completed 10 years later. The 27.25-mile waterway linked the Merrimack River at Chelmsford (now Lowell) with the Charles River in Charlestown (now a part of Boston). The canal was part of an 80-mile link between Boston, Massachusetts and Concord, New Hampshire. The canal was used for nearly 50 years before being supplanted by railroads (MHC 2009).

Boston's trade with the interior during the late eighteenth century was hampered by the lack of a river that penetrated into the hinterlands. The canal diverted trade from the Merrimack Valley of New Hampshire to Boston by allowing significantly larger loads of cargo to be transported quickly and cheaply. The barges on the canal were 9.5 feet wide and 55 to 75 feet long. They could carry up to 30 tons and could be towed by a single horse or ox. A team of horses or oxen was required to haul a wagon, which had a capacity of no more than 3 tons. Rafts of lumber were also floated on the canal, and in fact, in the first five years of operation, 90 percent of the freight on the canal was lumber. The canal could not be operated in winter, however (MHC 2009).

Thirteen men, including the Attorney General and future governor of Massachusetts, James Sullivan, and engineer, Loammi Baldwin, organized the Proprietors of the Middlesex Canal in 1793 to oversee its construction. Financing was obtained through the sale of shares. The survey was conducted using the first "Y" level and rod with magnetic needle employed in the United States. The route generally followed the contours of the land, avoiding cuts and fills. Land for the canal was purchased or donated, and contractors and landowners were employed in construction of the ditch. The dimensions of the waterway were generally consistent at 30.5 feet wide at the waterline, 20 feet wide at the bottom, and 3.5 feet deep. The slopes of the tow path and berm on the outside of the canal extended out to a form a 75-foot wide base that represented the canal "prism." The ditch was sealed by a technique called puddling, which involved layering wet clay on the walls and pounding them to compress the clay. A 10-foot wide tow path was located on one side and a five-foot berm on the other. Water for the canal was provided by the Concord River at Billerica, its high point of 107 feet above sea level, and by Horn Pond Brook in Winchester. Raising and lowering barges was done using 20 lock chambers, and eight aqueducts were constructed to carry the canal over major waterways. Locks, bridges, and aqueducts were constructed primarily of stone and timber. A floating towpath was constructed to tow boats across the Concord River millpond in Billerica, about a mile west of AOC 1. Freight was accepted at eight docks or landings, which typically included a tollkeeper's house. The proprietors of the canal built taverns and liveries at these landings to serve those using the canal. The canal company constructed lumber mills and shops for servicing and repairing the canal. In time, the canal attracted outside development, as well. Mills were also constructed at several locations along the route (MHC 2009).

The canal opened along its entire length in 1803, and was the longest canal in the country until the completion of the Erie Canal in 1825. Although it offered clear advantages over overland travel, it was a few years before the canal was operating profitably. It flourished after 1808, when James Sullivan's son, John, took over management of the enterprise following his father's death. Caleb Eddy was the superintendent of the canal from 1825 to 1845. The canal remained profitable during these years, and major improvements were made in the late 1820s, when many of the wooden locks were replaced with stone (MHC 2009).

The Middlesex Canal was able to compete with the turnpikes that were constructed in the first three decades of the nineteenth century by lowering their tolls to remain competitive. However, beginning in the 1830s, the canal began to lose traffic as a result of the construction of parallel railroads, including the Boston & Lowell and the Nashua & Lowell. In the 1840s, the company began selling off excess property to balance its books. In 1852, the canal was closed for good. Over time, portions of the canal were

covered over, while others remained intact (MHC 2009). In 1913, the Boston & Maine Railroad constructed a railyard to the west of AOC 1 that covered over a section of the canal. A new section of ditch was constructed around the north side of the yard, presumably to control drainage, and connected with the old canal on the east side of AOC 1, leaving a segment of the original canal intact along the southern edge of AOC 1.

2.2 Previous Cultural Resources Investigations

In 1972, the portion of the Middlesex Canal between Lowell and Woburn, the best preserved section, was placed on the NRHP. The canal was nominated as an individual resource with broadly defined boundaries and no precise inventory of the surviving features or associated resources (Hale 1972). A number of related features of the canal system have been listed individually on the NRHP, including the Shawsheen Aqueduct (1971), Lowell Locks and Canals Historic District (1977), and Billerica Mills Historic District (1983). In 1980, Industrial Archaeological Associates (IAA) completed a comprehensive survey of the entire route of the canal, which recommended parcel-level deed research be conducted for the route to establish its exact location (IAA 1980). This was not accomplished until 1999, when the Public Archaeology Laboratory (PAL) began research for an updated NRHP nomination that established the Middlesex Canal Historic and Archaeological District. The District encompasses the entire length of the original canal, and the nomination includes a comprehensive route map based on deed research (MHC 2009). The 2009 nomination established the boundaries of the NRHP District as a 75-foot wide corridor that is based on the typical width of the canal prism along the majority of its route (MHC 2009).

The Data Sheet in the 2009 NRHP registration form includes all of the related features of the District within each parcel of the route. The section that borders AOC 1, between the south end of the B&M railroad yard (Iron Horse Park) and Pond Street, consists only of the prism, which still contains water. It is listed as a contributing resource of the District. No related canal features such as locks, aqueducts, bridges, culverts, or sluiceways are located in this area. Davis Bridge crossed the canal at Pond Street, but the current bridge is a replacement (MHC 2009).

The Middlesex Canal is also considered an archaeological resource in the District nomination, and contains subsurface features that could provide information important to history. As of 2009, 11 archaeological investigations had been conducted within the canal corridor. These studies have identified 23 archaeological sites related to the canal, including 12 sites recorded during investigations conducted as part of the reconnaissance survey for the 2009 NRHP nomination. The investigations have contributed important information regarding the engineering, operation, and maintenance of the canal (MHC 2009).

Archaeological studies of other segments of the canal have established that the canal prism is intact in those places, and that archaeological investigations can provide information on a number of topics, including design specifications, construction methods, materials, and the integrity of the canal, as well as information on the social history of people associated with the daily operation and use of the canal (Russo and Kierstead 1999). An investigation of a section of the canal in Billerica documented dry-laid stone walls along the canal embankments and the use of “puddling,” the application of layers of pounded clay to the walls of the canal to seal it (Donohue et al. 2001). Another study failed to find evidence of puddling, and suggested that the technique was abandoned during the later years of construction due to its expense (Heitert and Kierstead 2004).

2.3 Historical Development of the Middlesex Canal in the Vicinity of AOC 1

A plan of the canal made in 1829 and notes from a survey book show the geography in this area after the construction of the canal (Baldwin 1829a, 1829b). The survey book map (Figure 4) shows a heading and distance (N 59 ½ W, 27.15 rods [1,792 feet]) from Pond Street to the B&M Railroad Yard that encompasses the survey area. In this view, the south side of the canal is on the left and the north side on

the right. The numbers in the center to the left of the canal show the heading and distance, the sequential number of headings, the number of chains (equal to 66 feet) from the last point recorded, and the cumulative number of chains from the beginning of the spread. The survey for the section near AOC 1 shows hachure marks on the east and west ends on the north side of the canal that indicate high ground, while most of the 1,791-foot section bordered a swamp. Most of the area on the south of the canal was labeled “alder swamp.” The towpath and berm that held in the water of the canal are not shown, but would have been necessary in this area to separate the canal from the low areas. The plan map (Figure 5) shows a similar swampy area on both sides of the canal at AOC 1 between Pond Street and a bend in the canal that was covered by the construction of the B&M Railroad Yard in 1913.

According to J. Jeremiah Breen of the Middlesex Canal Association, the canal in the vicinity of AOC 1 likely had a profile similar to that shown in a section of the canal at Maple Meadow drawn by George Baldwin in 1830 (Baldwin 1830; Figure 6). The prism at AOC 1 would have been about 75 feet wide. The exact height of the berm and towpath are not known. The towpath appears to have been narrower than at other points on the canal at about 6.5 feet. The towpath was located on the south side of the canal, outside of the Limits of Waste (LOW) for AOC 1 (on the opposite bank from the landfill). The design depth of the canal was a minimum of 3.5 feet, although that varied depending on the terrain and water levels (J. Breen to J. Holland, email dated 10 September, 2020). The canal was last used in 1852, and by 1858, the canal is no longer represented on maps of the Town of Billerica (Beers 1875; Walling 1856).

The Iron Horse Park Railroad Yard was constructed in 1913, and the canal to the west of AOC 1 was covered over by railroad sidings and shops. A series of aerial photographs (NETROnline 2020) shows that the banks of the canal between Pond Street and the railroad yard were well defined during the mid-twentieth century, but as the wetlands on the north side of the canal were filled in with waste from the railroad yards, the boundary of the canal became less distinct. A 1938 aerial photograph shows that the eastern portion of AOC 1 was almost entirely wet at that time, and the towpath and berm are clearly defined (Figure 7). By 1971, fill from the railroad yard had pushed well into the western part of the wetlands and the line of the north bank of the canal had become more irregular (Figure 8). The southern bank containing the towpath remained straight, however, with a row of trees separating the canal from the wetlands to the south. By 1995, both banks of the canal had become irregular and less distinct from the adjacent lands.

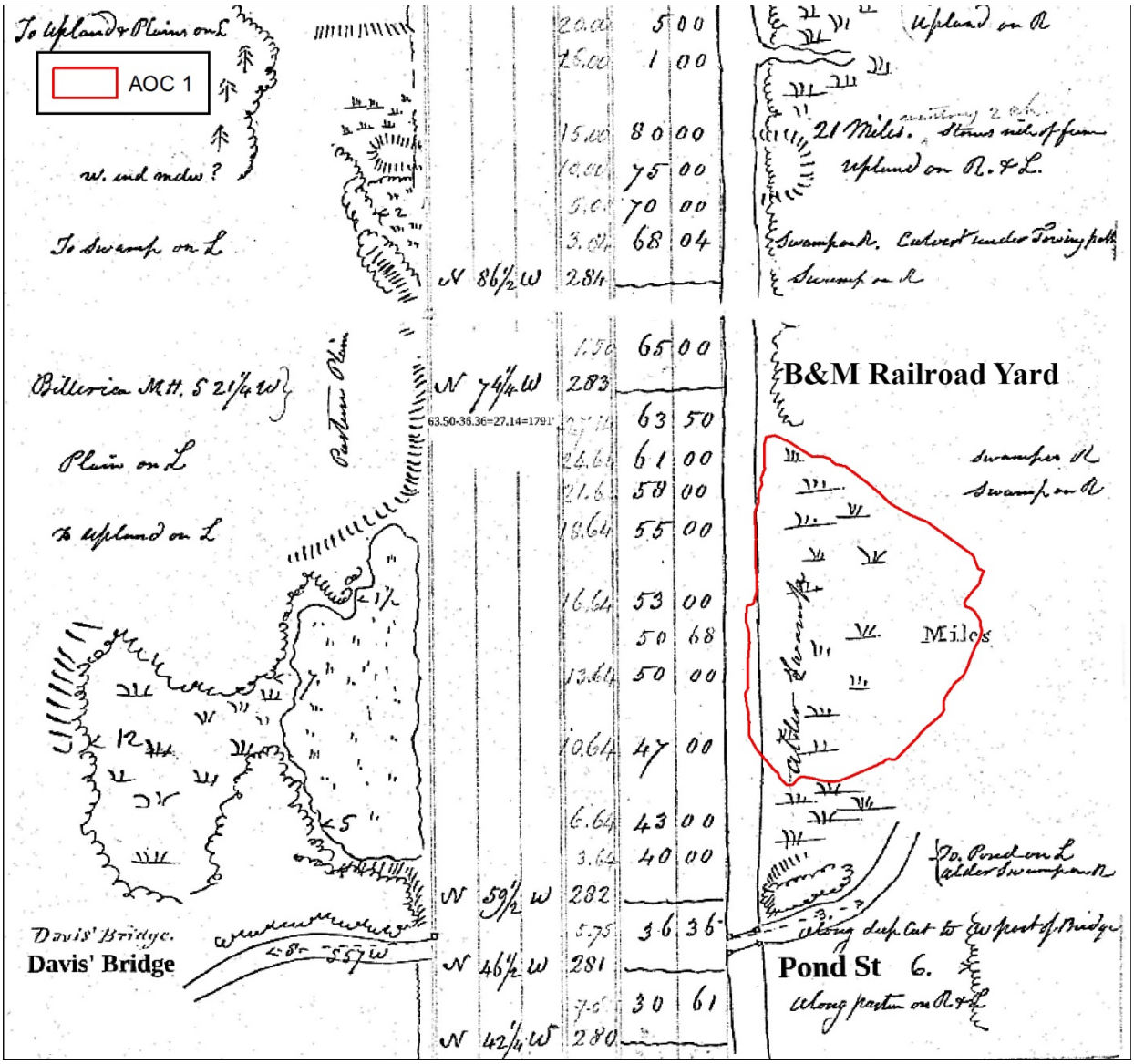


Figure 4: Field Survey Showing Middlesex Canal in 1829 in the Vicinity of AOC 1

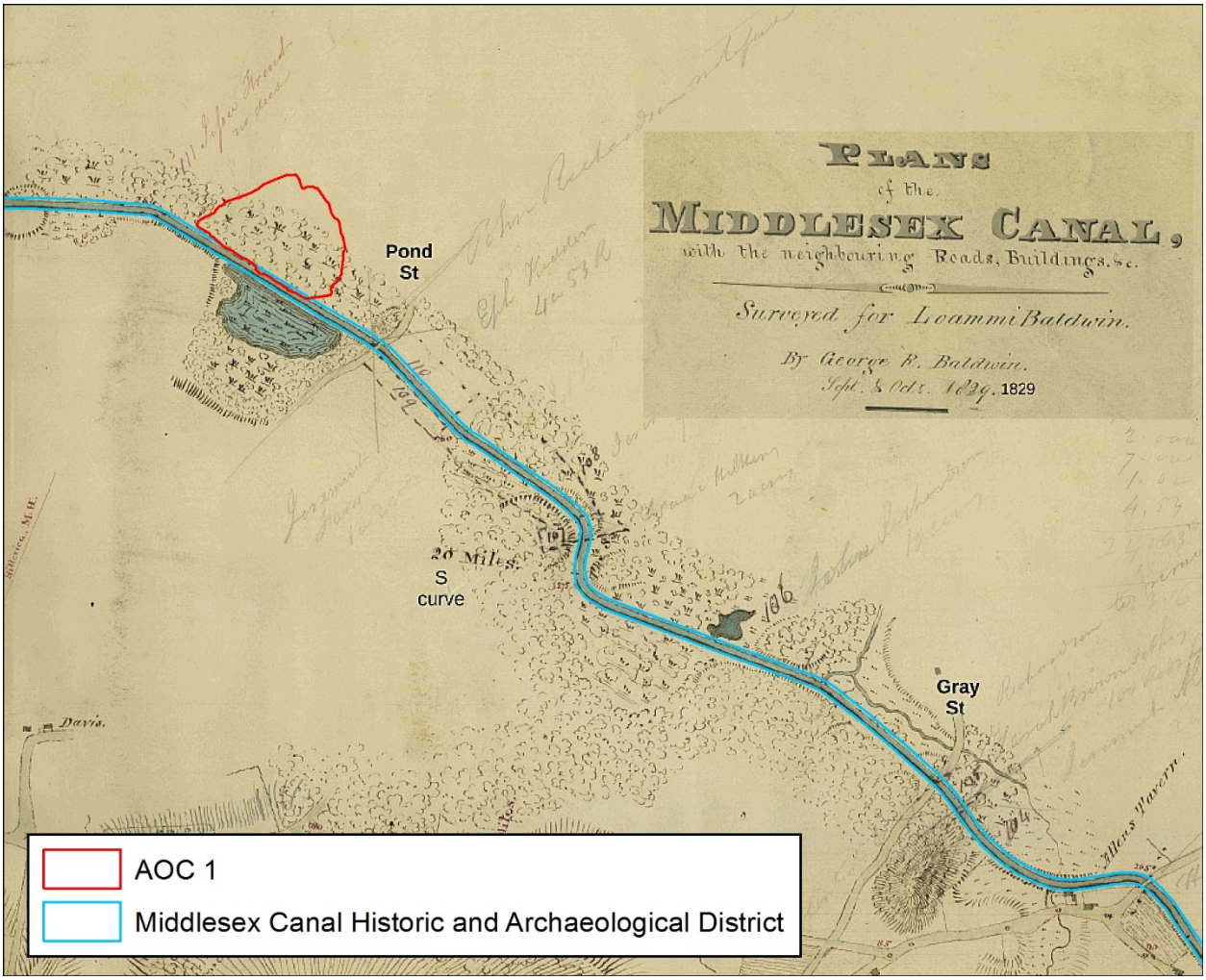


Figure 5: Plan of the Middlesex Canal in 1829 in the Vicinity of AOC 1

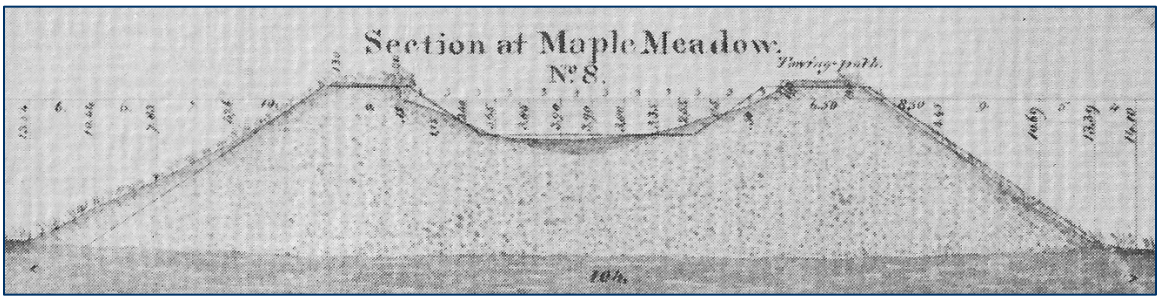


Figure 6: Cross-section of Middlesex Canal in 1830 Similar to Historic Cross-section at AOC 1

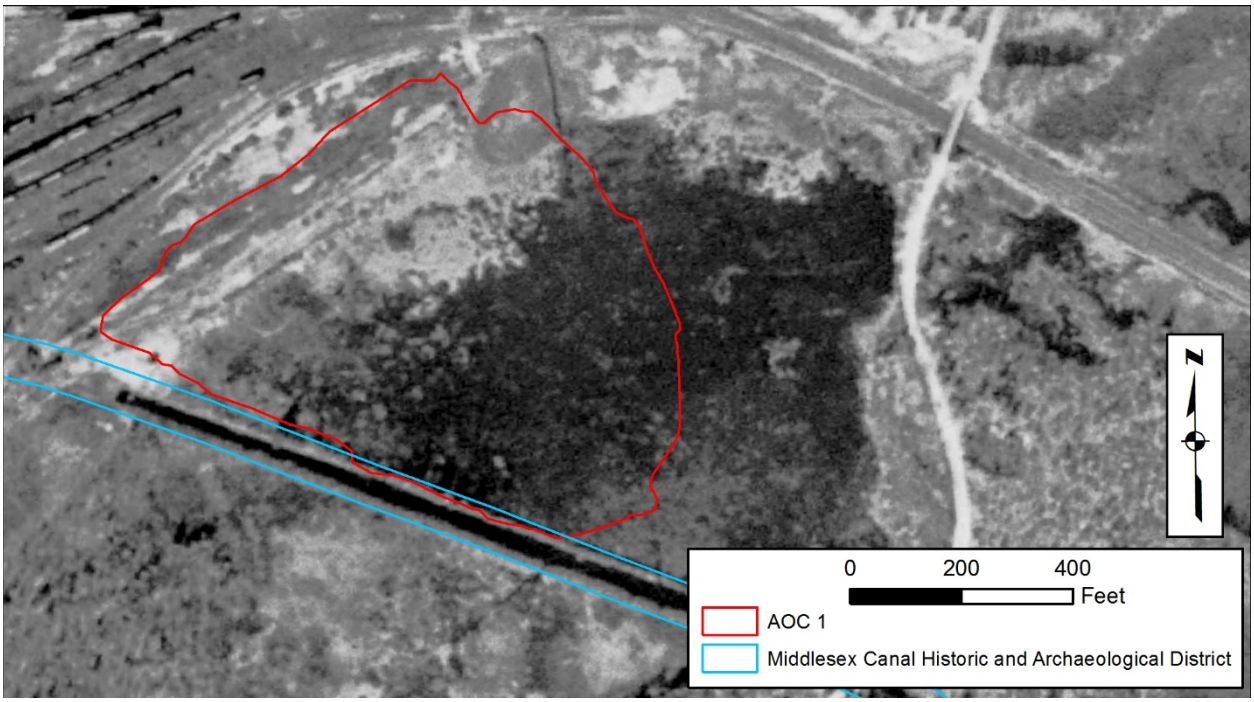


Figure 7: Aerial Photograph of the Vicinity of AOC 1 in 1938

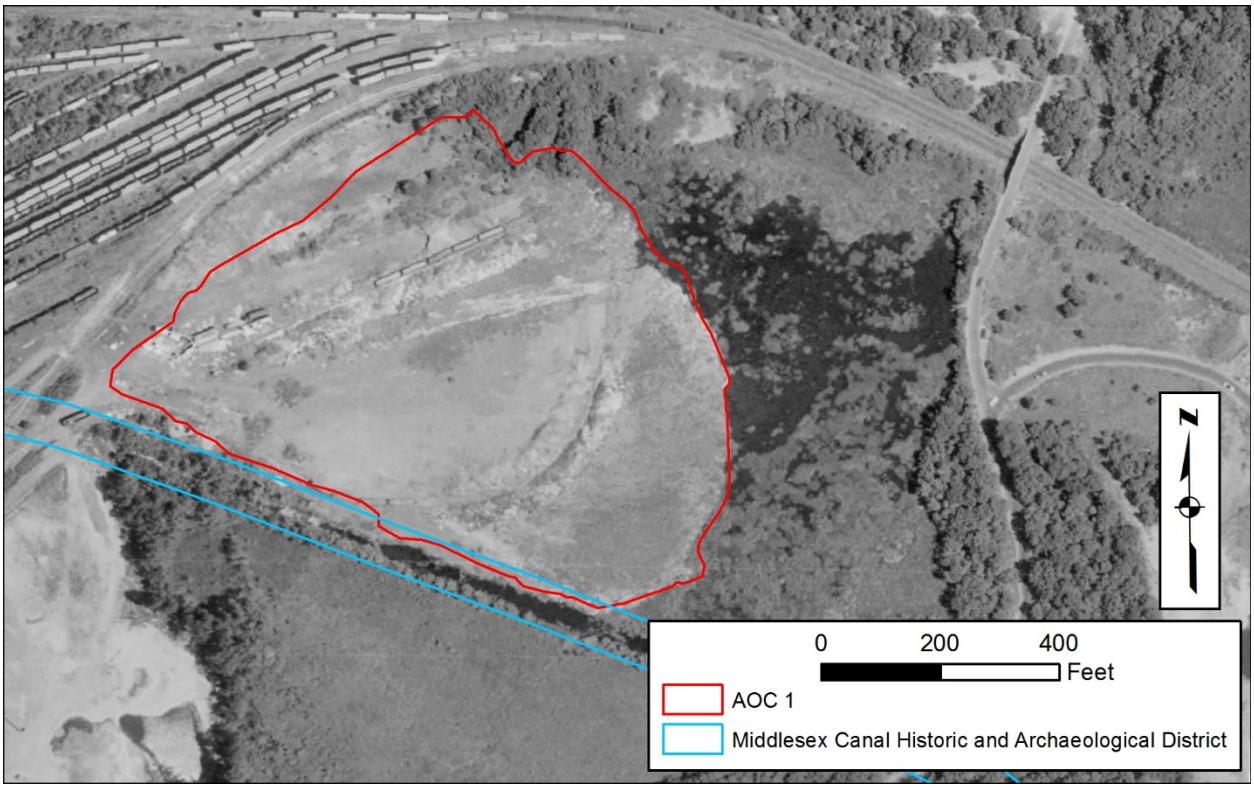


Figure 8: Aerial Photograph of the Vicinity of AOC 1 in 1971

3. ASSESSMENT OF EFFECTS

3.1 Current Site Conditions

See Figure 3 for an illustration of the current conditions at AOC 1 in the vicinity of the Middlesex Canal (ERM 2019). The canal is located along the southern edge of the LOW for AOC 1. The canal is approximately 725 feet long within the LOW. It is bordered on the south by a wetland that is at approximately the same elevation as the southern bank of the canal. This would have been the location of the canal towpath, but there appears to be no evidence of the berm on which it was located. On the north side of the canal, the bank rises 1–2 feet above the water level of 110 feet AMSL. A bench of 50–100 feet in width extends northward, before the terrain rises gradually to 125 feet at the center of AOC 1. The slope on the back side of the berm that would have kept the waters of the canal from flowing into the wetland is no longer extant and has been absorbed by the fill from the railroad yard that has been dumped into the wetland. The width of the canal channel ranges from 25–45 feet along the portion that borders AOC 1. This is wider than the standard 30-foot design width from the edge of the towpath to the edge of the berm. This is likely due to erosion of the banks of the canal into the channel and adjacent wetlands after abandonment.

3.2 Remediation Plan at AOC 1

Figure 9 shows the waste removal plan proposed at AOC 1, while Figure 10 shows the final grading plan (ERM 2019). The remedy for AOC 1 is the excavation of wetland soils around the edges of the site and the placement of the excavated soils into the center of the landfill within the site. A geosynthetic liner will be placed along the margin of the landfill site to prevent leeching, and the excavated soils replaced with imported fill. The landfill will then be graded and capped, with the top of the fill being less than 135 feet AMSL. The surface of the graded landfill would be planted in cool season grass (ERM 2012).

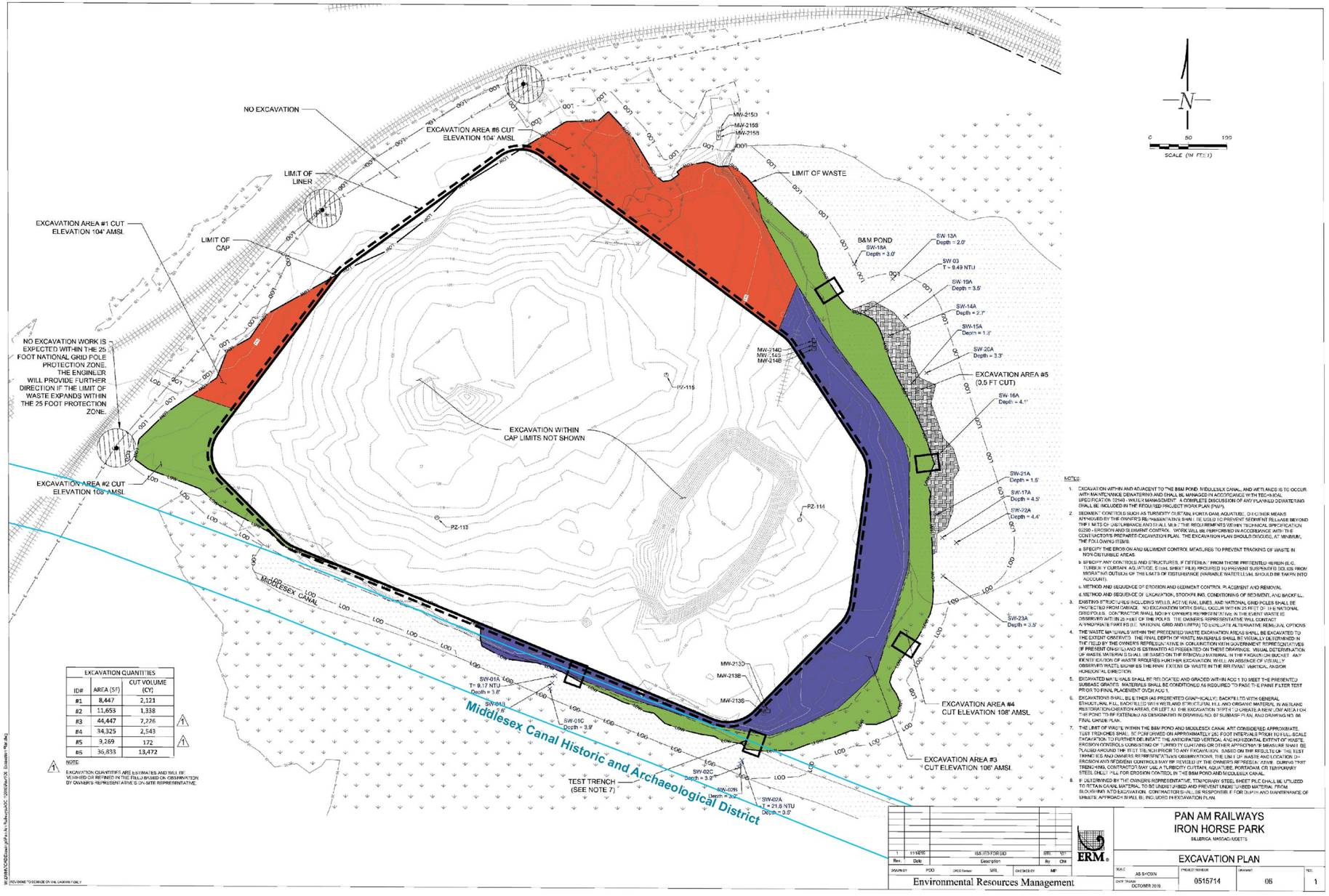
Environmental investigations at AOC 1 found that no distinct boundary between landfill and natural soil was evident at the interface of the landfill and adjacent waterbodies, including the Middlesex Canal. The properties of the soil at this interface will be assessed during excavation in order to properly design the protective barrier and cap. Test pits revealed waste deposits in the southwestern portion of the AOC adjacent to the western end of the canal channel to be less than 3 feet deep. In the southeastern part of the AOC adjacent to the canal, waste was found to extend 9–15 feet below ground surface. The limit of waste was defined as extending to a few feet back from the canal in the southwestern portion of the site and into the canal in the southeastern part of the site (ERM 2012).

Excavation Area #2, in the southwestern part of the site, extends in a narrow band along the northern bank of the far western end of the extant canal channel. The limit of waste does not encroach on either the historical or current canal limits and therefore the erosion controls for this excavation area will be limited to coir logs installed inboard of the canal. Once all waste has been removed and consolidated within the landfill, the excavation would be filled and graded. The top of the bank would be approximately 1 foot higher. From the top of the bank, or berm, the slope would continue uniformly and steeply toward the center of the landfill cap in AOC 1. This differs from the current slope, which levels somewhat, then slopes upward to 128 feet AMSL, compared to 133 feet.

Prior to excavation within the canal, two test pits will be completed to provide final confirmation of the limits of waste. Once these limits are established the final excavation activities can be completed. Excavation Areas #3 and #4 in the southeastern part of the site extend in a narrow band along the northern bank and extant canal channel for approximately 400 feet. Depending on the results of the test pits, the approach of waste excavation in the canal will be determined (either a dry excavation or wet excavation). A dry excavation will include a temporary sand bag berm installed within the canal prior to excavation activities. This sandbag berm will allow a portion of the canal to be dewatered and will act as

erosion control in addition to turbidity curtains. If the test pit results indicate waste is located deeper than expected or the canal subbase is soft, a sandbag dam may not be feasible to install and the excavation will be conducted in a wet excavation approach. The wet excavation approach will utilize turbidity curtains as the sole erosion control.

Once complete, it is estimated that the excavation would extend approximately 10 feet into the canal channel. The excavated area would then be filled and graded, which would change the profile of the canal bank, creating a steeper rise that would be 1 foot higher than currently exists, and would slope more uniformly and steeply away from the bank and to a greater height. However, the current profile does not reflect the historical profile of the canal because of erosion of the berm and infilling of the wetlands behind the berm as part of the development of the B&M Railroad Yard during the twentieth century.



EXCAVATION QUANTITIES		
ID#	AREA (SF)	CUT VOLUME (CY)
#1	8,447	2,121
#2	11,653	1,338
#3	44,447	7,226
#4	34,325	2,543
#5	9,269	172
#6	36,833	13,472

NOTE:
EXCAVATION QUANTITIES ARE ESTIMATES AND WILL BE VERIFIED OR REFINED IN THE FIELD BASED ON OBSERVATION BY OWNER'S REPRESENTATIVE'S ON-SITE REPRESENTATIVE.

NOTES:
1. EXCAVATION WITHIN AND ADJACENT TO THE B&M POND, MIDDLESEX CANAL, AND WETLANDS IS TO OCCUR WITH MAINTENANCE DEWATERING AND SHALL BE MANAGED IN ACCORDANCE WITH THE TECHNICAL SPECIFICATION 02540 - WATER MANAGEMENT. A COMPLETE DISCUSSION OF ANY PLANNED DEWATERING SHALL BE INCLUDED IN THE REQUIRED PROJECT WORK PLAN (PWP).
2. SEDIMENT CONTROLS SUCH AS TURBIDITY CURTAIN, HORTA-DAM, AQUATUBE, OR OTHER MEANS APPROVED BY THE OWNER'S REPRESENTATIVE SHALL BE USED TO PREVENT SEDIMENT RELEASE BEYOND THE LIMITS OF DISTURBANCE AND SHALL MEET THE REQUIREMENTS WITHIN TECHNICAL SPECIFICATION 02280 - EROSION AND SEDIMENT CONTROL. WORK WILL BE PERFORMED IN ACCORDANCE WITH THE CONTRACTOR'S PREPARED EXCAVATION PLAN. THE EXCAVATION PLAN SHOULD DISCUSS, AT MINIMUM, THE FOLLOWING ITEMS:
   a. SPECIFY THE EROSION AND SEDIMENT CONTROL MEASURES TO PREVENT TRACKING OF WASTE IN NON-DISTURBED AREAS.
   b. SPECIFY ANY CONTROLS AND STRUCTURES "DIFFERENT" FROM THOSE PRESENTED HEREIN (E.G., TURBIDITY CURTAIN, AQUATUBE, SILT SHEET PILE) REQUIRED TO PREVENT SUSPENDED SOILS FROM MIGRATING OUTSIDE OF THE LIMITS OF DISTURBANCE (VARIABLE WATER LEVEL SHOULD BE TAKEN INTO ACCOUNT).
   c. METHOD AND SEQUENCE OF EROSION AND SEDIMENT CONTROL PLACEMENT AND REMOVAL.
   d. METHOD AND SEQUENCE OF EXCAVATION, STOCKPILING, CONDITIONING OF SEDIMENT, AND BACKFILL.
3. EXISTING STRUCTURES INCLUDING WELLS, ACTIVE RAIL LINES, AND NATIONAL GRID POLES SHALL BE PROTECTED FROM DAMAGE. NO EXCAVATION WORK SHALL OCCUR WITHIN 25 FEET OF THE NATIONAL GRID POLES. CONTRACTOR SHALL NOTIFY OWNER'S REPRESENTATIVE IN THE EVENT WASTE IS OBSERVED WITHIN 25 FEET OF THE POLES. THE OWNER'S REPRESENTATIVE WILL CONTACT ALTERNATIVE PARTIES (I.E., NATIONAL GRID AND USPS) TO EVALUATE ALTERNATIVE REMEDIAL OPTIONS.
4. THE WASTE MATERIALS WITHIN THE PRESENTED WASTE EXCAVATION AREAS SHALL BE EXCAVATED TO THE EXTENT OBSERVED. THE FINAL DEPTH OF WASTE MATERIALS SHALL BE VISUALLY DETERMINED IN THE FIELD BY THE OWNER'S REPRESENTATIVE IN CONJUNCTION WITH GOVERNMENT REPRESENTATIVES (IF PRESENT ON-SITE) AND IS ESTIMATED AS PRESENTED ON THESE DRAWINGS. VISUAL DETERMINATION OF WASTE MATERIAL IS SHALL BE BASED ON THE HETEROGENEOUS MATERIAL IN THE EXCAVATION BUCKET. ANY IDENTIFICATION OF WASTE REQUIRES FURTHER EXCAVATION. WHILE AN ABSENCE OF VISUALLY OBSERVED WASTE SUGGESTS THE MAXIMUM EXTENT OF WASTE IN THE INSITU VERTICAL AND/OR HORIZONTAL DIRECTION.
5. EXCAVATED MATERIALS SHALL BE RELOCATED AND GRADED WITHIN AOC 1 TO MEET THE PRESENTED SUBBASE GRADES. MATERIALS SHALL BE CONDITIONED AS REQUIRED TO PASS THE PAINT FILTER TEST PRIOR TO FINAL PLACEMENT OUTSIDE AOC 1.
6. EXCAVATIONS SHALL BE EITHER AS PRESENTED GRAPHICALLY; BACKFILLED WITH GENERAL STRUCTURAL FILL, BACKFILLED WITH WETLAND STRUCTURAL FILL AND ORGANIC MATERIAL IN WETLAND RESTORATION/CREATION AREAS, OR LEFT AS THE EXCAVATION WIDTH TO CREATE A NEW LOW AREA FOR THE POND TO BE EXTENDED AS DESIGNATED IN DRAWING NO. 07 SUBBASE PLAN AND DRAWING NO. 08 FINAL GRADE PLAN.
7. THE LIMIT OF WASTE WITHIN THE B&M POND AND MIDDLESEX CANAL ARE CONSIDERED APPROXIMATE. TEST TRENCHES SHALL BE PERFORMED ON APPROXIMATELY 25 FOOT INTERVALS PRIOR TO FULL-SCALE EXCAVATION TO FURTHER DELINEATE THE ANTICIPATED VERTICAL AND HORIZONTAL EXTENT OF WASTE. EROSION CONTROLS CONSISTING OF TURBIDITY CURTAINS OR OTHER APPROPRIATE MEASURE SHALL BE PLACED AROUND THE TEST TRENCH PRIOR TO ANY EXCAVATION. BASED ON THE RESULTS OF THE TEST TRENCHES AND OWNER'S REPRESENTATIVE'S OBSERVATIONS, THE LIMIT OF WASTE AND LOCATION OF EROSION AND SEDIMENT CONTROLS MAY BE REVISED BY THE OWNER'S REPRESENTATIVE. DURING TEST TRENCHING, CONTRACTOR MAY USE A TURBIDITY CURTAIN, AQUATUBE, PORTADAM, OR TEMPORARY STEEL SHEET PILE FOR EROSION CONTROL IN THE B&M POND AND MIDDLESEX CANAL.
8. IF DETERMINED BY THE OWNER'S REPRESENTATIVE, TEMPORARY STEEL SHEET PILE SHALL BE UTILIZED TO RETAIN CANAL MATERIAL TO BE UNDISTURBED AND PREVENT UNDISTURBED MATERIAL FROM SLOUGHING INTO EXCAVATION. CONTRACTOR SHALL BE RESPONSIBLE FOR DEPTH AND MAINTENANCE OF LIMITS. APPROACH SHALL BE INCLUDED IN EXCAVATION PLAN.

Rev.	Date	Description	By	Chk
1	11/19/19	ISSUED FOR BID	MRL	KAT

ERM
Environmental Resources Management

PAN AM RAILWAYS
IRON HORSE PARK
BILLERICA, MASSACHUSETTS

EXCAVATION PLAN

SCALE	PROJECT NUMBER	DRAWING	REV.
AS SHOWN	0515714	06	1

DATE ISSUED: OCTOBER 2019

PROJECT: PDD | CHKD Review: MRL | CHECKED BY: MP

NOT ISSUED TO SERVICE ON THE LAGOON ITSELF

Figure 9: Waste Removal Plan for AOC 1

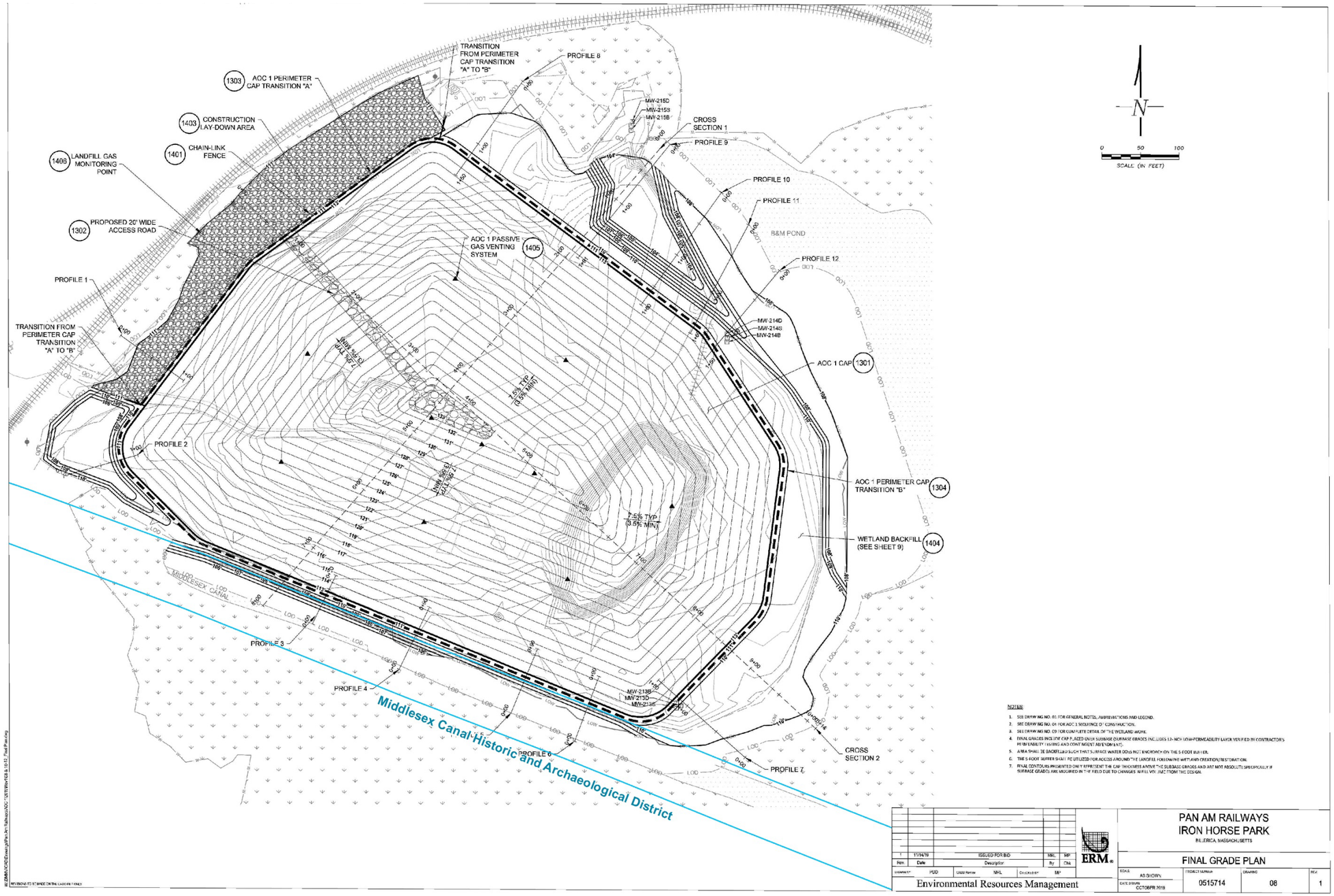


Figure 10: Grading Plan for AOC 1

3.3 Assessment of Integrity

Historical maps and documents, as well as previous investigations of the canal along its entire length, suggest that the historic plan and profile of the section of Middlesex Canal that would be affected by the Remedial Action at AOC 1 was typical of other sections of the canal where the surrounding land was low-lying. The canal prism, which included the base, towpath, berm, and canal channel, would have been approximately 75 feet wide. The canal channel from the edge of the berm to the edge of the towpath would have been 30 feet wide, with a 5-foot-wide berm on one side and a 10-foot-wide towpath on the other. The towpath may have been a narrower version that was 6.5 feet wide. The width of the water in the channel would have been approximately 30 feet and the typical depth was 3.5 feet. The berm and the towpath would have been only about 1-foot above the level of the water in the canal. The overall height of the canal prism from the base to the top of the berm or towpath would vary based on the level of the ground surface.

The current profile of the canal adjacent to AOC 1 does not appear to reflect the historic profile. The southern boundary of the canal where the towpath would be is at approximately the same level as the water in the canal channel. The berm on the north side of the canal has about a 2-foot bank from the level of the canal, but no outside slope due to fill in the wetland to the north. The width of the water in the canal channel varies from 25-45 feet along the section adjacent to AOC 1, which is on average greater than the 30-foot typical design width of the water in the canal.

In 2008, the Waterfield Design Group conducted a study of the remaining portion of the Middlesex Canal, located between Winchester and Lowell, Massachusetts (Waterfield Design Group 2008). The study was sponsored by the Middlesex Canal Commission to document the condition of the existing segments of the canal and make recommendations regarding the tasks required and the costs to restore these sections for use as public greenspaces. The canal was divided into 19 segments, which were evaluated based on ownership (public or private), condition, continuity with other sections, visibility from public spaces, and proximity to other public facilities. Each segment was then given a Restoration Priority Rating. AOC 1 is located within Segment 15, between Pond and High streets. Of the 19 segments, Segment 15 was one of three that were given a Restoration Priority Rating of Low. According to the field observations, the wetted portion of the canal between Pond Street and Iron Horse Park that would be affected by the RAs is difficult to access, and the tow path on the south bank is submerged from a point 200 feet west of Pond Street to Iron Horse Park, where fill has covered the original canal route. Because of its high visibility from Pond Street, however, the study recommends restoring the first 100 feet of the canal at the road. This would not include the portion of the canal to be affected by the remediation at AOC 1.

Because of erosion of the towpath and berm, and infilling of the wetlands behind the berm as part of the development of the B&M Railroad Yard during the twentieth century, the current profile of this segment of the Middlesex Canal does not reflect the historical profile of the canal, indicating diminished integrity of design. Although the profile of the canal has changed since it was in operation, this section of the canal is in its original location and still contains water, retaining integrity of location and association. The channel is straight, despite somewhat irregular sides. The integrity of the sides and bottom of the canal and the base on which it is constructed is unknown, but is likely mostly intact. Without subsurface investigations, it is not possible to determine whether the canal section retains integrity with respect to materials or workmanship, but the activities in AOC 1 to the north, combined with natural forces like erosion, have affected the original profile of the canal. The setting has been compromised by the loss of the berm and towpath and the intrusion of the landfill on its north, but the site still retains wetlands to the northeast and south that are reflective of the historical landscape of the area, contributing to the canal's integrity of feeling.

Despite some losses to its integrity, this section of Middlesex Canal retains sufficient integrity to be a contributing element of the NRHP-listed historic district.

3.4 Assessment of Effects

The Middlesex Canal Historic and Archaeological District is listed on the NRHP for its significance in the areas of Commerce, Engineering, Social History, and Transportation. The period of significance is from 1803–1852, the years during which the canal was operational. It is significant under Criterion A for its association with events that have made a significant contribution to the broad patterns of history, under Criterion C for embodying the distinctive characteristics of a type, period, and method of construction that represents the work of a master, and under Criterion D as a property that has yielded and is likely to yield information important to history.

The remedial action proposed for AOC 1 will affect the Middlesex Canal Historic and Archaeological District by removing original materials that were used in the construction of the canal channel and berm and replacing them with new materials and altered design. These changes will impact the integrity of the canal as a contributing resource of the District under the NRHP criteria.

The establishment of a new profile on the north bank of the canal and the construction of the capped landfill will affect the setting and feeling of the resource, impacting its capacity to convey its historic associations under Criterion A. The berm has already been altered significantly by activities related to the filling of the adjacent wetlands, but the channel is extant and retains water, preserving the appearance of a man-made canal, and the bench adjacent to the north side of the canal allows the canal and the wetlands on the south side of it to be viewed in a natural setting. The remedial action will affect this setting and feeling by eliminating the bench adjacent to the canal and maintaining a grass-covered, capped landfill structure that will rise higher than the existing ground and be more visible from the canal as a result of the removal of vegetation. Although the setting and feeling would be affected by the remediation, ERM recommends that the effect to the District's integrity under Criterion A is not adverse, since the canal channel will be preserved, and the existing setting and feeling already have been affected by changes to the canal's profile due to the filling of the wetland on the north side of the canal and the erosion of the towpath on the south side.

The replacement of the berm on the north side of the canal with an altered design would affect the resource's significance under Criterion C as an example of late eighteenth century engineering. However, the portion of the canal that will be affected by the proposed remedial action is not one of the best preserved sections along its length. The canal prism has been affected by the filling of the adjacent wetland on the north side and the loss of the towpath on the south. In addition, there are no associated features that would be affected such as locks, aqueducts or culverts. Other more well-preserved sections of the canal and its associated features exist that better convey the District's significance in engineering and transportation history. ERM recommends that the effect to the District's integrity under Criterion C is not adverse, since changes to the canal's profile have already compromised its structural integrity, and more intact sections of the District retain sufficient integrity to convey the canal's historical significance.

The removal of material from the berm during remediation and the restructuring of the bank with new materials and design would result in the loss of a portion of the canal that could provide archaeological information on the construction of the canal, affecting its significance under Criterion D. However, previous studies of other sections of the canal with greater integrity have documented the engineering features and construction process of the canal (Donohue et al. 2001; Heitert and Kierstead 2004). The previous impacts to this section of the canal have likely obscured the original structure, limiting its potential to yield important archaeological information. In addition, the approximately 725 feet of canal berm to be replaced represents only a small portion of the existing canal. ERM recommends that the replacement and alteration of this section of the canal berm would not have an adverse effect on the District's significance under Criterion D.

In summary, ERM recommends that the proposed remedial action for AOC 1 will not have an adverse effect on the Middlesex Canal Historic and Archaeological District.

4. CONCLUSION

ERM prepared this memorandum to assess the effects of remedial actions at AOC 1 of the Iron Horse Park Superfund Site in Billerica, Massachusetts, on a portion of Middlesex Canal, the main component of the NRHP-listed Middlesex Canal Historic and Archaeological District. The memo is intended to aid the EPA in meeting ARARs under the CERCLA.

The remedial action for AOC 1 will affect the Middlesex Canal Historic and Archaeological District by removing original materials that were used in the construction of the canal channel and berm and by altering the shape of these elements of the canal. However, the berm and the prism itself have already been altered significantly by activities related to the filling of the adjacent wetlands. The setting will be affected by the maintenance of a grass-covered, capped landfill structure that will rise higher than the existing ground and be more visible from the canal as a result of the removal of vegetation. ERM recommends that the effect to the design and setting of the canal is not adverse, since the canal channel will be preserved, and other aspects of canal's integrity at this location have historically been adversely affected.

The removal of material from the berm as part of the remediation would result in the loss of a portion of the canal that could provide information on the construction of the canal; however, ERM recommends that the effect would not be adverse, due to previous investigations of better preserved examples and the presence of existing sections that have yet to be examined archaeologically.

Because no adverse effects are expected, ERM recommends that the remedial actions recommended in the Final Design Report be approved without further cultural resources consultations.

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